Biennial Report

August 2012 - August 2014

Kansas Cooperative
Fish and Wildlife Research Unit

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

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Preface

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

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

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

The Kansas Unit opened in October 1991 at Kansas State University in Manhattan. Dr. Timothy R. Modde was appointed as the first Unit Leader. Ms. Joyce Brite was hired as 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, Forestry, and Recreation 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, 20 new projects were initiated or on-going and 8 were completed. Seven students finished Master's degrees and two finished Ph.D. degrees.

<u>New Projects:</u>

Multi-scale examination of the distribution and habitat use patterns of the Regal Fritillary (*Speyeria idalia*) within the Fort Riley Military Reservation

Climate Variation and human-landscape interactions affect functional capacity of the Central Great Plains Wetlands

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

Assessing Distribution and Movement of Blue Catfish in Kansas Reservoirs

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

Plum Island Ecosystems LTER

Modeling the Effects of Climate Change on Fish Populations In Large Rivers

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

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

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

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

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

Climate Variation and human-landscape interactions affect functional capacity of Central Great Plains Wetlands

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

<u>Completed Projects</u>:

A Multi-Scale Investigation of Movement Patterns among Black-tailed Prairie Dog Colonies

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

Habitat Use and Origins of American Woodcock Wintering in east Texas

Lead Exposure and Nesting Ecology of Black-necked Stilts (*Himantopus mexicanus*) on the Upper Texas Coast. Stephen F. Austin State University

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

Deer Density, Movement Patterns, and Group Dynamics on Quivira National Wildlife Refuge: Assessing Potential Risk for Disease Transmission

Community Response to Use of Prescribed Grazing and Tebuthiuron Herbicide For Restoration of Sand Shinnery Oak Communities

Master's Theses Completed:

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

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

Dan Sullins (M.S. 2013; advisor Conway/Haukos) – Habitat use and origins of American woodcock wintering in east Texas. Stephen F. Austin State University

Kennedy, Cristina. (M. S. 2013; advisor Mather). Discontinuities concentrate predators within the seascape: quantifying spatially-explicit patterns of physical complexity and striped bass distribution to understand the ecological significance of geomorphology for higher trophic levels within a north temperate estuary. University of Massachusetts, Amherst, MA.

Zavaleta, Jennifer. (M.S. 2012; advisor Haukos). Effects of grazing and herbicide treatments to restore degraded sand shinnery oak grasslands. Texas Tech University.

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

Ph.D. Dissertations Completed:

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

Rachael 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

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State of Kansas

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Ogallala Commons
Dr. Darryl Birkenfeld

Kansas Alliance for Wetlands & Streams
Jeff Neel

Playa Lakes Joint Venture
Dr. Anne Bartuszevige

Graduate Students Supported by Unit Projects, 2012-present

Student and Degree Sought	Thesis Project	Previous Education	Advisor
Emily Ball, Ph.D	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. State University of New York at Potsdam, M.S. Clarkson University	Dr. Mather
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. McBee 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 Kerns, 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
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
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	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


Photo by Jill Haukos

Fisheries Projects

The Kansas River near St. George, Kansas

Ongoing Fisheries Projects

Assessing Distribution and Movement of Blue Catfish in Kansas Reservoirs

Investigators
Kayla Gerber, M.S. Student
Zach Peterson, M.S. Student
Joe Smith. Post-doctoral fellow
Jason Goeckler, KDWPT
John Reinke, KDWPT

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
December 2014

Status
On-going

Progress and Results

Overall
The objectives of this project are to (a) develop methods that can be used to monitor and understand fish movement in general, (b) document distribution and movement patterns of multiple sizes of blue catfish, and (c) collect related data that will help explain reasons for distribution and movement of this important, popular, and highly mobile sport fish.

Many Kansas anglers target this family of sport fish through specialized clubs (e.g., KC Catfish, Catfish Chasers, US Catfish, US Catfish Association), largely because blue catfish provide trophy catches (i.e., KS state record, 102.8 lbs). For example, in 2001, 216,000 Kansas anglers spent $40.1 million fishing for catfish. Thus, the specific results from this research can provide technical guidance for stocking decisions, better assessment protocols, basic scientific information on sport fish in general, and outreach to anglers.

Team Blue Catfish is a collaboration among biologists from KDWPT and KSU on a project administered through the Kansas Cooperative Fish and Wildlife Research Unit (KCFWRU). In 2012, we developed and tested tagging protocols at the KDWPT hatchery at Milford Lake. In 2012 and 2013, KDWPT biologists worked with KCFWRU personnel to capture blue catfish for acoustic tagging and diet analysis. KCFWRU personnel are using these tagging data to test hypotheses about patterns and drivers of blue catfish distribution. This research will result in M.S. degrees in fisheries for Kayla Gerber and Zach Peterson through the Division of Biology at Kansas State University.

Patterns of Distribution and Movement Blue Catfish (Kayla Gerber)
With KDWPT, on June 26-28, 2012, we surgically implanted 48 blue catfish (400-600 mm TL), captured at three different locations in Milford Lake, with VEMCO V9 acoustic tags. Twenty VEMCO receivers, placed throughout Milford Lake, 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 left Milford Lake. On June 3-6, 2013, an additional 75 blue catfish (mean = 517 mm TL, range = 361-1090 mm TL) were tagged with V9 and V13 tags. Data were retrieved regularly and analyzed by monthly time periods.

In both years, all blue catfish survived the tagging. Tagged fish were detected over a million times each year. No tagged catfish left Milford Lake 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. 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, and night even though catfish are often assumed to change their distribution at night. Distribution changed across seasons with a subset of tagged fish moving to the deeper lower part of Milford Lake 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 distribution and movement 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.

Drivers of Blue Catfish Distributional Patterns and Movements (Zachary Peterson)

A major goal in ecology and fisheries biology is to understand and predict spatial and temporal patterns of organisms, the causes and consequences of those patterns, and the role of heterogeneity in space and time. Consequently, research that helps to understand and predict the distribution and movements of mobile organisms under current and changing conditions is of paramount scientific and management importance. This research will focus on a highly mobile fish, the blue catfish, in a large, heterogeneous environment, Milford reservoir, KS, to better understand and predict blue catfish distribution and movement.

This aspect of the project will address three objectives to explain which variables (e.g., depth, flow velocity, geographic region, habitat type, prey, temperature, water quality) explain blue catfish distribution and abundance. Specifically, for this project, we will identify ecologically important variables from the peer-reviewed literature (*Objective 1*), test combinations of variables that explain and predict blue catfish distribution with multiple habitat selection models (e.g., classification and regression trees, logistic regression, discrete choice, electivity) (*Objective 2*), and map relationships between combinations of variables and fish distribution (*Objective 3*).

Relevant abiotic and biotic variables were collected monthly at the same 57 locations from June to November, 2013. For example, in 2013, 13,560 depth measurements and pictures with a side scan sonar, 3,750 temperature and dissolved oxygen measurements with a YSI, 375 secchi depths, 375 ponar grabs, 180 temperature logger downloads, and 150 acoustic doppler current profiles to measure water velocity were recorded. Electrofishing resulted in capture and measurement of 2,150 fish prey. These spatially and temporally explicit abiotic and biotic data were statistically and spatially related to blue catfish location data via 285 manual tracking events at each of the 57 monthly survey locations. Spatial and statistical analyses are underway.

Products since 2012

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. Presentation. 144th Annual AFS Conference, Quebec City, Quebec, Canada.

Gerber, K.M., M.E. Mather, Z. Peterson, J.M. Smith, J. Reinke, and J. Goeckler. 2012. Where are those $$#@@ fish? Distribution and movement of a top predator (blue catfish) in a large, highly-variable Midwestern reservoir. Presentation. 73rd Midwest Fish and Wildlife Conference, Wichita, KS.

Peterson, Z.J., M.E. Mather, K.M. Gerber, J.M. Smith, J. Reinke, and J. Goeckler. 2012. Quantifying spatially-explicit patterns in a large reservoir: an approach for determining associations between a top fish predator and physical habitat. Poster. 73rd Midwest Fish and Wildlife Conference, Wichita, KS.

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. Upcoming Presentation. 144th Annual AFS Conference, Quebec City, Quebec, Canada.


06/05/2013


06/27/2012

Developing and Testing a Spatially-Explicit, Science-Based, Decision-Support Tool for Making Riverscape-Scale Management Decisions: How Dams Affect Fish Communities in the Neosho River, KS

Investigators
Jane Fencl, M.S.
Sean Hitchman, Ph.D.
Dr. Joseph Smith
Dr. Katie Costigan
Dr. Martha Mather
Jason Luginbill, 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
Develop and test a spatially-explicit, decision-support tool for managing human impacts in stream and river networks

Quantify how dams and scale affect fish communities

Identify the role of heterogeneity in stream networks

Location
Neosho River, KS

Completion
February, 2017

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, that fragment the riverscape. To assist managers making science-based decisions on the impact of dams on native fish communities, the Neosho River research team (Jane Fencl, M.S. student; Sean Hitchman, Ph.D.; Dr. Joseph Smith, post-doctoral fellow; Dr. Katie Costigan, post-doctoral fellow; and Dr. Martha Mather, Principal Investigator) are sampling fish communities and instream habitat at sites within the upper Neosho River, Kansas, that have low-head dams (as well as at undammed control sites). 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), most of our efforts over the last two years have been focused on the collection of fish and habitat data at sites with dams and undammed control sites. 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 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. These results have been incorporated into our standardized sampling protocols.

In 2012, we sampled three dams and one undammed control. Fish and habitat were sampled at 20 transects above and below all dams (or the site centerline of the undammed location). In 2013, we expanded the number of sample sites from 4 to 11 (six dams, 5 undammed controls) and extended the distances we sampled at each site to include 22 transects which extended 3 km above and below each dam (or undammed site centerline).

How Dams Alter Fish Communities (Jane Fencl)

Dams fragment ecological, hydrological, and geomorphological aspects of connectivity, which are fundamental characteristics of riverine ecosystems. Of the over 2,770 peer-reviewed papers on dams and fish, only about 6% target low-head dams (<6 m) even though these small dams are the most common type of instream barrier. To increase scientific knowledge about the geomorphic and ecological impacts of these ubiquitous low-head dams, we quantified the geomorphic and ecological extent of the dam footprint at multiple low-head dams within the Neosho River, Kansas.

In 2012, overall, we collected 37 fish species. In 2013, we collected 42 species from 265 samples collected at 52 upstream transects, 70 downstream transects, 70 transects at undammed sites, and 73 additional transects designed to address temporal variation. Although patterns at dam sites varied, overall fish richness downstream of dam sites was greater than sites upstream of dams. No differences in fish communities were observed upstream and downstream at control sites. Data analyses of the fish community continues.

In 2013, at the six dam sites, we also quantified the geomorphic dam footprint using longitudinal trends in median substrate size. In testing for the spatial extent of the dam impact, using geomorphic principles, we found the median substrate size returned to the local equilibrium at a distance of between 0.213 km and 1.4 km for low-head dams in the Upper Neosho River. Thus, our research sampling included sites within and outside of the geomorphic dam footprint. These data can be combined with the fish community data, described above, to make inferences about the distributions of species around low-head dams.

Heterogeneity in Stream Networks (Sean Hitchman)

This component of the Neosho River project asks how should habitat heterogeneity be measured in the field?; how does habitat heterogeneity vary across sites?; how does habitat heterogeneity and/or the spatial arrangement of patches influence fish biodiversity?; and is scale effect influenced by heterogeneity? To test these questions, in 2013, at the same 11 sites described above, we also collected samples to identify the relationship between fish communities and specific habitat types. Specifically, we sampled five replicates of four specific habitat types (pool, riffle, run, 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 macrohabitat data for patch mosaics across 51 km of stream.

When mapping the mosaic of macrohabitats across 6 km at dammed sites and 3 km at undammed sites, patterns of pool, glide, riffle, and runs differed across sites resulting in a range of estimates of habitat diversity (H'= 0.659-1.153). Habitat diversity, especially the percent and density of riffle habitat, was positively related to species richness. Macrohabitat upstream of dams was less diverse than macrohabitat downstream. Fish species diversity and richness reflected this difference in habitat diversity with higher fish diversity downstream of the dam. The control sites also had higher macrohabitat and fish species diversity. Data analysis continues.

Products Since 2012

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

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. 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. 2014. Do FRAGSTATS sink or swim? Calculating metrics of heterogeneity for aquatic macrohabitat within the Neosho River, KS. Kansas Natural Resource Conference. Wichita, KS.

Smith, J.M., M.E. Mather, S.M. Hitchman and J.S. Fencl. 2013. An evaluation of metrics that quantify the composition of fish communities in aquatic systems. Midwest Fish and Wildlife Conference. Wichita, KS.

Plum Island Ecosystems LTER

Investigators
Dr. Martha Mather
12 other Principal Investigators from multiple universities

Project Supervisor
Dr. Anne Giblin, MBL, Woods Hole. MA

Funding
National Science Foundation

Cooperators
Kansas State University

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 studies of movement on fish predators

Location
Plum Island Estuary

Completion
September 2017

Status
Initiation Fall 2012, On-going

Progress and Results

The Plum Island Ecosystems (PIE) LTER has, since its inception in 1998, been working towards a predictive understanding of the long-term response of coupled land-water ecosystems. The Plum Island Estuary-LTER includes the coupled Parker, Rowley, and Ipswich River watersheds. Over the next three years, we will build upon the progress we have 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. At larger scales, striped bass, a top predator, develops two distinct feeding groups–one specializing in feeding on marsh-dependent species and one specializing in pelagic fish in the open bay. This specialized behavior may allow them to become more efficient predators, potentially increasing their top-down control on prey.

Understanding the role of striped bass requires that we understand the regional scale dynamics of highly migratory striped bass. My 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) winter in Delaware Bay and over 60% return to PIE the following year.

The scientific questions and methods used are very similar to those asked in the blue catfish distribution and movement project. This research should complement ongoing fish movement work in Kansas.

Products since 2012

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 Supervisors
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 2017

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 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 using three pieces of data: 1) spring river temperature (March – May) as triggers for the initiation of migration from tributaries into the main stem, 2) spring river discharge (March-May) as the determinant of how fast salmon smolts move from the tributaries to the estuary, and 3) spring river temperatures (March-May) in the main stem as the ultimate determinate of whether smolts will survive outmigration (2 -20^{o} C fish survive, otherwise they die). For this we used real river temperatures and real discharge collected throughout the Connecticut River watershed for a 10 year period.

We continue to take a modeling approach using fish life history (e.g., spawning behavior, thermal preferences, 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.

Products since 2012

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

Investigators
Emily Ball
Robert Mapes
Dr. Martha Mather
J. Goeckler, KDWPT
Doug Nygren, 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:
1. Characterize the diet and stable isotope values of age-0 LMB in Hillsdale and Perry Reservoirs

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 age-0 largemouth bass can switch to fish prey early during their first summer, they can grow faster, overwinter at a larger size, and possibly survive better as adults. However, age-0 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 will compare habitat-specific size through time, diet, stable isotope values, and distribution among three groups of age-0 largemouth bass [(1) stocked phase 1 early-spawned bass, (2) stocked phase 2 early-spawned bass, (3) naturally spawned bass] in a treatment reservoir (Hillsdale Lake) compared to an unstocked control with naturally spawned largemouth bass only (Perry Lake). 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.

Two graduate students will work together to collect data for the common grant objectives. For this, we will sample multiple habitats within each lake twice a month to collect data on age-0 largemouth bass distribution, abundance, size, diet, isotope, and prey. Both graduate students will also develop independent, hypothesis-based research projects that will result in graduate degrees. Currently, Emily Ball is exploring a food web approach as a mechanism to unravel the complex biotic interactions that affect a size-structured freshwater fish community. Bob Mapes is considering whether landscape-scale variables (e.g., habitat type, size, and arrangement) can explain variations in size-structure interactions across systems and years. Both graduate students have written initial proposals. Since this project started six months ago, we have identified a standardized sampling plan, formulated standardized, science-based protocols, and have started our sampling in Hillsdale and Perry Lakes.

Location
Hillsdale and Perry Reservoirs, KS

Completion
December, 2017

Field work continues.

Products since 2012

Completed Fisheries Projects

Collaboration between KCFWRU and KDWPT on blue catfish acoustic tagging at Milford lake, June, 2012

Recruitment of Fishes in the Kansas River

Investigators
Joe Gerken, Ph.D. student
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
Final Report May 2013

Progress and Results
The exchange of nutrients between inundated terrestrial habitats and the main channel is thought to be a vital component of nutrient flow and food web assemblages in large rivers. Inundated terrestrial habitats may increase nutrient availability to fishes both directly (e.g. movement into flooded habitats) and indirectly (e.g. nutrients flushed into main channel) during periods of high flow. Allochthonous inputs during high flows may also provide fishes and invertebrates with necessary nutrients and energy after floods recede and return to base flow.

Despite the perceived importance of high flows for fishes and their invertebrate prey base, few studies have quantitatively examined how fish and invertebrate communities respond to flooding and floodplain inundation. We sampled fishes and benthic and drifting invertebrates in inundated habitats and adjacent main channel and downstream reaches of the Kansas River from 2009 – 2011. Samples were collected from each reach before, during, and after floods to quantify how nutrient flow is impacted by floodplain inundation. Drifting invertebrate densities were highest during high flows ($\bar{x}$=1.07 invertebrates/m3) and lowest post flooding (0.39 invertebrates/m3) ($p<0.001$). During high flows, invertebrate density was significantly higher in flooded habitats ($\bar{x}$=1.03 invertebrates/m^3) than in the main channel ($\bar{x}$=0.73 invertebrates/m^3) and downstream reaches ($\bar{x}$=0.64 invertebrates/m^3) ($p<0.001$) indicating that prey may be more readily available to fishes that move into these habitats. Stable isotope analyses used to examine nutrient use by fishes in the main channel and inundated habitats found that carbon (δ13C) and nitrogen (δ15N) isotope signatures were similar between fishes in flooded habitats and main channel reaches indicating that both groups of fishes are utilizing similar nutrient sources.

Preliminary results of this study indicate that large bodied fishes utilized flooded habitats when available, and that the inundation of terrestrial habitats during the flood pulse provides invertebrates to the main channel that may be consumed by main channel fishes. Data analysis is ongoing and is expected to be completed by Dec. 2012.

Products since 2012

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.

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

Expected Completion
Sept 2015

Status
On-going

Progress

We developed a framework to examine dynamic processes in a dense, broad-scale wetland habitat network. In particular, we provide a formal mechanism for the representation, measurement and modeling of potential movements between spatially discrete populations of playa wetland-dependent species within the Southern Great Plains. We used this framework to model and quantify changes to the structural and functional connectivity of Texas playa wetlands and identify playa wetlands critical to the maintenance of system wide connectivity (and hence, top priority for conservation) based on historic records, recent surveys, and forecasted future scenarios.
Initially, we conducted a network analysis on playa wetlands throughout the GPLCC (n = 48,981). We used a network hierarchical decomposition analysis to identify distinct, emergent sub networks based on the underlying physical structure of the playa wetlands within the region. Percolation behavior in response to variation in playa wetland configuration (h) was used to decompose the network into a hierarchy. Beginning at h = 20 km, links of decreasing distance were sequentially removed at increments of 1 km (i.e., h = 19 km, 18 km, 17 km...) to a distance of h = 500 m. At each distance, a quantified description of network-level percolation was obtained. The Texas playa wetland network (TPWN) was identified as a distinct and dominate sub network within this system. The TPWN emerged rapidly (i.e., h = 2 km) and remained a distinct sub network when h = 15 km. The TPWN included 24,338 playa wetlands within portions of New Mexico, Oklahoma, and Texas, US (Fig. 1a). To quantify the range in variation and to provide a standard for which network connectivity metrics calculated from further parameterize network models could be compared we constructed a random reference network of the TPWN. The potential range of variation in connectivity within the TPWN in both space and time were calculated using sequentially lower values of wetland availability (p) and h across 88,000 random playa wetland removal simulations. Our results indicate that the TPWN is characterized by dense clustering across the network at fine spatial scales (h > 2 km but < 5 km) and a single dominant sub network at broader spatial scales (> 5 km) even when p was relatively low (i.e., p = 0.2). Furthermore, we quantified the percolation metric ΔD across the range of scalar parameter (h x p) values to define the spatiotemporal domain of the phase transition and the percolation threshold of the TPWN (Fig. 1b). At the percolation threshold (i.e., h = 4 km, p = Δ0.2 -0.4) within the critical phase transition, the TPWN rapidly shifts from a network dominated by many small, dense, loosely connected sub networks to a single large sub network connected by increasingly direct and redundant paths. Through time, fine-scale redundancy in the formation of localized playa wetland clusters and broad-scale redundancy in path formation among playa wetlands across the TPWN insulate the network from total collapse by minimizing the probability of complete loss in function at any point in time. The phase transition in the TPWN acts as a

bridge linking fine and broad-scale population dynamics and it is at the percolation threshold that the TPWN is most sensitive to changes in playa wetland availability and configuration.

Network damage processes are used to characterize the robustness of complex networks to failure from damage. Using a network damage process, we assessed the relative importance of individual playa wetlands to maintaining network-level connectivity by comparing the response of network-level percolation metrics from a heterogeneous weighted TPWN to the reference distribution after targeted removals of high ranking playa wetlands. To construct the heterogeneous TPWN model, we assigned weights to each wetland that reflected differences in the potential magnitude of movement from wetlands. Weights were used in a bivariate, distance-decay kernel and were a product of probability of inundation estimates calculated using field and weather station data and habitat quality estimates derived using sediment deposition rates from a Universal Soil Loss equation (Fig. 1a & 1c). To target playa wetlands for removal in the network damage process, we calculated two different centrality metrics for each wetland that conceptually capture alternate aspects of connectivity at different scales (Fig 1d & 1e). At finer scales, playa wetlands with greater degree centrality may be important because their position in a localized cluster implies that these wetlands are highly accessible and thus sub populations within these wetlands are more likely to persist through time (i.e., Metapopulation Theory). At broader scales, playa wetlands with greater betweenness centrality may be important because their position in a network implies that populations have to move through these playa wetlands more often to cross the network. Within the large patchy populations that breed throughout the TPWN, these playa wetlands may act as "stepping stones" on long routes through the network maintaining movements within wetland clusters and facilitating occasional movements among sub networks. Based on the percolation behavior of the reference TPWN, we rank-ordered the wetlands of the TPWN by normalized weighted degree and betweenness centrality metrics calculated with $h = 4$ km in a distance decay kernel function and targeted the top 40% for removal in a network damage process. When removed, the dense, fine-scale clustering indicative of the TPWN when playa availability was relatively low (i.e., $p = 0.2$) shifted upward to $p = 0.4$ (Fig.1f). Additionally, the global TPWN failed to coalesce and redundant, broad-scale paths across the network did not form. These results suggest that the targeted wetlands are critical to maintaining functional connectivity across spatiotemporal scales among populations of playa wetland-dependent species within the TPWN.

Products Since 2012

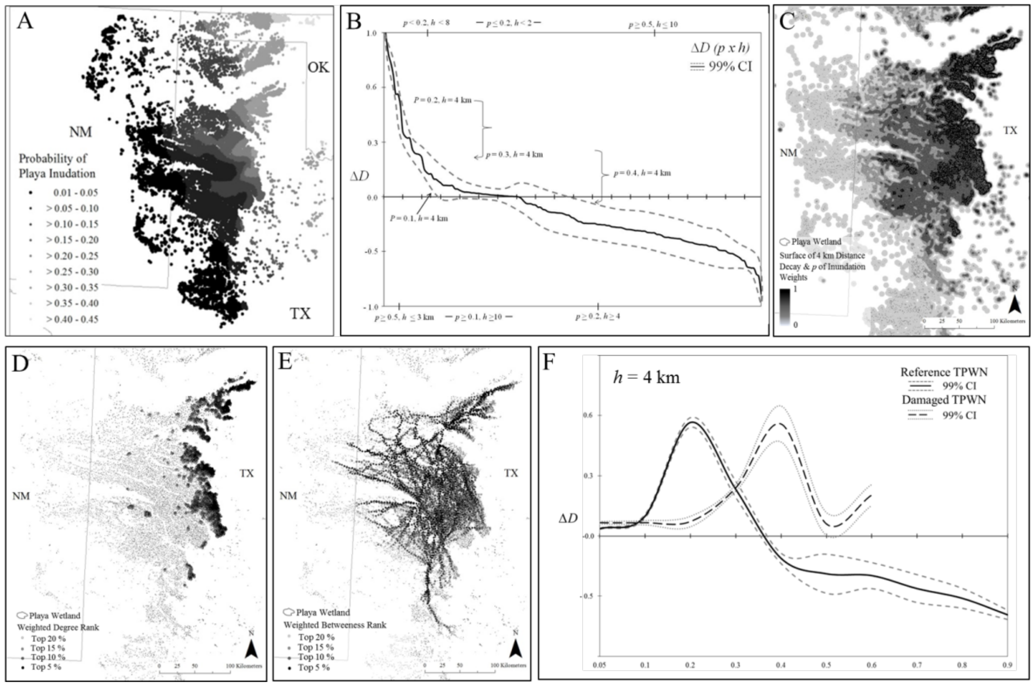


Figure 1. Image A shows the study region with the locations of playa wetlands within the Texas playa wetland network (TPWN) depicted as points. The probability of these playa wetlands being inundated in January based on models of historical and current annual precipitation patterns are indicated. The rank-ordered mean and 99 % CI of the global percolation metric ΔD for the TPWN varying wetland availability (p) and link distance (h) across 88,000 random playa wetland removal simulations is shown in image B. A large shift in percolation (i.e., positive to negative values ΔD) across the range of scalar parameter (h x p) values defines the spatiotemporal domain of the phase transition and the percolation threshold (i.e., h = 4 km, p = Δ0.2 - 0.4). To calculate node output estimates for each playa wetland within the TPWN, habitat quality and probability of inundation estimates were used as weights in a bivariate, distance-decay kernel with the scalar parameter (h) = 4 km (image c). Normalized weighted degree (image d) and betweeness (image e) centrality were calculated for each playa wetland in a heterogeneous TPWN model. Image F illustrates the effect of a targeted damage process on the percolation threshold of the TPWN. For the targeted damage process, playa wetlands in the heterogeneous TPWN network were rank-order by weighted degree and betweenness centrality metrics and the top 40% were removed.

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

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

Project Supervisor
Dr. Melinda Daniels

Funding
National Science Foundation

Cooperators
Kansas State University

Objectives:
1. How will interacting dynamics between climate variation, human land and water use decisions, and aquatic ecosystem dynamics affect surface runoff, hillslope erosion, groundwater recharge, stream flow regimes and wetland hydroperiods?

2. How will interacting dynamics between climate variation, human land and water use decisions, and hydrosystem dynamics affect aquatic biodiversity, ecosystem services and recreational services provided by streams, wetlands and reservoirs?

Status
On-going

Progress and Results

Overall
Models are needed that account explicitly for human-landscape interactions. In the four components of this proposal, we develop a coupled human-landscape model that incorporates atmospheric, terrestrial, aquatic, and social processes that can be used to predict the potential impact of climate variability, climate change, land use, and human activity on water resources. Here, M.E. Mather evaluates the effects of the above or on aquatic processes (native Kansas fish communities) and D. Haukos does the same for wetlands.

Throughout the US, freshwater ecosystems provide valuable societal goods and services that are being adversely affected by human behavior. Climate, likely is exacerbating these adverse impacts. Great Plains rivers are model systems for looking at a coevolved animal community that inhabit naturally-connected dendritic ecosystems which are adversely affected by climate change and human land and water use.

Our collaborative research is unique in that it integrates multiple disciplines with the goal of understanding how water systems in the Great Plains (geomorphology, hydrology, ecology) are affected by human land and water use, as well as, how humans value the components of an aquatic ecosystem. All stakeholders (farmers, ranchers, urban residents, conservationists, anglers) will benefit from the interdisciplinary insights about how aquatic ecosystems are structured and function that this research will provide. Although, this type of integrated research is a priority throughout the US, it is unusual to have the right combination of disciplinary experts who can collaborate effectively on this complex problem, as we have here.

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 and this integrated research should provide wide benefits to both science and society.

Fish comprise a large biomass in aquatic systems and have several attributes that make them an ideal focus for interdisciplinary research on natural and anthropogenic process drivers of biodiversity. First,

3. How will landowners respond, through land use and water use decisions, to climate-induced changes in water supply, water quality and ecosystem services?

4. How can policy structures be optimized to produce the most robust, sustainable, coupled human-biophysical system in the face of climate change scenarios?

Location
Smoky Hill River

Completion
December 2017

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 and wildlife. Thus, these charismatic megafauna, are an obvious link between natural and human systems.

Mather's contribution to this collaboration will be to quantify distribution of fish communities in river areas impacted by humans (dams, water withdrawal, land use change) compared to unimpacted areas. Our methodology will follow closely that used by my lab for sampling how low-head dams alter fish biodiversity and connectivity in the Neosho River. By coordinating fish biodiversity sampling in the Smoky Hill river with geomorphology, hydrology, and land use, our research team will better understand how humans impact aquatic systems. This information can then be combined with human surveys of use and value to advance science and increase the efficiency of conservation efforts.

Products since 2012

Climate Variation and Human-Landscape Interactions Affect Functional Capacity of the Central Great Plains Wetlands

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

Objective
Determine how climate variation and human land and water use decisions can impact hydroperiods and the functional capacity of wetlands

Location
Smoky Hill River watershed

Completion
December 2016

Status
Initiation Fall 2014

Progress

Freshwater resources in the Central Great Plains are becoming increasingly unstable through land use and water practices. As the global climate continues to change, it will affect these ecosystems as the precipitation events increase in intensity and duration of dry periods in-between precipitation events increase. As the hydroperiods change, it can affect the biotic community, decrease biodiversity and the support for carbon stores. Biodiversity is currently declining due to natural and anthropogenic factors such as habitat fragmentation, agricultural sedimentation and nutrient pollution. These wetlands are important ecosystems and stopover sites for waterfowl and shorebirds during migration. To achieve a more conservative landscape management, research is needed to explain the human-landscape interactions and develop models of the hydrosystem and human system responses to climate change.

The stimulation model, WETLANDSCAPE will facilitate an understanding of the effects of climate change on wetlands. The model will simulate wetland surface water, groundwater, vegetation, and apply it to wetlands with changing hydroperiods. The Soil and Water Assessment Tool model will simulate the future hydrological responses to climate changes such as wetland hydroperiods, volume, and sediment yield. This project will increase understanding of how interactions among climate change, changing precipitation levels and temperature will potentially affect the functional capacity of wetlands.

The wetlands studied will be in the Smoky Hill watershed, which can be related to the Central Great Plains area. The wetlands will be mapped and categorized with remote sensing and GIS capability. Wetlands sampling will estimate the storage volume of each wetland category. Staff gauges on water level monitoring techniques will determine the hydroperiod. Water quality changes and measurements (temperature, depth, DO, BOD, nutrients, turbidity) will be monitored. The water quality, temperature, and precipitation will evaluate the effects of climate change. Weekly avian counts will identify the wetland's species richness, chronology, behavior, and habitat selection as it relates to the wetland's hydroperiod. Results from this project are a component of a bigger proposal that will develop an integrative mechanistic human-landscape interaction model to achieve sustainable landscape management.

Wildlife Projects

Ongoing Wildlife Projects

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

Investigators
David Spencer, M.S. Student, 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

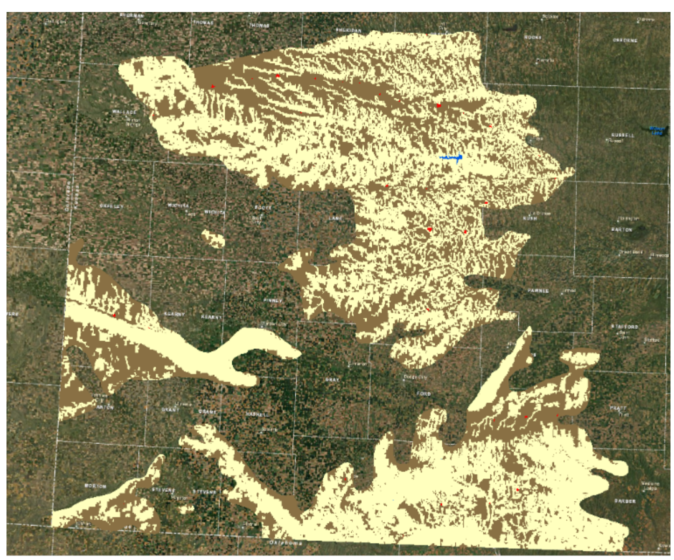
Location:
LEPC range in Kansas; Western Kansas

Completion: August 2014

Status
In Progress

Progress and Results

The lesser prairie-chicken (*Tympanuchus pallidicinctus*) has experienced significant changes to the size and distribution of its range during the 20th and 21st centuries. Our objective is to document the changes in cover type in the lesser prairie-chicken range in Kansas from 1950 to 2013 using aerial photography and satellite imagery. Using aerial photographs from the Army Map Service and the Farm Service Agency, land cover shape files representing native prairie and agriculture were digitized for a period during both the 1950s and 1960s. Beginning in the 1970's, LANDSAT satellite images were spectrally classified to create land cover maps for a year during each decade from 1970 through 2013. To document changes between decades, land cover classes of each shape file were analyzed using the program FragStats to obtain multiple landscape metrics, such as areal extent of land cover classes and connectivity between classes. Preliminary results indicate that within the lesser prairie chicken range, there has been a reduction in prairie grasslands and an increase in croplands from 1950-2013. However, beginning in the 1980's, areas of croplands transitioned to perennial grasslands as a result of initiation of the USDA Conservation Reserve Program. The change in spatial arrangement of available habitat has affected the density and distribution of lesser prairie-chickens.



Products since 2012

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.

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

Investigators
Reid Plumb, M.S. Student

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.

Establish functional relationships between habitat patch use and vital rates of LPCH populations.

Compare vital rates and drivers among populations.

Status
On-going

Progress and Results

The lesser prairie-chicken (*Tympanuchus pallidicinctus*; hereafter LPCH) is a prairie grouse species once widely distributed in the southwestern Great Plains of Texas, New Mexico, Oklahoma, Kansas, and Colorado. Their range and population have been reduced by an estimated 90% since European settlement in the 1800s. As a result of continued population declines, the USFWS has listed the species as threatened under the Endangered Species Act of 1973. Survival, space use, and habitat use are confounding factors that drive population trajectories. Therefore, more recent and robust estimates of these factors are crucial for effective management and conservation decisions. The goals of this project are to estimate breeding season survival rates, movement, space use, and habitat use of adult female LPCH in Kansas and Colorado. LPCH were trapped and marked during the spring (March – May) of 2013 and 2014. Habitat at all study sites was sampled at the patch scale type and sampled to characterize the composition and structure. Preliminary survival estimates were produced using staggered entry, known-fate modeling procedures in Program Mark. We had a total of 54 confirmed mortalities of marked individuals across the study sites. Mortality during the nesting period accounted for 63% of all breeding season mortality with the first 3 weeks accounting for 43% alone. GPS transmitters did not bias survival of adult females as GPS marked birds had slightly higher weekly survival rates (0.96 $\pm$ 0.01) and a greater probability of surviving the entire breeding period (0.39 $\pm$ 0.04) than did VHF marked birds (0.93 $\pm$ 0.01; 0.22 $\pm$ 0.07), respectively. Survival varied regionally with the SC Kansas having the highest derived estimates and NW Kansas having the lowest. Female movements varied between periods with larger movements occurring during the lekking and re-nesting periods (12.17 – 21.31-km) than the nesting, brooding, and post breeding periods (4.75 – 10.61-km). Movement also varied regionally with NW Kansas consistently having larger average weekly movements that the SC Kansas. Home-range size varied temporarily with the lekking and post-breeding periods having the largest home-range sizes. Home-range size did not substantially vary between regions. Home-range core area sizes were relatively consistent between regions and across the breeding season (Figure 2). Habitat use did not vary greatly between regions with LPCH females using grassland habitats at a higher proportion compared to CRP and Crop. However, grassland usage varied from 50%-90% in NW Kansas depending on the period (Figure 3). Intuitively, cropland was used relatively infrequently through the breeding season. Marked individuals in SC Kansas used grassland habitats exclusively during the breeding season. Further data analysis is ongoing and is expected to be completed by December 2014.

Products since 2012

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

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

Evaluate potential radio marked handicap between 2 radio transmitter types

Location: Kansas and Colorado

Completion: December 2014

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.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.

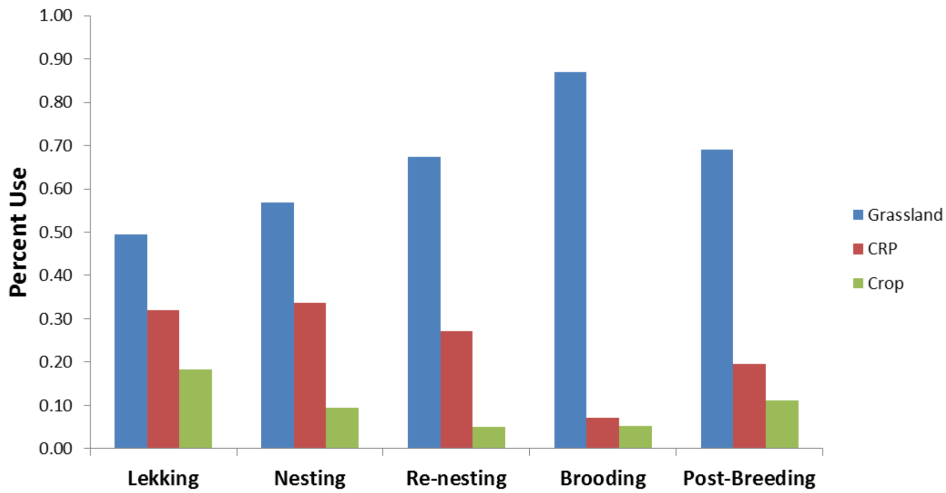
Plumb, R.T., J. Lautenbach, B. Ross, D. Spencer, D. Haukos, J. Pitman, J. Augustine, K. Oxenrider, and D. Dahlgren. 2014. Breeding season space use dynamics of female lesser prairie-chickens in Kansas and Colorado. Symposium on Animal Movement and the Environment, Raleigh, North Carolina.

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.

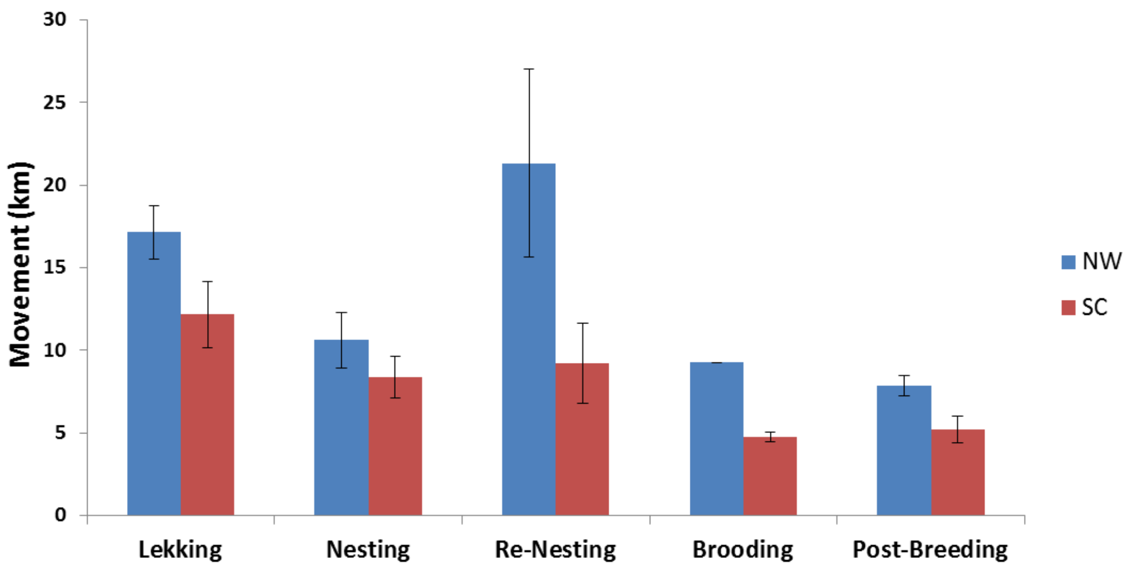
Plumb, R.T., J. Lautenbach, D. Haukos, J. Pitman, J. Augustine, K. Oxenrider, and D. Dahlgren. 2014. Breeding season home-range characteristics of female lesser prairie-chickens in Kansas and Colorado. Kansas Natural Resource Conference, Wichita, Kansas.

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.



2013 breeding season habitat use by period of female lesser prairie-chickens in NW Kansas.



Temporal and regional variation of average weekly movements of female lesser prairie-chickens in Kansas.

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

Investigators
Joseph Lautenbach M.S. student

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
On-going

Progress and Results
Lesser prairie-chicken (*Tympanuchus pallidicinctus*) occurs primarily on the High Plains of the Southern Great Plains. Population numbers and range have declined >80% since European settlement due to habitat loss and degradation. Increases in relative cover of native shrubs (e.g., sand shinnery oak [*Quercus havardii*) and sand sagebrush [*Artemisia filifolia*]) and other woody vegetation (e.g., eastern red cedar [*Juniperus virginiana*]) is reducing the amount of available grassland habitat. In addition, increasing presence of eastern red cedar is believed to cause avoidance of surrounding available habitat by LEPC due to occurrence of an unnatural structure on the landscape. However, much remains unclear regarding the influence of presence of eastern red cedar and other excessive cover of woody vegetation on LEPC populations including density thresholds, avoidance patterns, and response to removal. 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.

Nest success for LPCs varied among regions in 2013 (south-central Kansas-0.483 [95% CI- 0.278, 0.662], northwest Kansas - 0.293 [95% CI- 0.192, 0.401] eastern Colorado- 0.398 [95% CI 0.060, 0.745]). Nests were located in areas of greater visual obstruction on average than at paired points (1.33 dm, 0.65 dm, respectively. $P < 0.0001$). Grass was not selected for at a significant level, when compared to paired points. Nests were located in larger habitat patches than the surrounding patches. Brood survival varied among regions (South-central Kansas-Daily Survival Rate (DSR)- 0.980 [95% CI- 0.944, 0.993] northwest Kansas- DSR- 0.786 [95% CI- 0.584, 0.906], eastern Colorado- DSR- 0.931 [95% CI- 0.868, 0.965]. Broods used areas of greater visual obstruction than paired points (1.43 and 1.09, respectively. $P = 0.005$). Broods were more likely to use areas of greater forb cover (30.5% and 25.6%, respectively. $P = 0.07$).

We found 11.6% of all prairie-chicken locations were located within 100 m of trees and 36.9% of prairie-chicken locations were within 200 m of trees. Tree densities of habitat patches ranged from 0.01 trees/ha to 22.90 trees/ha, with a mean of 3.09 trees/ha. We observed 88.6% of all prairie-chicken locations were in habitat patches with <1.0 trees/ha and 95.5% of all prairie-chicken locations were in patches with <1.5 trees/ha.

Location:
Throughout Kansas, eastern Colorado

Completion: December 2014

Products since 2012

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.

Lesser Prairie-Chicken Adult Female Seasonal Habitat Selection, Use of Grazed Range, and Predation Risk in Kansas and Eastern Colorado

Investigators
John Kraft, M.S. Student

Project Supervisor
Dr. David Haukos
Jim Pitman

Funding
Kansas Department of Wildlife, Parks, and Tourism

Cooperators
Christian Hagen
Kansas Department of Wildlife, Parks, and Tourism
U.S. Fish and Wildlife Service
Great Plains LCC
USDA Forest Service

Objectives

Evaluate habitat selection by LPCH adult females in Kansas and eastern Colorado in various habitat landscapes

Investigate LPCH vital rates and habitat use influenced by common livestock grazing strategies.

Investigate the influences of predator communities on LPCH success and habitat use.

Location:
Western Kansas and eastern Colorado

Completion: May 2016

Status
Initiation Spring 2014

Progress and Results
Lesser prairie-chickens (*Tympanuchus pallidicinctus;* hereafter LPCH) and their status throughout their five-state range are popular topics of conversation. The listing of LPCH as "Threatened" under the Endangered Species Act has stimulated conservation efforts and plans for management. The majority of the individuals that persist occur in within the Kansas and Colorado borders. However, most research investigating LPCH has been concentrated on southern populations (Texas, Oklahoma, and New Mexico). This project aims to assist in the management of LPCH within the northern reaches of LPCH range by answering questions in regard to habitat selection, livestock grazing and its effects on LPCH, and predator community influences on LPCH habitat use and success. Collaborating researchers are determining demographic characteristics for the species within Kansas and Colorado. From this information (movements, survival, recruitment), habitat types that are selected by adult LPCH females for various ecological functions (nesting, brooding, non-breeding seasons) will be determined and quantified in terms of size, vegetation, and management. These inferences will then aid in the determination of target habitats that are essential pieces for landscape management of LPCH. Common livestock grazing strategies and practices within the Kansas and Colorado LPCH range are also important to large scale management. Adult females have been trapped, marked, and being monitored via telemetry on selected ranching operations at each field site. Habitat use and success (recruitment and survival) of adult female LPCH will be investigated among the various grazing techniques represented at each field site. This will assist managers (private and public) in the future by helping shape grazing operations towards LPCH management goals. Predator populations are currently being monitored via road surveys (avian) and motion-sensored camera traps (mammalian). Relative values of abundance for LPCH predator species will be determined spatially (across habitats) and temporally (thought breeding season). These values will then be used to make inferences about LPCH adult survival and habitat selection across various time periods and habitats. Results of this project will contribute to effective population management and hopefully the delisting of LPCH from the Endangered Species Act.

Products since 2012

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

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Investigators
Samantha Robinson, M.S. Student

Project Supervisor
Dr. David Haukos
Jim Pitman

Funding
Kansas Department of Wildlife, Parks and Tourism

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

Objectives
Design an ideal landscape for Lesser Prairie-Chickens.

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

Location
Northwestern and South Central Kansas, Eastern Colorado

Completion
May 2016

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Status
Initiation Spring 2014

Progress and Results
Lesser Prairie-Chickens are an imperiled prairie grouse species that are located in the southern Great Plains. Having recently been listed under the Endangered Species act of 1973, in May of 2014, further research and management is required to try and mitigate their past population declines. As a landscape scale species which uses habitat of different configurations and compositions, landscape scale management is necessary. To identify prime areas for management, a spatially explicit model will be used correlating prairie-chicken demographics with landscape variables. The landscape within the model will be incrementally changed via modifying quantities of grassland, Conservation Reserve Program tracts, and anthropogenic features to determine the ideal landscape design for lesser prairie-chicken population growth.

Kansas, specifically, currently contains over 80% of the worldwide population of Lesser Prairie-Chickens. However, non-breeding season demographic information is lacking. This is especially true for the contemporary northwestern portion of their range. Using satellite GPS transmitters, and VHF transmitters, survival, movements, home range and habitat use will be calculated for Lesser Prairie-Chickens in Kansas and Colorado, during the non-breeding season. The non-breeding season is being classified as the time period in which females are not attending leks, nesting or brooding chicks.

Products since 2012
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.

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

Investigators
Dan Sullins, Ph.D. Student

Project Supervisor
Dr. David Haukos
Jim Pitman

Funding
Kansas Department of Wildlife, Parks, and Tourism
USDA NRCS
USDA FSA
Kansas State University

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

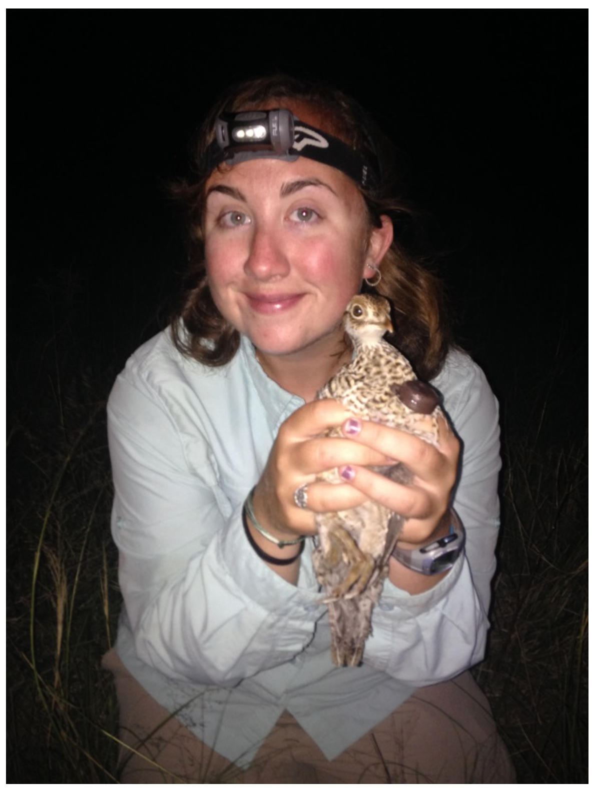
Location:
Kansas and eastern Colorado

Completion: May 2017

Status
Initiation Spring 2014

Progress and Results

Loss of habitat and concurrent long and short-term population declines have led to the recent listing of the lesser prairie-chicken (*Tympanuchus pallidicinctus*, LPC) as a threatened species under the Endangered Species Act (1973). Recovering LPC to stated population goals will require a solid understanding of LPC boom and bust population cycles across time and metapopulations. Past research has shown that fragmented populations likely rely on the immigration of individuals from other areas. Therefore, we plan to examine variables for which the population rate of change may be sensitive, or elastic, and to use influential parameters to model differences in predicted population rate of change and population persistence amongst multiple spatial scenarios.



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
USDA FSA

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

Objectives

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

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

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

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

Status
On-going, initiated June 2013

Progress and Results
Significant numbers of lesser prairie-chickens of Kansas and Colorado are associated with former croplands that have been enrolled in a U.S. Department of Agriculture conservation programs/practices, principally the Conservation Reserve Program (CRP) and Environmental Quality Incentive Program (EQIP). At a broad-scale CRP has reduced habitat fragmentation and assisted in connecting extant and expanding populations. Additionally, conservation practices with CRP fields that may be affecting these populations include vegetation species composition, development of supplemental water areas, mid-term management practices, and emergency haying/grazing declarations. Use of CRP may also be related to juxtaposition of CRP, cropland, and other land uses. In addition, the overall population response by lesser prairie-chickens to conservation programs needs to be assessed in regard to demography of the population to model future population trends. Concurrent with CRP and land use practices, more information is needed on the response of lesser prairie-chickens to changes in climate. The Great Plains region is predicted to experience increasing drought conditions, which could negatively affect lesser prairie-chickens in the future. A better understanding of the interaction between land use and climate change on lesser prairie-chicken population demographics is important for future management practices. Our results thus far indicate that extreme values of Palmer Drought Severity Index (both low and high, or dry and wet conditions) during the spring breeding season were the best predictors of changes in lesser prairie-chicken abundance, though neither had a significant effect on male lesser prairie-chicken abundance on leks. Abundance on leks was highest during the mid-1980s, followed by low population abundance in the 1990s. The population has remained relatively stable since the late 1990s. Future research will incorporate land use variables to determine how vital rates (nest success, survival relative to other habitat types) differ by landscape type. Interactions between land use type and with climate change will be quantified, as well as interactions with climate and a variety of landscape metrics (e.g., edge, patch size, patch configuration). Population demography will be linked to a variety of USDA conservation practices. The influence of CRP on LEPC populations will be determined by scaling results up to landscape levels.

Location:
Throughout Kansas and Eastern Colorado

Completion
June 2015

Products since 2013

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. 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. 2014. Combining multiple data sources to determine climate and land-use impacts on lesser prairie-chickens. Annual Meeting of The Wildlife Society, Pittsburg, Pennsylvania.

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
On-going

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 dataset which shows the frequencies of inundation for the months of January, June,

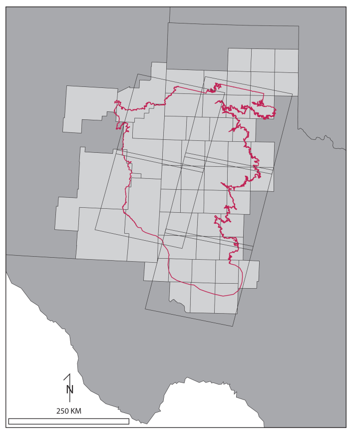
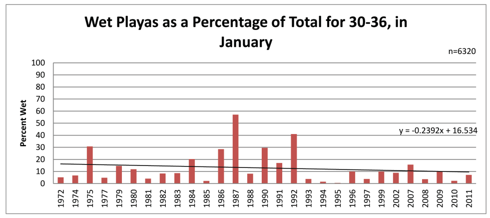
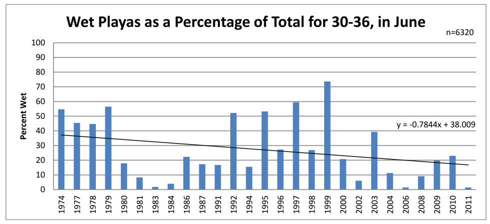
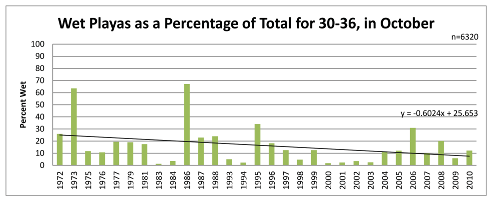


Figure 1. Study area showing SHP extent (red line), counties (light grey), and Landsat path/rows used (black line, no-fill polygons).







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.

Products since 2012

A multi-scale examination of the distribution and habitat use patterns of the Regal fritillary (*Speyeria idalia*) within the Fort Riley Military Reservation

Investigators
Kelsey McCullough, Undergraduate Student
Dr. Gene Albanese, Post-Doctoral Research Associate

Project Supervisor
Dr. David Haukos

Funding
Department of Defense, Fort Riley

Cooperators
Shawn Stratten
Department of Defense

Konza Prairie Biological Station

Objectives

Provide spatially explicit estimates of the current distribution and relative abundance patterns of the Regal fritillary and its host plant, Prairie violet at the FRMR and KPBS.

Provide baseline population estimates of the Regal fritillary within the FRMR.

Provide models that identify habitat features and management practices that influence the occurrence of late instar larvae among discrete clusters of Prairie violet within the FRMR and KPBS.

Provide models that identify habitat features and management practices that influence the density of adult Regal fritillary within the FRMR and KPBS.

Status
Pilot Project 2014

Progress and Results

The Regal fritillary was once an abundant butterfly species of the prairie biome with a range that extended from the Canadian border to Oklahoma and east to the Atlantic coast. Populations have declined approximately 99% in the prairie region and it is nearly extirpated from the eastern portion of its former range. However, populations within northeastern Kansas remain relatively abundant and are considered stable. The Regal fritillary is univoltine with adults flying in Kansas from June to mid-September. Larvae hatch in fall, enter larval diapause and then emerge in spring to begin feeding. The larval host plants of Regal fritillary are all violets (Viola spp.), with Kansas populations feeding on Prairie violet (V. pedatifoda). Prairie violet is a small (<8 cm), perennial plant characteristic of native tallgrass communities within Kansas. Causes of Regal fritillary decline remain largely undetermined but like many oligophagous butterflies associated with native plant communities, the decline of this species appears to be the result of habitat loss and the subsequent breakdown of metapopulation dynamics. The large tracts of native tallgrass prairie at the Fort Riley Military Reserve (FRMR) and Konza Prairie Biological Station (KPBS) offer a unique research opportunity to examine the habitat-use patterns and metapopulation dynamics of a stable population of this imperiled species. The objectives of the research are to (1) provide spatially explicit estimates of the current distribution and relative abundance patterns of the Regal fritillary and its host plant, prairie violet at the FRMR and KPBS; (2) Provide baseline population estimates of the Regal fritillary within the FRMR; (3) provide models that identify habitat features and management practices that influence the density of adult Regal fritillary within the FRMR; (4) provide models that identify habitat features and management practices that influence the occurrence of late instar larvae among discrete clusters of prairie violet within the FRMR and KPBS ; and (5) produce information products on the effectiveness of current and potential management strategies for the conservation of Regal fritillary populations within the FRMR. Using GIS and distribution modeling, we produced a predictive distribution map of Prairie violet within our study area and inferred on the importance of the environmental variables that contributed to the model. These results will be evaluated and improved with field validations of prediction areas. Further, these model predictions will be used to locate Regal fritillary larvae among host plant clusters to examine microhabitat conditions suitable for larval development. Additionally, we will use repeated-modified Pollard walks to survey adult Regal fritillaries and estimate adult abundance and detectability.

Products since 2012

Produce information products on the effectiveness of current and potential management strategies for the conservation of Regal fritillary populations within the FRMR and KPBS.

Location
Fort Riley Military Reserve
Konza Prairie Biological Station

Completion
May 2015

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: May 2015

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 since 2012

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

Investigators
Brian Kearns, Ph.D Candidate

Project Supervisor
Dr. David Haukos
Dr. Warren Conway

Funding
U.S. Fish and Wildlife Service
U.S. Geological Survey

Cooperators
Texas Chenier Plain NWR Complex
Stephen F. Austin State University
Dr. Dan Collins
Patrick Walther

Objectives

Within the context of a formal risk assessment, evaluate the risk of environmental lead exposure for mottled ducks and other waterbirds.

Model factors determining lead availability and resulting mottled duck species distribution

Develop a body condition model for predicting non-breeding season fat stores in mottled ducks

Analyze lead isotope ratios in soil, vegetation, and mottled duck blood samples to determine past and ongoing sources of lead deposition

Status
On-going

Progress and Results

Currently, ongoing studies on the Texas Chenier Plain and Midcoast NWR Complexes are quantifying spatial availability of lead pellets and lead concentrations in the soil, birds, and plants. In addition, that study is also relating environmental lead concentrations with concentrations in blood of mottled ducks and other species. This project combines all of those data in conjunction with unique analyses and data collection to conduct a formal risk assessment of lead exposure for mottled ducks. We used interpolation techniques in ArcGIS to produce maps for all NWRs that predict probability density functions of lead availability in all sampled habitats used by mottled ducks. To determine potential sources of lead in these samples (i.e., natural or anthropogenic), ratios of stable lead isotopes following the methods of Saint-Laurent et al. (2010) were evaluated and modelled spatially as well. Using the model being developed for predicting the influence of environmental lead on population demography of mottled ducks on the Texas Chenier Plain NWR, we have additionally estimated the effects of available lead on mottled duck species distribution using MaxENT models, which includes elucidation of landscape-level environmental covariates that may be contributing to lead "hot-spots" and where areas of increased lead concentration may overlap with areas of high mottled duck usage. This information may, in future, be used in conjunction with the non-breeding season fat index developed herein, which produced an equation that will allow managers to predict fat from age class, mass, and a length metric. Finally, these data will be used to conduct a cumulative risk assessment for lead exposure in these ecosystems, determining the quantitative value of risk related to a concrete situation and a recognized threat. Risk assessment consists of an objective evaluation of risk in which assumptions and uncertainties are clearly considered and presented. Part of the difficulty of risk management is the measurement of both of the quantities in which risk assessment is concerned - potential loss and probability of occurrence. The collected data will provide these quantities. We will follow the EPA framework for ecological risk assessment, including the following three general phases: (1) problem formulation, (2) analysis, and (3) risk characterization.

Location:
Texas Chenier Plain National Wildlife Refuge Complex

Completion: May 2015

Products since 2012

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.

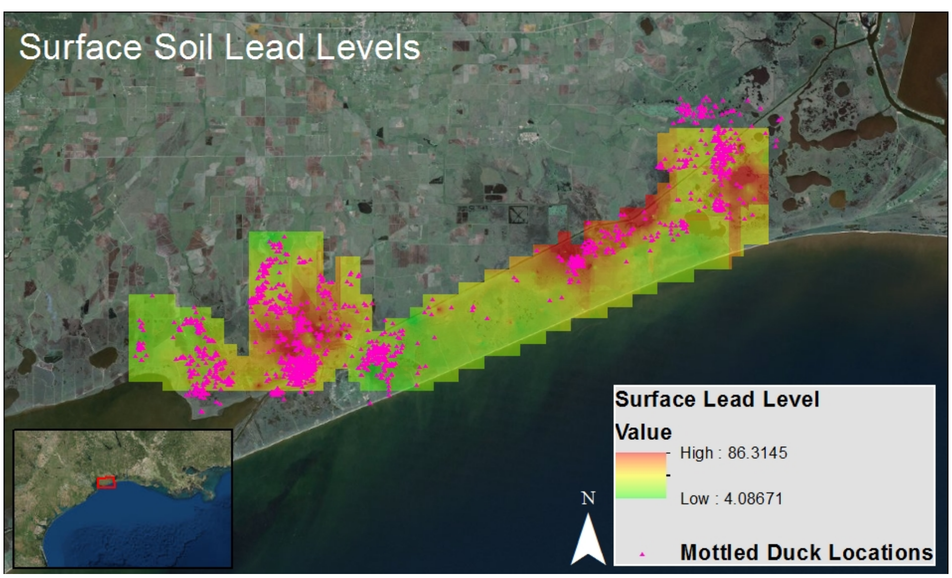
Kearns, B., S. McDowell, J. Moon, and D. Haukos. 2013. Spatial analysis and ecological risk assessment for lead exposure in Gulf Coast waterfowl: does environmental lead represent an ecological trap? Annual Meeting of the Ecological Society of America. Minneapolis, Minnesota.

Kearns, B., 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., 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.

Kerns, 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.

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.



Occurrence and Prediction of Avian Disease Outbreaks in Kansas

Investigators
Thomas Becker

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: December 2015

Status
Ongoing

Progress and Results
There are a wide variety of diseases that affect birds. These diseases can be bacterial, viral, fungal, parasitic, and toxic (i.e., environmental contaminant). Of the diseases that affect migratory, wild birds, those of primary concern are avian cholera, avian botulism, duck plague, aspergillosis, West Nile, Newcastle disease, and avian influenza. Avian cholera and avian botulism are bacterial diseases, *Pasteurella multocida* and *Clostridium botulinum*, respectively, that typically affect waterfowl and shorebird species. Occurrences, causes, and impacts of disease in wild bird populations are rarely studied beyond documentation of large outbreaks in terms of date, duration, species affected, and estimated number of individuals affected. These records are stored throughout many different venues. For many avian diseases, certain environmental conditions are hypothesized to be necessary prior to the occurrence of epizootic events. By location in the middle of the Central Flyway, Kansas provides critical habitat for breeding, migrating, and wintering migratory birds. In addition, several areas (e.g., Cheyenne Bottoms, Quivira, Jamestown, and McPherson wetland habitats) support large populations of migratory waterfowl and other waterbirds that would result in a major mortality event should a disease outbreak occur. Further, survey evidence f indicate that migratory birds are staging for longer periods in Kansas compared to historical duration, increasing the likelihood of increased impacts of disease outbreaks in the state. All records of disease outbreaks will be compiled through a comprehensive search of all potential locations that may house any such reports. Once all possible records are compiled, a data base will be generated that includes all potential information related to disease outbreaks (e.g., date, location, duration, species involved, number of dead birds counted). Upon completion of the historical data base, a web-based reporting process will be developed for use by anyone in the state of Kansas. We will use one of the suite of available models and software (e.g., MaxEnt, Environmental-Niche Factor Analysis, Genetic Algorithm for Rule-Set Prediction) used to develop predictive models based on known occurrence of a disease outbreak and the environmental conditions associated with the outbreak.

Products since 2012

Completed Wildlife Projects

Andy Stetter, Lesser Scaup Ducklings, Red Rocks Lake NWR, Montana

Community Response to Use of Prescribed Grazing and Tebuthiuron Herbicide For Restoration of Sand Shinnery Oak Communities

Investigators
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Texas Tech University

Project Supervisor
Dr. David Haukos
Dr. Clint Boal

Funding
Grasslands Charitable Trust
Weaver Ranch
Texas Tech University

Cooperators
Charles Dixon
Willard Heck
Jim Weaver

Objectives
Determine the community response to tebuthiuron and grazing treatments used to restore sand shinnery oak grasslands

Assess the temporal response of the community to the treatment combinations over a 12-year period

Compare resulting vegetation composition to historical standards.

Location
New Mexico

Completion
March 2012

Status: Completed

Results:
The sand shinnery oak (*Quercus havardii*) mixed-grass community is an isolated, relict habitat located within short-grass prairie of the Southern High Plains. With the introduction of center-pivot agriculture, unmanaged grazing, oil and gas exploration and suppression of the natural fire regime, the vegetation composition of the shinnery oak community has changed during the past century. Land managers have used herbicides (e.g., tebuthiuron) and a variety of grazing systems as tools to manage shinnery oak. Results show that at relatively low levels of tebuthiuron (0.60 kg/ha) and subsequent moderate grazing system, sand shinnery oak can be reduced and maintained at near historical levels without reapplying tebuthiuron because the tested management approach allowed grasses to remain competitive in the system. There was 91% less shinnery oak in untreated areas. The removal of shinnery oak made environmental soil moisture more available for grasses and forbs to germinate and grow. Grasses increased by 149% and forbs increased by 257% in treated areas as compared to untreated areas throughout the study period. In terms of visual obstruction, there was both an herbicide and grazing effect in April such that visual obstruction increased by 30% in treated areas as compared to untreated and decreased by 6.5% in grazed areas as compared to non-grazed areas. There was no significant herbicide effect of overall abundance of small mammals. However, there was a significant grazing effect such that there was 23% more abundance of small mammals in grazed areas as compared to non-grazed areas, which was likely driven by kangaroo rats. Areas that were treated with tebuthiuron and had moderate grazing statistically reached historical standards only during one year, but showed trends that were comparable to historical standards throughout the study compared to other treatment combinations. The largest difference between treated areas and historical standards was that treated areas had more forbs. The change from a shrub monoculture to a mixed-grass prairie changes the plant composition and structure and provides more niches for invertebrates, mammals and herptiles to fill.

Products since 2012:

Zavaleta, J. 2012 Effects of grazing and herbicide treatments to restore degraded sand shinnery oak grasslands. Thesis, Texas Tech University.

Zavaleta, J., D. Haukos, and C. Boal. 2012. Community response to use of prescribed grazing and herbicide for restoration of sand shinnery oak grasslands. 48th Annual Meeting, Texas Chapter of The Wildlife Society, Fort Worth, Texas.

Zavaleta, J., B. Grisham, D. Haukos, and C. Boal. 2013. Invertebrates of sand shinnery oak communities and the influence on lesser prairie-chicken brood survival. Annual Meeting of The Texas Chapter of The Wildlife Society, Houston, Texas.

Zavaleta, J., P. Maloney, and D. Haukos. 2013. Understanding the human component for conservation in the sand shinnery oak grasslands. Annual Meeting of The Texas Chapter of The Wildlife Society, Houston, Texas

Zavaleta, J. 2013. An annotated bibliography of the lesser prairie-chicken. Western Association of Fish and Game Agencies, Tucson, AZ. 550 pp.

Example of a restored sand shinnery oak grassland in eastern New Mexico

Deer Density, Movement Patterns, and Group Dynamics on Quivira National Wildlife Refuge: Assessing Potential Risk for Disease Transmission

Investigators
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Dr. Jonathan Conard

Project Supervisor
Dr. Jonathan Conard

Funding
US Fish and Wildlife Service
Kansas Department of Wildlife, Parks, and Tourism
U.S. Army Corps of Engineers

Cooperators
Quivira NWR

Sterling College

Kansas State University

Objectives
Identify factors contributing to direct and indirect contact rates among deer.

Background on density, movements, and social structure to develop testable hypothesis for future research on white-tailed deer of QNWR

Location
Quivira National Wildlife Refuge

Completion
July 2012

Status
Completed

Progress and Results
In our study, small grains (winter wheat / rye) are the most common crop within the predominantly agricultural landscape surrounding Quivira National Wildlife Refuge. This type of crop was used most frequently by deer, and was preferred by deer in winter time periods during some years of our study. In addition to winter wheat, deer used a variety of other crop types including corn, alfalfa, and fallow fields. Use of corn by white-tailed deer peaked during the summer which is consistent with observations that deer will consume corn during the summer (Nixon et al. 1991) and that home ranges may shift closer to corn fields during the tasseling-silking developmental stage Fallow fields were used by deer most frequently during the summer (May-August) and were not avoided by deer during any season. The use of fallow fields by deer during the summer months was unexpected and to our knowledge has not been documented in other agricultural systems. Since deer used habitat selectively with respect to agricultural crops, it may be possible to use existing crop fields on Quivira National Wildlife Refuge as a means of managing distributions and movement patterns of deer. However, our results suggest that male deer often completely avoided burned areas for several weeks following burning and used burned areas of mixed-grass prairie less than expected in the 4 month time period following prescribed burning during the spring and late summer. Deer did not strongly avoid burned areas between 4-16 months following spring burning and did not exhibit a consistent pattern of avoidance or preference for burned areas during this time period. Our results suggest that fire in mixed-grass prairie may strongly influence patterns of habitat selection up to 4 months following a prescribed burn that occurs during the spring or summer.

Products since 2012
Conard, J.M. and R. Lauben. 2012. Patterns of habitat selection and densities of white-tailed deer at Quivira National Wildlife Refuge. Final Report

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

Investigators
Jena Moon, Ph.D. 2014
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 – May 2014

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 λ = 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 since 2012

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

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.

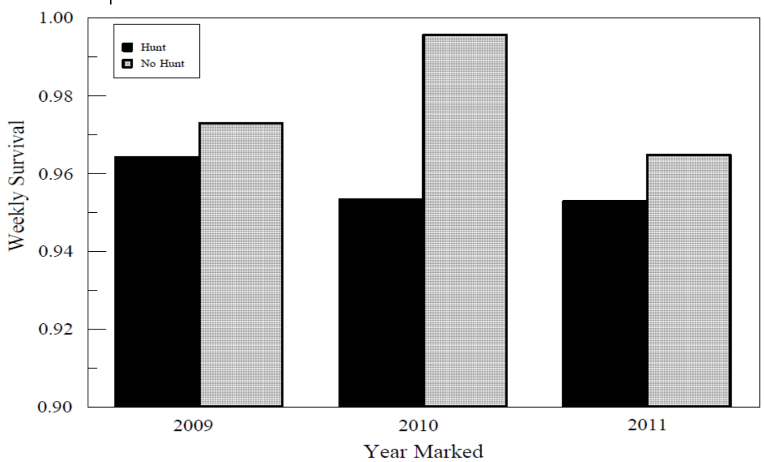
Moon, J.A., D.A. Haukos, and W.C. Conway. 2014. Mottled duck (*Anas fulvigula*) movements in the Texas Chenier Plain Region. Journal of the Southeastern Association of Fish and Game Agencies

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.

Moon, J.A., D.A. Haukos, W. Conway, and P. Walther. 2013. Potential implications of climate change on the mottled duck. 6th North American Duck Symposium, Memphis, Tennessee. Poster

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.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.



Average weekly survival of hunted and non-hunted periods calculated by Program MARK for adult female mottled ducks radio-tagged in the Chenier Plain Region of Texas and monitored 1 June 2009-31 May 2012.

Habitat Use and Migratory Origins of American Woodcock Wintering in East Texas

Investigators
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Project Supervisor
Dr. Warren Conway
Dr. David Haukos

Funding
Webless Migratory Game Bird Research Program
U.S. Fish and Wildlife Service
U.S. Geological Survey
Rumsey Research and Development fund
Stephen F. Austin State University

Cooperators
Dr. Keith Hobson
Dr. Leonard Wassenaar
Dr. Dan Collins

Objectives
Measure patch occupancy of wintering American woodcock

Using band recovery and isotope data, determine harvest derivation for southern wintering grounds.

Location:
North America

Completion: December 2013

Status
Completed – December 2013

Progress and Results

American woodcock (*Scolopax minor*) Singing Ground Surveys (SGS) indicate short-term population stabilization, but long-term declines since monitoring began in the 1960s (Cooper and Rau 2013). Multiple factors likely contribute to these declines; however, our inability to quantify woodcock population dynamics across its range makes it difficult to decipher these factors. Moreover, spatial coverage by the SGS of woodcock breeding grounds remains unevaluated and available data may not represent trends of the entire population(s). Quantification of habitat availability and use in regionally important wintering, breeding, and stopover sites, combined with estimates of connectivity among these sites is needed for a more holistic understanding of woodcock population dynamics. Therefore, the objectives of this study were to (1) use stable isotope techniques to estimate population sources and link connectivity among natal, summer, and winter ranges of hunter-harvested juvenile American woodcock and (2) estimate landscape level occupancy and population densities of American woodcock wintering in east Texas and their relationships with a Habitat Suitability Index (HSI) and habitat covariates.

Harvest and band recovery data, as well as recent telemetry and departure and arrival data, have provided insight into woodcock migration and movement patterns. However, the elusive use of dynamic early successional mesic habitats by woodcock has made it difficult to monitor populations and determine continental scale migratory connectivity. Identification of key regional population sources, or production areas, that contribute to winter harvest would be valuable for implementing new and updating current monitoring programs. Stable isotope analyses are an emerging means by which to link birds to specific regions, as ratios of stable isotopes vary among landscapes. Stable isotopes of hydrogen are commonly used in bird migration studies because feathers retain a fixed isotopic signature from the location of its growth, and can be linked to general geographic locations. Standardized stable hydrogen isotope ratios (δ^2H) in feathers have been strongly correlated with long-term precipitation data at large geographic scales, where deuterium values in precipitation follows a gradient across North America where δ^2H_p generally decreases from the southeast to the northwest.

In winter 2010 - 2011 and 2011 - 2012, S13 and P1 feathers from 494 individual wings were used for stable isotope analysis. Feather deuterium values from known natal origin (prefledged) woodcock (n = 43) were regressed with same location growing season precipitation deuterium ratios to create the δ^2H_f isoscape used to make migratory assignments. Modeled growing-season precipitation deuterium values explained 79% ($r^2 = 0.79$, $P < 0.001$) of the variance in same location feather deuterium values ($\delta^2H_f = 0.98\delta Dp + 11.6$), indicating relatively good fit of continental scale deuterium signatures to woodcock feather origins. The poor relationship between S13 δ^2H_f and expected deuterium values in precipitation ($r^2 = 0.22$) precluded early fall origin assignments. Deuterium values of the S13 feathers, molted in early fall, on average were 30.0 ‰ (SD = 15.4 ‰) greater than values in P1 feathers, which are molted at natal origins.

Natal origin assignments, for all subsampled juvenile woodcock, were made using δ^2H of P1 feathers. The greatest predicted proportion (64%) of the 2010 - 2011 and 2011 - 2012 harvest sample were assigned to cells in the northernmost (>44 °N) portion of both Central and Eastern Management Regions. Juvenile woodcock assignments were more uniformly distributed along the Atlantic coast throughout the Eastern Region as opposed to in the Central region where most woodcock were assigned to origins within and north of the Great Lakes States. The proportions of all sampled juvenile woodcock assigned to regions north, within, and south of SGS coverage was 14%, 77%, and 9% respectively. This provides evidence that the SGS effectively surveys the majority of the population but that a significant number of harvested juveniles may have origins north of survey coverage.

Limiting habitats within or among winter, breeding, and migratory stopover sites have not been identified because habitat occupancy, population densities, availability of potentially suitable habitats, as well as migratory linkages among them are largely unknown throughout the annual cycle (Straw et al. 1994). Occupancy and densities of potentially available habitat in east Texas was estimated using GPS-tracked pointing dog surveys. Two study areas were selected based on land use and were representative of available land cover types in east Texas, one on a timber property in San Augustine County and one on the Davy Crockett National Forest in Houston and Trinity counties. Surveys were conducted on 24 - 0.5-km radius representative survey sites randomly selected based on soil texture and drainage class; surveys encompassed 82 forest stands within survey sites. American woodcock were sparsely distributed throughout study areas and occupied 70 to 90% of the 78.5 ha survey sites and approximately 40% of stands within each survey site. During woodcock surveys, 283 flush events were recorded. In 2010 - 2011, an average of 1.7 birds was flushed per survey on both study areas combined, and in 2011 - 2012, an average of 1.6 birds was flushed per survey on both study areas combined.

Of the surveyed stands, pine forests 1 – 3 m tall supported the greatest densities. Greatest occupancy rates occurred in stands with somewhat poorly drained soils to moderately-well drained soils and soil textures with greatest occupancy rates were loams; greatest woodcock densities occurred on silt loams, despite sandy loams being most available. In 2010 - 2011, estimated American woodcock population densities were 0.105 (SE = 0.0086) birds/ha and in 2011 - 2012 estimated densities were 0.067 birds/ha (SE = 0.007). Summed survey site abundance estimates were 196.66 woodcock (SE = 16.28) for 2010 - 2011 and 126.58 woodcock (SE = 14.14) for 2011 - 2012. Habitat suitability index scores (HSI) estimated for each stand were not good predictors of woodcock occupancy or density. However, singular variable and non-indexed components of the HSI were related to occupancy and density.

Weather conditions during the study were not typical and occupancy rates and densities were likely influenced by drought. At the onset of drought in 2010 - 2011, woodcock readily used available coverts along the edges of streams and wetlands holding residual moisture. Extensive drying of these areas throughout 2011 made them less suitable in winter 2011 - 2012 and woodcock densities along streamside and wetland habitats decreased. The widespread, but sparse distribution of woodcock in the Davy Crockett National Forest and on the Campbell timber property should be expected in similar habitats throughout eastern Texas and western Louisiana.

Products since 2012

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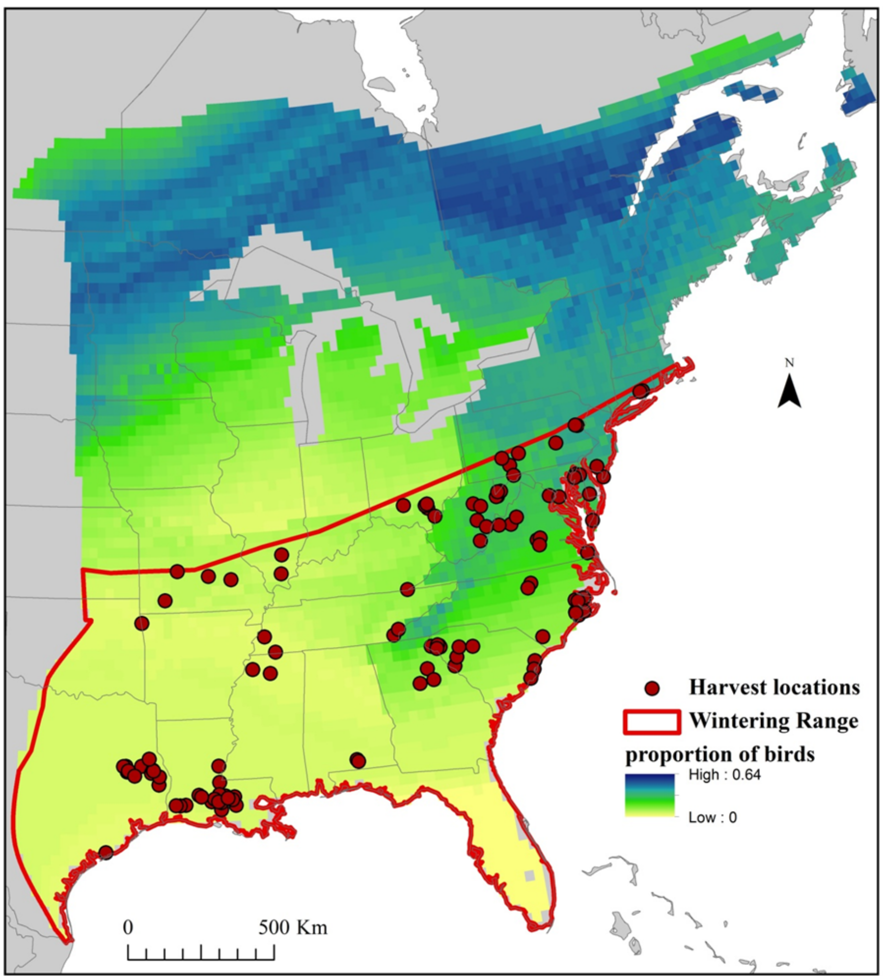
Thomas Eddings and Abigail Arfman measuring vegetation in an East Texas pine plantation.



Probability surface natal origin assignments of 256 juvenile American woodcock collected on the wintering range (following Straw et al. 1994) in 2010 - 2011 and 2011 - 2012. Assignments were made using δ^2H of P1 feathers and a flyway prior probability of origin estimated from band return data. They are displayed as proportion of birds sampled (0-1) and have 3:1 odds compared to the random null model.

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

Investigators
Stephen McDowell, M.S. 2014
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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
Determine the availability of lead on the upper Texas Gulf Coast

Estimate the exposure of lead by mottled ducks

Evaluate pathways of lead exposure for waterbirds of the upper Texas Gulf Coast

Location:
Anahuac NWR

Completion: December 2012

Status
Compete – May 2014

Results

Mottled ducks (*Anas fulvigula*) are a non-migratory, dabbling waterfowl species dependent upon coastal marsh systems, including those on the Texas Chenier Plain National Wildlife Refuge Complex (TCPNWRC), and are considered a regional indicator species of marsh habitat quality. Populations on the upper Texas coast are experiencing long-term declines where estimates have decreased from >77,000 in 1971 to <30,000 in 2013. Loss of wetlands due to anthropogenic alteration and development are thought to be the primary causes of regional declines, but other factors such as drought, salt water intrusion, increased predator populations, exotic invasive plants, and Pb toxicosis may also play significant roles. Mottled ducks have long been known to be susceptible to Pb toxicosis. Research from the early 1970s, 1990s, and mid-2000s indicated that mottled ducks continued to exhibit elevated wing-bone Pb, decades after implementation of non-toxic shot regulations with wing-bone Pb concentrations reported as 11.6 and 18.4 parts per million (ppm) for Anahuac and McFaddin NWRs, respectively, where 40% of after-hatch-year (AHY) and 19% of hatch-year (HY) birds were considered exposed (>20 ppm). Although current wing-bone Pb levels have decreased, they remain near those reported in mallards (*A. platyrhynchos*) and greater than levels in American black ducks (*A. rubripes*) and Northern pintails (*A. acuta*) in the early 1970s, prior to non-toxic shot requirements. While ingestion of Pb shot has long been considered the greatest source of Pb exposure to waterfowl, elevated Pb levels in sediment, vegetation, and invertebrates may be alternate sources of Pb exposure to mottled ducks. Soil is major sink of lead in the environment where approximately 60-70% of annual global atmospheric Pb emissions are estimated to be deposited directly onto the soil. Vegetation and invertebrates that mature in these soils may bio-accumulate enough Pb to be an additive source of Pb to waterfowl. Therefore, the objectives of this research were to 1) establish baseline blood Pb concentrations for all ages of mottled ducks on the TCPNWRC, 2) determine and compare the proportion of the sampled population that was exposed to Pb during summer and winter to potentially identify relevant temporal windows of exposure, 3) determine baseline Pb concentrations in soil, vegetation, and invertebrates on the TCPNWRC and adjacent, privately owned rice fields, 4) determine any environmental effects on soil, vegetation, and invertebrate Pb concentrations using multilinear regression, and 5) determine Pb shot densities on both the TCPNWRC and adjacent rice fields.

A total of 260 blood samples were collected from summer (*n* = 124) and winter (*n* = 136) mottled ducks during 2010 – 2012 on the TCPNWRC. Pb levels ranged from below detection limits to >12,000 µg/L, where >500 µg/L was associated with adverse health effects in waterfowl. We identified four plausible models where the interaction among age, sex, and season, year, site, and between age and season were included in the top-ranked models. Blood Pb concentrations were greatest in adult males, and were greater during winter, indicating a window of exposure to environmental Pb exists between the nesting and hunting season. Likewise, the percentage of exposed females increased from 14 – 47% from summer to winter, respectively. Identifying sources of environmental Pb is key to minimizing threats to mottled ducks throughout the upper Texas coast.

We collected 217 soil cores from 2010-2012 which, when separated into sections, resulted in 584 sub samples (Organic: *n* = 178, Middle: *n* = 206, Bottom: *n* = 200) analyzed for Pb. Pb concentrations ranged from 0.01-1,085.5 mg/kg with eight samples above background concentrations (>50 mg/kg) as set by the EPA. Soil Pb concentrations were typically greater on McFaddin NWR than on Anahuac NWR, and were greatest in the top 5 cm of the clay pan (i.e. middle layer) followed by the organic layer and the bottom layer. Soil Pb concentrations were likewise greater on the Complex than in the soils of the local, adjacent rice fields. While the global model was the only plausible model for overall soil core layers, individual layers relied on water presence, water depth, and salinity. No correlation existed between the organic and middle layers while a weak correlation existed between the organic and bottom layers and a strong correlation existed between the middle and bottom layers. Two Pb shot pellets were found in two core samples from the Complex, extrapolating out to >60,000 pellets/ha across the Complex.

We collected 168 vegetation samples (root: *n* = 119, seed: *n* = 28, widgeongrass: *n* = 21) during 2010-2012. Pb concentrations ranged from non-detection to 41.02 mg/kg with a geometric mean of 5.92 mg/kg. Pb concentrations were greatest in widgeongrass samples, followed by root samples and seed samples. Our models indicated that vegetation Pb concentrations were influenced by species, salinity, refuge, unit, and refuge*unit. However, model performance was poor and did not provide reliable data on covariate influences. A weak correlation existed between root and seed Pb concentrations and, because widgeongrass samples were analysed separately, no correlation existed between widgeongrass and root or seed samples.

We collected 17 invertebrate samples from the Complex from 2010-2012. Due to a lack of individual mass, samples were combined based on refuge unit. Pb concentrations ranged from 0.21 mg/kg to 2.93 mg/kg with a geometric mean of 1.07 mg/kg.

Blood Pb concentrations remain elevated in mottled ducks despite Pb shot bans enacted >25 years prior. The increase in Pb concentrations from summer to winter suggest a temporal, persistent source of Pb exposure coinciding with the time that mottled ducks increase their use of local agricultural fields over which mourning dove (*Zenaida macroura*) are harvested using Pb shot. Due to the non-migratory behavior exhibited by mottled ducks, Pb shot availability and Pb concentrations with the soil, vegetation, and invertebrates may be a potential and persistent source of environmental Pb. While Pb shot availability is greater than densities considered dangerous to waterfowl (>50,000 pellets/ha), shot densities are based on two pellets and are not definitive. Though Pb concentrations were not greatly elevated in soil, vegetation, and invertebrates, persistent exposure to low level Pb concentrations can be detrimental to birds. With mottled duck population numbers continuing to decrease, blood Pb concentrations should continue to be monitored along with Pb shot availability in both local agricultural fields and in historic hunt areas on the Complex in order to better understand when and where mottled ducks are exposed to Pb.

Products since 2012

McDowell, S.K. 2014. Environmental availability and lead exposure to mottled ducks (*Anas fulvigula*) in the Texas Chenier Plains region. Masters Thesis, Stephen F. Austin State University, Nacogdoches, TX

McDowell, S.K., W. Conway, and D. Haukos. 2012. Potential exposure to environmental lead in mottled ducks (*Anas fulvigula*) on the Texas Chenier Plains National Wildlife Refuge Complex. 48th Annual Meeting, Texas Chapter of The Wildlife Society, Fort Worth, Texas.

McDowell, S., W. Conway, C. Comer, and J. Moon. 2013. Blood lead concentrations in mottled ducks (*Anas fulvigula*) on the Texas Chenier Plain National Wildlife Refuge Complex. Annual Meeting of The Texas Chapter of The Wildlife Society, Houston, Texas.

McDowell, S., W. Conway, C. Comer, and J. Moon. 2013. Potential exposure of mottled ducks (*Anas fulvigula*) to lead contaminated soil on the Texas Chenier Plains. Annual Meeting of The Texas Chapter of The Wildlife Society, Houston, Texas.

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.

Lead Exposure and Nesting Ecology of Black-necked Stilts on the Upper Texas Coast

Investigators
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Project Supervisor
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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
Measure lead exposure in black-necked stilts

Model the population effect of lead exposure on black-necked stilts

Determine effect of coastal marsh management practices on population demography of black-necked stilts.

Location:
Anahuac NWR

Completion: December 2013

Status
Complete – December 2013

Results
The black-necked stilt (*Himantopus mexicanus*) is a migratory shorebird of temperate and tropical America, occurring in fresh, intermediate, brackish, and saline wetland habitats. throughout its range. Although studied extensively in western North America, its ecology, habitat use, movements, and even basic natural history remain poorly understood elsewhere. The objectives for this research were to 1) establish baseline blood Pb levels and evaluate factors potentially affecting blood Pb concentrations, 2) estimate nest success and evaluate factors potentially affecting nest success, and 3) characterize nest site selection of stilts nesting in managed wetlands on the upper Texas coast.

Adequate volume blood samples were collected from 166 stilts, of which 152 were used for data analyses. Of these, 79% (n = 120) exceeded lower threshold values for exposure (≥20 µg/dL) to Pb. Estimated blood Pb concentrations ranged from below detection limits to 109.1 µg/dL for all individuals, while median estimated blood Pb concentration was 27.5 µg/dL across all sexes, ages, and years. Despite consistent blood Pb exposure, toxic (3%) and potentially lethal (1%) exposure was rare or infrequent. As blood Pb is indicative of recent exposure, and HY stilts did not move long distances, blood Pb concentrations and high frequency of blood Pb exposure observed in HY stilts clearly indicate a local source of Pb contamination. Moreover, black-necked stilt Pb absorption pathways remain unclear, where future studies should examine isotopic Pb exposure at broader scales on the Chenier, incorporate other avian foraging guilds and trophic levels, examine potential Pb exposure pathways, and attempt to elucidate the potential physiological effects of Pb exposure on waterbirds.

A total of 356 black-necked stilt nests were monitored among three wetland types in 2011-2012. Apparent nest success estimates ranged from 3-31%, and Mayfield estimates of nest success ranged from 0–4%. Nest success was best predicted by habitat type, substrate, colony size, presence of vegetation, nest cover, year, and a quadratic time trend, where predation was the primary cause of nest failure. Daily survival rate increased during the second year, where DSR was positively related to freshwater wetland habitats, mudflat substrates, nest cover and presence of vegetation, and negatively related to nests within medium and large colonies, and rice field and intermediate wetland habitats. Daily survival rate exhibited a concave quadratic pattern as related to time during season. Parameter likelihoods did not support other covariates; other models were not considered plausible. The historically low nest success observed during this study may not be representative of all habitat types on the upper Texas coast. Nest success is expected to vary among habitat type, hydrology, and predation pressure, which are presumably interrelated. Future studies of black-necked stilt nest success on the Texas coast should examine nest success at broader scales, particularly in relation to predator densities, habitat type, and landscape fragmentation, as well as experimental water management regimes in managed and natural wetlands.

Black-necked stilt nests and associated random points were best predicted by an additive model of nest concealment (presence of vegetation, nest cover) and substrate, and an interaction between these covariates. Nests were more likely to be placed on dry ground substrates, where nests on these substrates may have experienced decreased nest survival. Moreover, shorebird nest-site selection may indicate preference in diverse habitats (Anteau *et al* . 2012), where habitats in this study were significantly different, and nest-site selection drivers differed accordingly. Consistently low nest survival rates among habitat types, and high breeding propensity in habitat types which experienced low nest success (see Chapter II), indicate that stilts may not be able to effectively distinguish between suitable and unsuitable habitats and nest sites, and may be disproportionately selecting nest sites in which they experience decreased success. If these trends continue, constructed and agricultural wetlands may continue to have limited utility as shorebird breeding habitat on the Gulf Coast.

Products since 2012

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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 *In Press*

Riecke, T.V., W. Conway, and D.A. Haukos. 2012. Nest success and nest site selection of black-necked stilts on the Texas Chenier Plain National Wildlife Refuge Complex. 48th Annual Meeting, Texas Chapter of The Wildlife Society, Fort Worth, Texas.

Riecke, T., W. Conway, C. Comer, and J. Moon. 2013. Causes of black-necked stilt nest failure at Anahuac National Wildlife Refuge. Annual Meeting of The Texas Chapter of The Wildlife Society, Houston, Texas.

Riecke, T., W. Conway, C. Comer, and J. Moon. 2013. Blood lead levels of black-necked stilts on the Texas Chenier Plain National Wildlife Refuge Complex. Annual Meeting of The Texas Chapter of The Wildlife Society, Houston, Texas.

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

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
Jane Austin, USGS

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

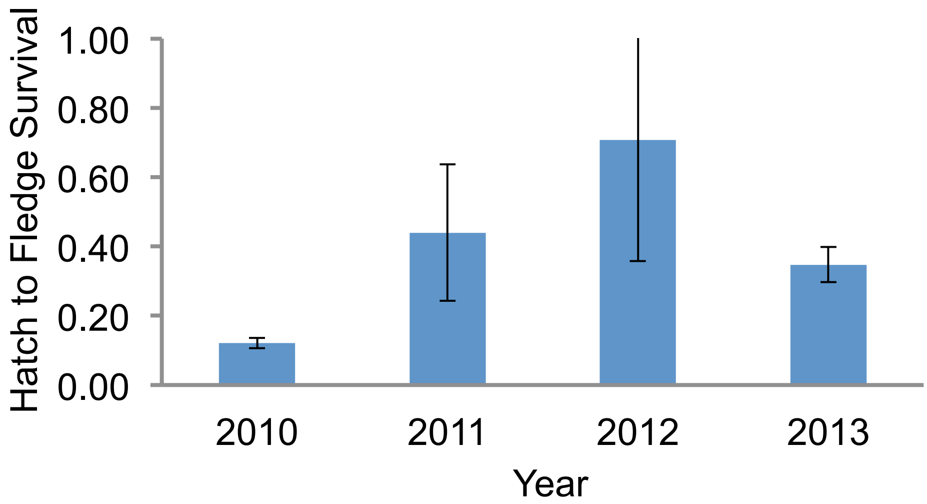
Status
Completed

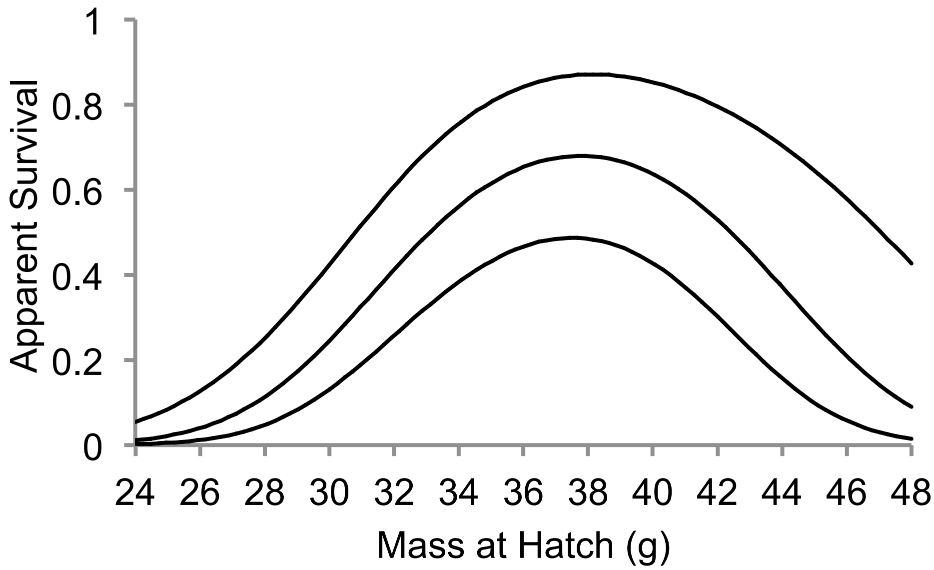
Progress and Results

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.


1.00
0.80
0.60
0.40
0.20
0.00
Hatch to Fledge Survival
2010
2011
2012
2013
Year


1
0.8
0.6
0.4
0.2
0
Apparent Survival
24 26 28 30 32 34 36 38 40 42 44 46 48
Mass at Hatch (g)

A Multi-scale Investigation of Movement Patterns among Black-tailed Prairie Dog Colonies

Investigators
Rachel Pigg, Ph.D 2014

Project Supervisor
Dr. Jack Cully

Funding
US Geological Survey
Berryman Institute
U.S. Park Service
Kansas State University

Cooperators
Gary Wilson

Objectives

Document rate of migration and other movements

Build a predictive model for disease transmission.

Determine effects of metapopulations on genetic connectivity

Location
Kansas, Colorado, Nebraska.

Completion
May 2014

Status:
Completed – May 2014

Results:
Dispersal remains one of the most important, yet least understood, life history traits. As the vehicle of gene flow, dispersal can both relieve inbreeding depression and prevent local adaptation. Similarly, dispersal can stabilize or destabilize metapopulations, given its critical role in both disease transmission and recolonization following local extinctions. Furthermore, in light of climate change and increasing habitat loss and fragmentation, the ability to navigate through the unfamiliar, unsuitable habitat separating populations is essential to the long-term survival of a species across its range. In this dissertation, I present a multi-scale investigation of factors affecting gene flow and disease transmission among populations of a keystone species and an agricultural pest of the North American prairie: the black-tailed prairie dog (*Cynomys ludovicianus*). Black-tailed prairie dogs are social, ground-dwelling squirrels that live in spatially isolated populations called colonies. First, we conducted a landscape genetic analysis of black-tailed prairie dogs throughout a large portion of their current range. Our estimates of gene flow indicate that the genetic neighborhood of both male and female prairie dogs reaches 40-60 kilometers within short-grass prairie; however, colonies within mixed-grass prairie are more isolated. At broad scales, we observed isolation-by-distance among colonies and great influence of grassland productivity on genetic connectivity; however, neither distance nor landscape characteristics greatly explained observed genetic differentiation among colonies separately by less than 50 kilometers. Finally, we investigated whether landscape features could predict disease transmission patterns of sylvatic plague among colonies in short-grass prairie and found evidence that pastures act as a corridor for plague transmission. Our results indicate that black-tailed prairie dogs are more resilient to habitat loss and fragmentation than other obligate grassland species and are certainly capable of transmitting sylvatic plague over large distances. Taken together, these studies illustrate how a multi-scale approach can reveal complexities of dispersal dynamics that would otherwise remain undetected.

Products since 2012

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Mather, M.E., H. J. Frank. J. M. Smith, R. D. Cormier, R. M. Muth, and J. T. Finn. 2012. Assessing freshwater habitat of adult anadromous alewives at multiple scales: a common challenge for fish and watershed restoration. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science, 4:1, 188-200.

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Mattson, B.J, M.C. Runge, J.H. Devries, G.S. Boomer, J.M. Eadie, D.A. Haukos, J. P. Fleskes, D.N. Koons, W.E. Thogmartin, and R. J. Clark. 2012. A prototypical modeling framework for integrated harvest and habitat management of North American waterfowl: case-study of northern pintail metapopulation dynamics. Ecological Modeling 225:146-158.

O'Connell, J., L. Johnson, L. Smith, S. McMurry, and D. Haukos. 2012. Land-use and conservation programs on wetland plant communities of the semi-arid United States Great Plains. Biological Conservation 146:108-115.

O'Connell, J., L. Johnson, B. Beas, L. Smith, S. McMurry, and D. Haukos. 2013. Predicting dispersal-limitation in plants: Optimizing planting decisions for isolated wetland restoration in agricultural landscapes. Biological Conservation 159:343-354.

O'Connell, J., L. Johnson, L. Smith, S. McMurry, D.W. Daniel, and D. Haukos. 2013. Effects of agriculture tillage and sediment accumulation on emergent plant communities in playa wetlands of the U.S. High Plains. Journal of Environmental Management 120:10-17.

Pirius, N.E., C.W. Boal, D.A. Haukos, M.C. Wallace, and R.W. Perez. 2013. Winter habitat use and movements of lesser prairie-chickens in west Texas. Wildlife Society Bulletin 37:759-765.

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 *In Press*

Rigby, E., and D. Haukos. 2012. Breeding season survival and breeding incidence of female mottled ducks on the upper Texas Gulf Coast. Waterbirds 35:260-269.

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.

Rosen, D.J., A.D. Casekey, W.C. Conway, and D.A. Haukos. 2013. Vascular flora of the Southern High Plains of Texas and eastern New Mexico. Journal of The Botanical Research Institute of Texas 7:595-602.

Rosenblatt, A. E., M. R. Heithaus, M. E. Mather, P. Matich, J. C. Nifong, W. J. Ripple, B. R. Silliman. 2013. The roles of large top predators in coastal ecosystems: new insights from Long-Term Ecological Research. Oceanography 26:156-167.

Ross, B.E., M. Hooten, and D.N. Koons. 2012. An accessible method for implementing hierarchical models with spatio-temporal abundance data. PLoS ONE 7(11).

Saalfeld, S.T, W.C. Conway, D.A. Haukos, and W.P. Johnson. 2012. Selection and spacing patterns of snowy plover nests in the Southern High Plains of Texas. Journal of Wildlife Management 76:1703-1711.

Saalfeld, S.T, W.C. Conway, D.A. Haukos, and W.P. Johnson. 2012. Alleviation of nest thermal extremes by incubating snowy plovers in the Southern High Plains of Texas. Wader Study Group Bulletin. 119:77-83.

Saalfeld, S.T, W.C. Conway, D.A. Haukos, and W.P. Johnson. 2012. Recent declines in apparent survival and survey counts of snowy plover breeding in the Southern High Plains of Texas. Wilson Journal of Ornithology124:79-87.
Saalfeld, S.T, W.C. Conway, D.A. Haukos, and W.P. Johnson. 2013. Seasonal variation in offspring sex ratio in the snowy plover. Western North American Naturalist 73:60-71.
Schloesser, J. T., C. P. Paukert, W. J. Doyle, T. D. Hill, K. D. Steffensen, and V. H. Travnichek. 2012. Fish assemblages at engineered and natural channel structures in the Lower Missouri River: implications for modified dike structures. River Research and Applications 28:1695-1707.
Schloesser, J. T., C. P. Paukert, W. J. Doyle, T. D. Hill, K. D. Steffensen, and V. H. Travnichek. 2012. Heterogeneous detection probabilities for imperiled Missouri River fishes: implications for large river monitoring programs. Endangered Species Research 16:211-224.
Shroder, J.F., Jr., and Weihs, B.J., 2014. Mass Movement. Encyclopedia of Geoarchaeology, New York: Springer-Verlag, *In Press.*
Shroder, J. F., Jr., and B.J. Weihs. 2014. Mass-movement disturbance regime landscapes, hazards and water implications: Grand Teton National Park, Wyoming. University of Wyoming-National Park Service Research Center 36th Annual Report 2014. *In Press*
Sidle, J. G., D. J. Augustine, D. H. Johnson, S. D. Miller, J. F. Cully, Jr. and R. P. Reading. 2012. Aerial surveys adjusted by ground surveys to estimate area occupied by black-tailed prairie dog colonies. Wildlife Society Bulletin 36:248-256.
Smith, J. M and M. E. Mather. 2013. Beaver dams maintain native fish biodiversity by increasing habitat heterogeneity throughout a low-gradient stream network. Freshwater Biology 58: 1523-1538.
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. Published online in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/aqc.2420
Tsai, J.S., L.S. Venne, L.M. Smith, S.T. McMurry, and D.A. Haukos. 2012. Influence of local and landscape characteristics on avian richness and density in wet playas of the Southern Great Plains, USA. Wetlands 32:605-618.

Technical Publications

Conard, J.M. and R. Lauben. 2012. Patterns of habitat selection and densities of white-tailed deer at Quivira National Wildlife Refuge. Final Report.
Haukos, D.A. 2012. Mottled Duck Focal Species Plan. U.S. Fish and Wildlife Service, Regional Migratory Bird Office, Albuquerque, New Mexico. 25pp.
Sullins, D.S., and W.C. Conway. 2013. East Texas timberdoodles: winter in the pineywoods. Skydance 1:2-8. Woodcock Limited, Montoursville PA, USA.
Zavaleta, J. 2013. An annotated bibliography of the lesser prairie-chicken. Western Association of Fish and Game Agencies, Tucson, AZ. 550 pp.

Theses and Dissertations

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

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

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

Dan Sullins (M.S. 2013; advisor Conway/Haukos) – Habitat use and origins of American woodcock wintering in east Texas. Stephen F. Austin State University

Kennedy, Cristina. (M. S. 2013; advisor Mather). Discontinuities concentrate predators within the seascape: quantifying spatially-explicit patterns of physical complexity and striped bass distribution to understand the ecological significance of geomorphology for higher trophic levels within a north temperate estuary. University of Massachusetts, Amherst, MA.

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

Zavaleta, Jennifer (M.S. 2012; advisor Haukos). Effects of grazing and herbicide treatments to restore degraded sand shinnery oak grasslands. Texas Tech University.

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.

List of Presentations 2012-present

Albanese, G. 2012 (Invited speaker). A multi-scale examination of stopover habitat use by migrant shorebirds in the southern Great Plains. The Wildlife Society's 19th Annual Conference, Portland, OR.

Albanese, G., and Davis, C. A. 2012. Broad-scale relationships between migratory shorebirds and landscapes in the southern Great Plains. 9th Intercol International Wetlands Conference. Orlando, FL.

Albanese, G., and Davis, C. A. 2012. A comparative examination of within wetland and wetland context characteristics on stopover habitat use by migrant shorebirds: Is the neighborhood important? 9th Intercol International Wetlands Conference. Orlando, FL.

Albanese, G., Davis, C. A., and B. Compton. 2012. Spatiotemporal scaling of continental interior wetlands: Implications for shorebird conservation. International Association for Landscape Ecology 2012 annual symposium. Newport, RI.

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.

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.

Finn, J. T., M. E. Mather, M. K. Burak, ' R. M. Muth, J. B. Kim, and M. Sutherland. 2012. Evaluating new approaches to modeling data sets with many zeros: an example using anadromous fish counts. Ecological Society of America Meeting, Portland, OR.

Fischer, J. J. Gerken, C. Paukert, and M. Daniels. Habitat and fish community response to sand dredging in a large Great Plains river. American Fisheries Society Annual Meeting, Seattle, WA.

Fischer, J., C. Paukert, and M. Daniels. 2012. Influence of in-stream and watershed alterations on sandbars and islands in the Kansas River. Kansas Natural Resources Conference, Wichita, KS.

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.

Grisham, B.A., C. Boal, and D.A. Haukos. 2012. The predicted influence of climate change on lesser prairie-chicken reproductive parameters. 48th Annual Meeting, Texas Chapter of the Wildlife Society, Fort Worth, Texas.

Grisham, B., J. Zavaleta, C. Boal, and D. Haukos. 2013. Management of lesser prairie-chicken populations in shinnery oak-grasslands: priorities and future directions. Annual Meeting of the Texas Chapter of The Wildlife Society, Houston, Texas.

Grisham, B., C. Boal, D. Haukos, and W. Heck. 2013. Population demography of lesser prairie-chicken populations in shinnery oak grassland communities of New Mexico and Texas. Annual Meeting of the Society for Range Management (Invited), Oklahoma City, Oklahoma.

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.

Haukos, D.A. 2012. Emerging issues related to diseases of migratory birds in the Great Plains. Annual meeting of the Disease Committee, Midwest Association of State Wildlife and Fisheries Agencies, Manhattan, Kansas.

Haukos, D.A. 2012. Playas of the Llano Estacado. Southern Plains Conference, Ogallala Commons, Muleshoe, Texas

Haukos, D.A. 2012. Restoration of sand shinnery oak grasslands using prescribed grazing and herbicides. Special Session "LCCs: Bridging the science-management gap symposia" 73rd Midwest Fish and Wildlife Conference (Invited), Wichita, Kansas

Haukos, D.A. 2012. The Great Plains LCC – Connections and Complexity. Joint Meeting of GPLCC Steering Committee and Science Team (Invited), Lubbock, Texas.

Haukos, D.A. 2013. Ecology and Conservation of Temporary Wetlands. Webinar, Natural Resource Conservation Service, (Invited).

Haukos, D.A. 2013. Lesser prairie-chicken response to restoration of sand shinnery oak grasslands in eastern New Mexico. Annual Meeting of the Society for Range Management (Invited), Oklahoma City, Oklahoma.

Haukos, D.A. 2013. Changing Landscapes and Grassland Birds: Effects and Conservation Strategies. Annual Meeting of the Colorado Chapter of The Wildlife Society (Invited Plenary), Colorado Springs, Colorado.

Haukos, D.A. 2013. The Future Role of Playa Wetlands for Waterfowl. 6th North American Duck Symposium, (Invited), Memphis, Tennessee

Haukos, D.A., J. Moon, and W. Conway. 2013. Survival of Mottled Ducks in the Texas Chenier Plain Region. 6th North American Duck Symposium, Memphis, Tennessee.

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. 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.

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.

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., 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., 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., 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.

Kerns, 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.

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.

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.

Mather, M. E., R. M. Muth, and H. J. Frank. 2012. Using the adopt-a-fish program to get stakeholders hooked on conservation. North American Congress for Conservation Biology, Invited Speaker, Symposium, Oakland, CA.

Mather, M. E. Spatial patterns of striped bass. 2012. All Scientists Meeting, Plum Island Long Term Ecological Research, Woods Hole, MA. Invited

Mattson, B., M. Runge, R. Clark, J. Eadie, D. Haukos, J. Fleskes, W. Thogmartin, and K. Gynn. 2012. A modeling framework to integrate harvest and habitat management of North American waterfowl: case-study of northern pintail metapopulation dynamics. 19th Annual Conference, The Wildlife Society, Portland, Oregon.

McDowell, S.K., W. Conway, and D. Haukos. 2012. Potential exposure to environmental lead in mottled ducks (*Anas fulvigula*) on the Texas Chenier Plains National Wildlife Refuge Complex. 48th Annual Meeting, Texas Chapter of The Wildlife Society, Fort Worth, Texas.

McDowell, S., W. Conway, C. Comer, and J. Moon. 2013. Blood lead concentrations in mottled ducks (*Anas fulvigula*) on the Texas Chenier Plain National Wildlife Refuge Complex. Annual Meeting of The Texas Chapter of The Wildlife Society, Houston, Texas.

McDowell, S., W. Conway, C. Comer, and J. Moon. 2013. Potential exposure of mottled ducks (*Anas fulvigula*) to lead contaminated soil on the Texas Chenier Plains. Annual Meeting of The Texas Chapter of The Wildlife Society, Houston, Texas.

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.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, 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.

Moon, J.A., D.A. Haukos, W. Conway, and P. Walther. 2013. Potential implications of climate change on the mottled duck. 6th North American Duck Symposium, Memphis, Tennessee. Poster

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.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.

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. Upcoming Presentation. 144th Annual AFS Conference, Quebec City, Quebec, Canada.

Pigg, RM, SM Wisely, C Lee, JF Cully, Jr. 2013. Broad-scale patterns of connectivity among black-tailed prairie dog colonies in a heavily managed landscape. American Society of Mammalogists Conference, Philadelphia, PA.

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.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.

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.

Riecke, T.V., W. Conway, and D.A. Haukos. 2012. Nest success and nest site selection of black-necked stilts on the Texas Chenier Plain National Wildlife Refuge Complex. 48th Annual Meeting, Texas Chapter of The Wildlife Society, Fort Worth, Texas.

Riecke, T., W. Conway, C. Comer, and J. Moon. 2013. Causes of black-necked stilt nest failure at Anahuac National Wildlife Refuge. Annual Meeting of The Texas Chapter of The Wildlife Society, Houston, Texas.

Riecke, T., W. Conway, C. Comer, and J. Moon. 2013. Blood lead levels of black-necked stilts on the Texas Chenier Plain National Wildlife Refuge Complex. Annual Meeting of The Texas Chapter of The Wildlife Society, Houston, Texas.

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.

Ross, B.E., M.B. Hooten, J.M. DeVink, and D.N. Koons. 2013. How biotic and abiotic factors affect spatio-temporal population dynamics of scaup. Ecology and Conservation of North American Waterfowl. Memphis, Tennessee.

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. 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. 2014. Combining multiple data sources to determine climate and land-use impacts on lesser prairie-chickens. Annual Meeting of The Wildlife Society, Pittsburg, Pennsylvania.

Smith, J.M., M.E. Mather, S.M. Hitchman and J.S. Fencl. 2013. An evaluation of metrics that quantify the composition of fish communities in aquatic systems. Midwest Fish and Wildlife Conference. Wichita, KS.

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., 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. 2013. Duckling survival at the edge of scaup range in Montana. Annual Meeting of The Wildlife Society, Milwaukee, Wisconsin.

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. 2014. Duckling survival at the edge of scaup range in Montana. Midwest Fish and Wildlife Conference, Kansas City, MO.

Sullins, D.A., W. Conway, and D. Haukos. 2012. American woodcock (*Scolopax minor*) habitat suitability and occupancy in eastern Texas. 48th Annual Meeting, Texas Chapter of The Wildlife Society, Fort Worth, Texas.

Sullins, D., W. Conway, C. Comer, K. Hobson, and I. Wassenaar. 2013. American woodcock connectivity as indicated by hydrogen isotope. Annual Meeting of The Texas Chapter of The Wildlife Society, Houston, Texas

Weihs, B.J., W. Butler, and R. Marston. 2012. Cross-Valley Profiles and Mass Movement Hazards in Deglaciated Canyons,Grand Teton National Park.Association of American Geographers Conference. New York, NY

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.

Zavaleta, J.C., D.A. Haukos, and C. Boal. 2012. Community response to use of prescribed grazing and herbicide for restoration of sand shinnery oak grasslands. 48th Annual Meeting, Texas Chapter of The Wildlife Society, Fort Worth, Texas.

Zavaleta, J., B. Grisham, D. Haukos, and C. Boal. 2013. Invertebrates of sand shinnery oak communities and the influence on lesser prairie-chicken brood survival. Annual Meeting of The Texas Chapter of The Wildlife Society, Houston, Texas.

Zavaleta, J., P. Maloney, and D. Haukos. 2013. Understanding the human component for conservation in the sand shinnery oak grasslands. Annual Meeting of The Texas Chapter of The Wildlife Society, Houston, Texas.

Committees and Other Professional Assignments
2012-present

<u>Emily Ball (GRA)</u>
- Teaching Assistant, Principles of Biology BIOL 198 (Spring 2014)

<u>Joyce Brite</u>
- Classified Employee Peer Review Committee, 2011-2013

<u>Jane Fencl (GRA)</u>
- Teaching Assistant, Principles of Biology BIOL 198 (Spring 2012, Fall 2012, Spring 2013, Fall 2013, Spring 2014)
- Welcoming Committee Chair, Biology Graduate Student Association (BGSA), September 2013 – August 2014
- Seminar Representative, Biology Graduate Student Association (BGSA) August 2012 – May 2013
- Treasurer, American Fisheries Society – Kansas State University subchapter, Jan 2014 – present
- Konza Prairie Biological Station Docent

<u>Kayla Gerber (GRA)</u>
- Teaching Assistant, Organismic Biology BIOL 201 (Spring 2012, Fall 2012, Spring 2013, Fall 2013, Spring 2014)
- BGSA (Biology Graduate Student Association) – member 2012-present
  Officer Position: Secretary 2014

<u>David Haukos</u>
- Chair, Pintail Action Group 2009-2013
- Member, Great Plains LCC Science Team
- Member, Playa Lakes Joint Venture Science Advisory Team
- Associate Editor, Wildlife Society Bulletin
- Subject/Associate Editor, Journal of Fish and Wildlife Management
- Search Committee, Assistant Professor-Wildlife Kansas State University
- Technical Representative, Great Plains Cooperative Ecosystems Study Unit, Kansas State University
- Member, KSU Institutional Animal Care and Use Committee
- Faculty Advisor, KSU Student Chapter of The Wildlife Society
- Facilitate KSU volunteers for semi-annual black-footed ferret surveys in western Kansas
- Member of the KDWPT Threatened and Endangered Task Committee
- Wildlife Program Committee for 73rd Midwest Fish and Wildlife Conference 2013
- Adjunct Professor, Texas Tech University
- Adjunct Professor, Stephen F. Austin State University
- Adjunct Professor, Oklahoma State University
- Participant, OneHealth On-Line Course, Kansas State University
- Organized visiting lecture by Mike Forsberg, Spring 2013
- Research Grade Evaluation Panel, US Geological Survey 2014
- Western Association of Fish and Wildlife Agencies – Lesser Prairie-Chicken Science Work Group 2014-Current

Sean Hitchman (GRA)

- Teaching Assistant, Organismal Biology BIOL 201 (Spring 2012, Fall 2012, Spring 2013, Fall 2013, Spring 2014)
- Vice President: Kansas State Biology Graduate Student Association

Brian Kearns (GRA)

- Teaching Assistant, Principles of Biology (Fall 2012, Spring 2013, Fall 2013, Spring 2014, Summer 2014)

Joseph Lautenbach (GRA)

- Teaching Assistant, Mammalogy (Fall 2012)
- Teaching Assistant, Principles of Biology (Fall 2013 [2 sections], Spring 2014)

Robert Mapes (GRA)

- Teaching Assistant, Principles of Biology (Spring 2014)

Martha Mather

- Subject Editor, Wetlands Ecology and Management
- Invited Participant, USGS Research Grade Evaluation Panel
- Search Committee, Assistant Professor-Wildlife Kansas State University
- Student Affairs Committee Chair**,** KDWPT Sponsored North Central AFS meeting
- Research Grade Evaluation Panel, US Geological Survey, Minneapolis, 2010
- Sponsor – Demonstration of the Mini-Missouri Trawl, 2012
- Invited Participant, National Science Foundation Pre-proposal Review Panel (Population and Community Ecology), Arlington, VA, March 2013
- Chair, Student Affairs Committee, Midwestern American Fisheries Society Meeting, December 2012, Wichita, KS.
- Member, Organizing Committee, Midwestern American Fisheries Society Meeting, December 2012, Wichita, KS.
- Member, American Fisheries Society Special Committee on Educational Requirements, December 2012-December 2013.
- Member, Search Committee, Research Coordinator Position, Kansas Department of Wildlife, Parks, and Tourism, May, 2012
- Organizer, Workshop – "An introduction to best practices in species distribution modeling (SDMs)." Division of Biology Fall 2012

Zach Peterson (GRA)

- Teaching Assistant, Principles of Biology BIOL 198 (Spring 2012, Fall 2012, Spring 2013, Fall 2013, Spring 2014)
- Represented Kansas at the North Central Division - Ictalurid Technical Committee Annual Business Meeting. Midwest Fish and Wildlife Conference. December 2012.

Rachel Pigg (GRA/GTA Graduated May 2014)

- Search Committee, Assistant Professor-Wildlife Kansas State University
- Search Committee, KCFWRU Unit Leader Search Kansas State University
- Biology Graduate Student Association - Faculty Award Committee Chair 2012
- Biology Graduate Student Association T-shirt Committee Member 2008—present
- Teaching Assistant, Principles of Biology (Spring 2012, Summer 2013)
- Instructor, Principles of Biology (Summer 2012)

Reid Plumb (GRA)

- Teaching Assistant, Organismic Biology BIOL 201 (Fall 2012), Principals of Biology (Fall 2013 [2 sections], Spring 2014)

Dan Sullins (GTA)

- Teaching Assistant Principals of Biology (Summer 2014)

Andrew Stetter (GRA Graduated August 2014)

- Teaching Assistant, Principles of Biology (Fall 2012, Spring 2013, Fall 2013, Spring 2014)
- Committee member of the Kansas State Student Chapter of Ducks Unlimited
- Attended Central Flyway Wingbee, Emporia, Kansas February 2013

Brandon Weihs (GRA)

- Instructor, Cartography and Thematic Mapping (Spring 2012)

Awards and Recognition
2012-present

Jane Fencl

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

Kayla Gerber

- VEMCO Student Scholarship, 2012 (a competitive award to a student using VEMCO fish tracking equipment for research).
- Fenske Award Finalist, 2012
- Kansas Cooperative Fish and Wildlife Research Unit: Outstanding Unit Student Award 2013
- Kansas State University Arts & Sciences Graduate Student Research Travel Award, 2014 $1000
- Kansas State University Graduate Student Council Travel Award, 2014 $750

David Haukos

- 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

- EEB Graduate Students on Parade Best Presentation - 2012
- Kansas State University College of Arts and Sciences Travel Award- 2014 ($1000)
- Kansas State University Graduate Student Council Travel Award- 2014 ($750)

Brian Kearns

- College of Arts and Sciences travel award, Kansas State University, April 2014
  Award amount: $1000

Joseph Lautenbach

- Robert J. Robel Award for Outstanding Graduate Student Research in Wildlife Biology and Ecology, Division of Biology, Kansas State University $500

Kelsey McCollough

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

Jena Moon

- Dennis Raveling Scholarship, California Waterfowlers Association 2013

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

Rachel Pigg

- Berryman Institute Graduate Fellowship, $15,000
- Honorable Mention for Student Poster Award, International Biogeography Society's 5th Biennial Conference
- Conservation Leaders of Tomorrow Workshop Scholarship, $2000
- Travel Award, $300, American Society of Mammalogists
- H. Henley Haymaker Award for Outstanding Presentation by a Graduate Student, $500, Division of Biology
- Outstanding KCRWRU Graduate Student 2012

Reid Plumb

- The Wildlife Society: Kansas State Chapter Travel Grant - $100.00
- 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

Andrew Stetter

- Wisconsin Waterfowl Hunters' Conference Scholarship - $1,000.00 2013
- Wisconsin Waterfowl Hunters' Conference Scholarship - $1,000.00 2014
- Graduate Student Council Travel Grant Award. Spring 2013 $750
- KSU College of Arts & Sciences Research Travel Grant. Spring 2013 $1,000
- Janice Lee Fenske Memorial Scholarship Finalist at the Midwest Fish & Wildlife Conference. Spring 2014.

Brandon Weihs

- Milton and Emma Jean Rafferty Gamma Theta Upsilon Scholarship – Spring 2013
- Kansas State University Geography Department Geography Travel Grant – Fall 2012
- Binghamton Geomorphology Symposium Travel Grant – Fall 2012
- University of Wyoming-National Park Service Research Grant; Award amount - $4,833 Co-PI with Dr. John F. Shroder
- Certificate(s) of Appreciation, National Geographic Society of America for volunteer service during the State (Kansas) Geography Bee for 2013 and 2012

Jennifer Zavaleta

- Fulbright Scholarship for research in Chile.
- Second Place Texas Tech University Annual Biological Sciences Symposium.

University Courses Taught by Unit Faculty 2010-2014

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

Kansas State University Degrees Completed 1996 – 2014

2014

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.


Photo by Jill Haukos