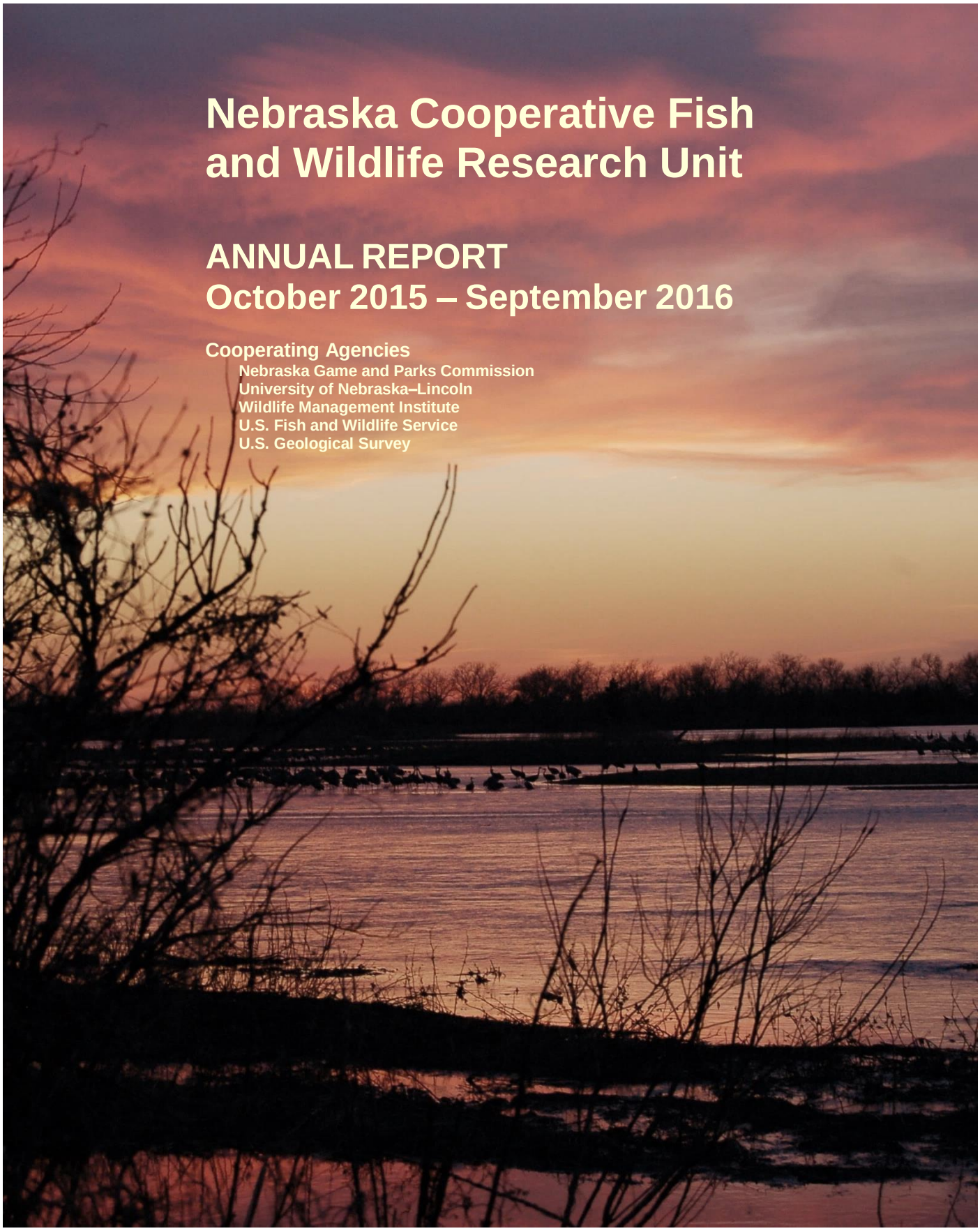

Nebraska Cooperative Fish and Wildlife Research Unit

ANNUAL REPORT
October 2015 – September 2016

Cooperating Agencies

Nebraska Game and Parks Commission
University of Nebraska–Lincoln
Wildlife Management Institute
U.S. Fish and Wildlife Service
U.S. Geological Survey

Report of Activities
October 2015 – September 2016

Nebraska Cooperative Fish and Wildlife Research Unit
University of Nebraska–Lincoln
School of Natural Resources
422 Hardin Hall, 3310 Holdrege Street
Lincoln, Nebraska 68583–0984
Phone (402) 472–0449
Fax (402) 472–2722
http://snr.unl.edu/necoopunit/

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INTRODUCTION

The U.S. Geological Survey (USGS) Cooperative Research Units Program has been in existence for more than 70 years as a partnership among USGS, state natural resource agencies, host universities, the Wildlife Management Institute, and the U.S. Fish and Wildlife Service. The first unit was founded at Iowa State University in Ames, Iowa. The program currently has 40 units in 38 states.

In 1960, the U.S. Congress gave statutory recognition to the program when they enacted Public Law 86–686, the Cooperative Research Units Act. The intent of the act was to "facilitate cooperation among the Federal Government, colleges, and universities, the States, and private organizations for . . . research and education relating to fish and wildlife, and for other purposes [by developing] coordinated, cooperative research and training programs for fish and wildlife resources. . . ."

The three–part mission of the Cooperative Research Units Program is focused on education, research and technical assistance.

- *Education*. Unit scientists teach graduate–level university courses and provide graduate students academic guidance, linking the research mission with student training.
- *Research*. Unit scientists conduct research that supports the needs of local cooperators and partners. Research can be of local, regional or national interests.
- *Technical Assistance*. Units provide technical assistance and training to state and federal natural resource managers, and to other natural resource managers as needed. Cooperators benefit from the expertise of unit scientists, cooperating university faculty, and biologists at state natural resource agencies.

In 2004, the Nebraska Cooperative Fish and Wildlife Research Unit became the newest state Cooperative Research Unit through a Cooperative Agreement signed by the U.S. Geological Survey, the University of Nebraska–Lincoln, the Nebraska Game and Parks Commission, the U.S. Fish and Wildlife Service and the Wildlife Management Institute.

PERSONNEL AND COOPERATORS

UNIT PERSONNEL

STAFF – U.S. GEOLOGICAL SURVEY, COOPERATIVE RESEARCH UNITS PROGRAM

Craig R. Allen, Unit Leader
Joseph J. Fontaine, Assistant Unit Leader – Ecology
Kevin L. Pope, Assistant Unit Leader – Fisheries

STAFF – UNIVERSITY OF NEBRASKA–LINCOLN

Caryl Cashmere, Unit Staff Assistant
Valerie Egger, Unit Administrative Assistant (2004 – April 2016)
Wilma Gerena, Unit Administrative Assistant

Adela Annis, Project Manager, Pheasant Population Dynamics (2012 – August 2014)
Caitlyn Gillespie, Research Communication Specialist (2012 – August 2014)
Claire Helmke, Project Manager, Canid Project
Caroline Jezierski, Coordinator, Nebraska Wind Energy and Wildlife Project (July 2011 – March 2016)
Mark Kaemingk, Research Assistant Professor, Aquatic Ecologist
Michelle Lute, Post–doctoral Associate, Wildlife Ecologist (2015 – August 2014)
Lindsey Messinger, Research Specialist, Wildlife Ecologist
Erica Stuber, Research Assistant Professor, Wildlife Ecologist
Michael Winkler, Project Manager, Hunter Survey (2014 – August 2014)
Dana Varner, Science Coordinator, Rainwater Basin Joint Venture
Allison Zach, Coordinator, Nebraska Invasive Species Program

RESEARCH TECHNICIANS

Aaron Aguire
Shannon Bassett
Jacalyn Beck
Danielle Berger
Brandon Bernhardt
Haley Blackwell
Emila Breitenbach
JoLeisa Cramer
David Damsky
Isael Del Nodal
Alexandre Dopkin
Hugh Ellerman
Steven Granroth
Dillon Hanson–Ahumada
Claire Helmke
Nathan Klopmeier
Phillip "Trey" Lindsey
Baillie Luff
Sean McHugh
Nathan Meadows
Brian Meyers
Nadejda Mirochnitchenko
Davis Moscicki
Janelle Ostroski
Emily Prosser
Samuel Reibman
Tyler Trump
Ashlee Wright
William White

CREEL AND HUNTER SURVEY CLERKS

Matthew Brym
Brittaney Buchanan
Peyton Burt
Greg Detweiler
Kyle Gaston
Dustin Golembiewski
Kathy Hixson
Lynn Hothan
Jeremy Johnson
Rhonda Lawing
Brian McCue
Sarah Moodie
Kaitlyn Nafziger
Stephanie Nefas
Lindsay Ohlman
Carly Otto
Christopher Pool
Jennifer Proescholdt
Gerald Ryschon
Heather Sterling
Dennis Thompson
Anthony Yates
Jonathon Yates
Kristie Vanderlinde
Rayma Volkmer

Student Workers

Courtney Anderson
Catherine Berrick
Krystal Bialis
Megan Binti Ehsan
Thane Carstens
Claire Donahoo
Isael Del Nodal
Autumn Dunn
Chelsea Forehead
Jessie Hall
Phoebe Haney
Dillon Hanson
Anthony Jenniges
Lisa Keys
Addison Krebs
Samantha Lange
Anastasia Madsen
Jessica McDaniel
Harlee Phillips
Suzanne Polzkill
Sarah Rothchild
James Rutledge
Brody Vorderstrasse
Jarrett Weimers
Brooke Welsh
Matthew Zink

Graduate Degree Candidates – University of Nebraska–Lincoln

Master of Science

Rebecca Bevans, School of Natural Resources
May 2015 – present

Nathan Bieber, School of Natural Resources
May 2014 – present

Cody Dreier, School of Natural Resources
January 2016 – present

Brittany Dueker, School of Natural Resources
August 2016–present

Alexis Fedele, School of Natural Resources
August 2014 – present

Aaron Gray, School of Natural Resources
January 2016 – July 2016

Brian Harmon, School of Natural Resource
October 2014 – present

Nadejda Mirochnitchenko, School of Natural Resources
August 2016 – present

Christine Ruskamp, School of Natural Resources
August 2016 – present

Baxter Seguin, School of Natural Resources
January 2016 – present

Victoria Simonsen, School of Natural Resources
August 2015 – present

Zachary Warren, School of Natural Resources
May 2015 – present

Lyndsie Wszola, School of Natural Resources
August 2014– present

Doctorate

Hannah Birgé, School of Natural Resources
January 2013 – present

Jessica Burnett, School of Natural Resources
August 2015 – present

Nicholas Cole, School of Natural Resources
August 2014 – present

Lucía Corral, School of Natural Resources
June 2012 – present

Kent Fricke, School of Natural Resources
June 2011 – present

Sarah Gaughan, School of Natural Resources
August 2016 – present

Michelle Hellman, School of Natural Resources
May 2013 – present

Amanda Lipinski, School of Natural Resources
August 2014 – present

Caleb Roberts, Department of Agronomy
August 2015 – present (co–advised)

Nicholas Smeenk, School of Natural Resources
August 2010 – present

Chad Smith, School of Natural Resources
August 2007 – 2014

Shana Sundstrom, School of Natural Resources
August 2011 – present

Bethany Teeters, School of Natural Resources
August 2012 – present

Helen Tripp, School of Natural Resources
August 2016 – present

Daniel Uden, School of Natural Resources,
August 2012 – present

Michael Whitby, School of Natural Resources
January 2014 – present

Graduates, 2015–16

Emma Brinley–Buckley, M.S., School of Natural Resources, UNL, August 2016

In Memoriam

Phillip "Trey" Lindsey, friend and Pheasant Project Technician passed away unexpectedly July 12, 2016, near McCook, Nebraska.

Trey had been with the Coop only a short time, but he made a positive, lasting impression. He was an intelligent young man who had a passion for the outdoors and wildlife. His great sense of humor put a smile on everyone's face and his practical jokes kept co–workers upbeat and motivated during the field day.

"He was such a good guy," said his friend and coworker David Damsky, "and it is truly unfortunate that this young man got taken from us so unexpectedly. He was very family–oriented and was always on the phone with his family, friends, or girlfriend after a long day of work. Trey was a very hands–on and artistic person. He awed us with his upland game bird drawings and taxidermy. He was a natural photographer and captured some amazing pictures of wildlife and scenery."

Addie Annis, project supervisor remembers Trey as "always ready to go and work his hardest".

Being from a small town in Tennessee, living and working in rural Nebraska was a natural fit for Trey. An athlete and a person who believed in community, he regularly played pickup basketball games over the summer with the neighborhood kids in Culbertson.

Trey's character, strong work ethic, passion for the outdoors, and love of family and friends, are just a few of the ways in which his life and actions made a genuine, enduring impact on the lives of others. He is missed and remembered.

Trey Lindsey holds a pheasant chick while working outside of Culbertson, Nebraska, during this summer's field work.
Photo: Claire Helmke

Coordinating Committee Members

U. S. Geological Survey

Joseph Margraf (through September 1); Kevin Whalen, Regional Supervisor
Cooperative Research Units Program
Denver Federal Center
Box 25046, MS 406
Denver, CO 80225–0046
(303) 236–1454

University of Nebraska–Lincoln

Ron Yoder, Interim Vice President and Vice Chancellor, Institute of Agriculture and Natural Resources
202 Agriculture Hall
Lincoln, NE 68583–0708
(402) 472–2871

Nebraska Game and Parks Commission

Jim Douglas, Director
2200 N. 33rd Street
Lincoln, NE 68503–0370
(402) 471–0641

Wildlife Management Institute

Pat Ruble, Midwest Field Representative
93 Central Station Place
Johnstown, OH 43031–8400
(740) 966–0496

U.S. Fish and Wildlife Service

Stephen Torbit, Assistant Regional Director for Science Applications
Region 6, Mountain–Prairie Region
134 Union Blvd, PO Box 25486
Denver, CO 80225
(303) 236–4602

Cooperating Organizations

Central Nebraska Public Power and Irrigation District
Emory University, Georgia
James S. McDonnell Foundation
National Socio–Environmental Synthesis Center
Nebraska Association of Resource Districts
Nebraska Department of Agriculture
Nebraska Department of Environmental Quality
Nebraska Department of Roads
Nebraska Educational Television
Nebraska Environmental Trust
Nebraska Forest Service
Nebraska Game and Parks Commission
Nebraska Invasive Species Advisory Council
Nebraska Natural Resources Districts
Nebraska Public Power District
Nebraska Weed Control Association
Swedish University of Agricultural Sciences, Sweden
The Nature Conservancy
University of Nebraska–Lincoln
Center for Grassland Studies
Daugherty Water for Food Institute
Department of Agricultural Leadership, Education and Communication
Department of Agronomy and Horticulture
Department of Computer Science / Engineering
Department of Earth and Atmospheric Sciences
Nebraska Water Center
School of Biological Sciences
School of Natural Resources
University of Nebraska Omaha
U.S. Department of Agriculture
    Animal and Plant Health Inspection Service
U.S. Department of Defense
    U.S. Army Corps of Engineers
U.S. Department of Interior
    U.S. Fish and Wildlife Service
    U.S. Geological Survey
    U.S. National Park Service
U.S. Environmental Protection Agency
Wyoming Game and Fish Department

MILESTONES AND HIGHLIGHTS

Golden Pillar Award

A tradition started in 2010, The Golden Pillar Award honors and recognizes outstanding individuals whose support is essential to the success of the Nebraska Cooperative Fish and Wildlife Research Unit. As we said then, "Unit support comes in many shapes and sizes." We appreciate the many individuals who provide crucial support to the Unit but there are a few select individuals that go well beyond the call of duty. The very first Golden Pillar Awards were given in 2010 to Kirk Nelson, John Owens, and Steve Riley.

Another opportunity for a Golden Pillar Award presented itself at the September 2015 Annual Coordinating Committee Meeting. The award was presented to Valerie Egger, the Unit's first administrative assistant. Valerie worked for UNL for nearly twenty–nine years and provided administrative support to the Nebraska Unit from when the doors first opened in July 2004 until she retired April 29, 2016. Valerie was presented with a Western Meadowlark hand–carved by Don Gabelhouse Jr. and hand–painted by his wife Diane.

For our 2016 meeting, we have two Golden Pillar's to present. Awardees are Don Gabelhouse, Fisheries Division Administrator for Nebraska Game and Parks Commission and Scott Taylor, Wildlife Division Administrator for Nebraska Game and Parks Commission. Both have departed the Game and Parks Commission, Don to a retirement filled, we hope, with plentiful time for fishing, and Scott to a new position in South Dakota. Both have been instrumental in supporting and developing the Nebraska Cooperative Fish and Wildlife Research Unit over time. Thanks Don and Scott!

Thanks for 12 Years!

I can't retire after nearly twelve years with the Nebraska Unit without saying, "Good–bye" and "Thanks." It was a great ride–one I always felt privileged to be a part of.

In my nearly thirty years with UNL, never was I as challenged (in a good way!) as much as in this position. It was never boring. This is a creative group, always thinking outside of the box. Somebody is always coming up with some new idea or new approach, and it was always, "Can we make this happen?" "How do we do this, and still stay within UNL, state, USGS parameters?" "What do you mean we can't do this?" ☺ It was a period of huge growth and learning, working for and with great people. It was an honor to be a part of building the Nebraska Unit.

I was stunned when honored with the Golden Pillar Award on behalf of the Unit, and will always cherish it. (I'm pretty sure my jaw dropped in surprise that day.) I am proud to have been part of this journey and will miss each and every one of you!

– Valerie

PHEASANT MANAGEMENT

In 2016, the Nebraska Game and Parks Commission unveiled a new pheasant management plan. The overall goal of the plan is to produce the best pheasant hunting experience for the most hunters in Nebraska. Highlighting the strong collaborative relationships between research and management in Nebraska the plan was informed by research efforts lead by Assistant Unit Leader Joseph Fontaine. Based on a pheasant habitat suitability model developed by former Coop Unit Master's student Chris Jorgensen, the Nebraska Game and Parks Commission selected 8 regions of Nebraska to focus their habitat management and hunter access efforts. As studies on pheasant and pheasant hunters in Nebraska continue, new information will help keep Nebraska on the forefront of pheasant management.

Creel Survey Personnel Changes

Last August, Chris Chizinski vacated his position as UNL research assistant professor and coordinator for the creel survey project and accepted a tenure track position with UNL's School of Natural Resources. We take this opportunity to thank Chris for his past work and to recognize his well–earned promotion to assistant professor of Human Dimensions of Wildlife Management with the UNL School of Natural Resources (SNR).

In January 2016, we welcomed Mark Kaemingk to the Unit and UNL as a research assistant professor with SNR and new coordinator for the creel survey project. He hit the ground running and has been on–the–go since then. Mark was recently appointed as an Adjunct Honorary Research Associate at Victoria University of Wellington, New Zealand, as he currently co–advises graduate students with a faculty member within the School of Biological Sciences.

Highly Visible Research

In the spring of 2016, a flurry of stories appeared locally, nationally and internationally following the first ever Unmanned Aerial Vehicle (UAV)– ignited prescribed fires test, with ideas and technologies developed by a small group of interdisciplinary researchers, from Agronomy, Computer Science and Engineering, and the Nebraska Unit (Craig Allen), at Homestead National Monument in Beatrice, NE. The coverage ranged from the Omaha World Herald, to Popular Science and Discovery, totaling more than 300 stories. Likewise, following the publication of the first scientific article describing the UAV – fire ignition prototype, there was much additional media attention, including by National Geographic, Science News, Nature World News, and Scripps TV (August 2016).

THESES AND DISSERTATIONS

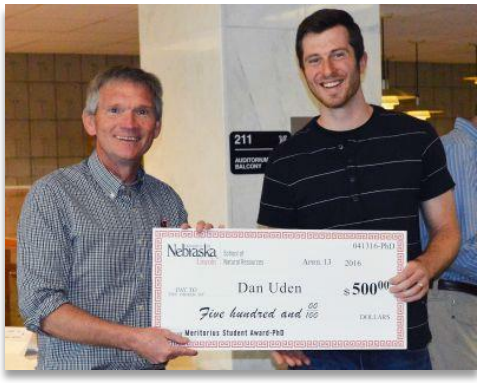
Brinley–Buckley Emma, M.S., July 2016

Applications of Time–Lapse Imagery to Capture and Communicate Ecological Dynamics of a Water–Stressed System.
University of Nebraska–Lincoln, Natural Resources. Advisor, Craig R. Allen

AWARDS AND RECOGNITIONS

SNR Meritorious Graduate Student Award

Dan Uden was one of two doctoral students selected to receive the 2016 School of Natural Resources Meritorious Graduate Student Award. The award usually is given to one master's and one doctoral student annually; this year, the committee chose to recognize two doctoral students. "Receiving this award is a wonderful honor," said Uden, doctoral student with the Nebraska Cooperative Fish & Wildlife Research Unit. "I'm truly grateful to my advisor, Craig Allen, fellow students, and numerous others from the SNR community who have invested in my development as a student over the past several years, and I'm excited to continue building on these and additional connections in the future." [Shawna Richter–Ryerson, Natural Resources.]



Dan Uden receiving award from School of Natural Resources director John Carol.
Photo: School of Natural Resources Media

Criteria for the award includes outstanding performance as a graduate student, research and professional contributions. The award is presented by the SNR Graduate Committee. Dan will receive a $500 stipend and his name will be included on a plaque that hangs in Hardin Hall.

Scholarships, Fellowships & Grants

Becca Bevans was awarded a $1,000 Weaver Grant from the Nature Conservancy to support grassland research.

Hannah Birgé earned a Dean's Fellowship for the 2016–17 academic year. The fellowships are awarded only to those landing in the top 10 percent of the applicant pool. Dean's Fellowships provide partial financial support to students, who may accept assistantships or other work. Birgé studies cross–scale interactions, including soil processes, land management and nutrient cycling, that help explain the resilience of complex social–ecological grassland systems. Her dissertation will focus specifically on the North Central Great Plains.

Hannah Birgé, Jessica Burnett, and Caleb Roberts were all awarded the University of Nebraska Great Plains Graduate Fellow status.

Nick Cole accepted the SESYNC doctoral fellowship proposal workshop invitation where doctoral students from around the country network and prepare SESYNC fellowship proposal submissions.

Lucía Corral received the Arthur William Sampson fellowship. The fellowship is awarded annually by UNL's Center for Grassland Studies to a graduate student who has an interest in pasture or range management in Nebraska. Lucía also received the Prairie Biotic Research grant which provides support for research the prairies of the United States.

Sarah Gaughan was awarded the prestigious University of Nebraska–Lincoln Othmer Fellowship. The fellowship is intended to assist in recruiting exceptional scholars who are seeking a terminal degree. Sarah is the 5th NE Coop Unit student to receive this fellowship. Previous recipients were Jason DeBoer, Shana Sundstrom, Amada Lipinski and Dan Uden.

Nadejda Mirochnitchenko received the Chancellors Fellowship. This fellowship is design to assist departments with the recruitment of superior graduate students by adding fellowship funds to an assistantship automatically renewable for a second year, given excellent progress toward the degree. Chancellor's Fellows will receive, in addition to the departmental assistantship, a $4,000 fellowship per year.

Victoria Simonsen received two scholarships for her research on quail ecology. The Wildlife Society Rusch Memorial Game Bird Research Scholarship, a national scholarship awarded annually to a graduate student studying any aspect of upland game bird or waterfowl biology and management, and the Nebraska Pheasants Forever Graduate Scholarship, a regional scholarship awarded annually to support graduate students in the field of wildlife biology.

Shana Sundstrom, earned a Maude Hammond Fling Fellowship, one of UNL's most prestigious graduate honors. The fellowship is awarded to advanced masters or doctoral students who have demonstrated the highest level of academic potential and provides a stipend that allows the student to be completely immersed in scholarship without having to hold an assistantship. Sundstrom studies behavior and dynamics of ecosystems as complex adaptive systems.

Elevator Speech Contest

The 3rd annual SNR Elevator Speech Contest took place February 25, 2016 with students competing for cash prizes of $5,600. The evening included the speech competition. a poster contest, and a Silent Auction hosted by the SNR Graduate Student Association that raised some $400.00 to support their service and outreach activities.

The contestants were evaluated by a three judge panel. In addition, a People's Choice category was based on a vote of the audience. The Nebraska Unit was well represented in the competition and students received the following awards.

Undergraduate Division

- Brooke Welsh, 4th place – Brooke also received the People's Choice award.

Masters Division

- Becca Bevans, 1st place
- Brian Harmon, 3rd place
- Alexis Fedele, 4th place

Ph.D. Division

- Jessica Burnett, 2nd place
- Michael Whitby, 3rd place

Elevator Speech Contest, February 25, 2016
Photo: School of Natural Resources Media

Poster and Presentation Awards

Alexis Fedele was awarded the Best Student Poster at the joint Kansas/Nebraska Chapter Meeting of the American Fisheries Society in Manhattan, Kansas. Her poster, presented at the February meeting, was: *Caught–and–released Fish May Alter Behavior in Response to Predatory Anglers.*

Travel Awards

Jessica Burnett received the Irvin A. and Agnes E. Nelson Memorial Fellowship based on her academic excellence and her clear potential as a future contributor to the field of avian conservation and ecology. This fellowship allowed her to attend the 2016 North American Ornithological Congress (NAOC) in Washington, D.C., where she presented preliminary results from her original research titled, "Identifying Broad–Scale Regime Shifts Using the Breeding Bird Survey," to an international community of experts.

Caleb Roberts received the Center for Great Plains Studies Travel Award, and the Hutchinson Travel Grant, from the University of Nebraska–Lincoln.

Michael Whitby was awarded two travel grants: the Wildwood Travel Grant and the School of Natural Resources GSA Travel Grant for a total of $750.00. These funds supported his travel to Lake Guntersville, AL for the Southeastern Bat Diversity Network Annual Meeting to coordinate the 2016 Bat Blitz, as well as cover the cost to make posters for presentations.

SNR Staff Recognition Award

Caryl Cashmere receiving award from School of Natural Resources director John Carol.
Photo: School of Natural Resources Media

Caryl Cashmere, staff assistant for the Unit, was awarded the spring 2016, School of Natural Resources Staff Recognition Award. Nomination forms are based upon the following criteria: exceptional service and dedication to SNR; creativity and innovation on the job; ability to interact with faculty, staff, students and clientele. Caryl joined the Nebraska Cooperative Fish and Wildlife Unit July, 2009 in a .50FTE position. According to her nominator, "In spite of being only half–time, she is currently serving as a member of the SNR Social Committee, and has served on two search committees in the past year—without having her job suffer in any way. Caryl is often the 'face of UNL' for new technicians and new graduate students. Their experiences working with Caryl can set the tone for their employment with UNL. Caryl represents the University admirably, and she is dedicated to providing the best service possible." Congratulations, Caryl!

OUTREACH ACTIVITIES

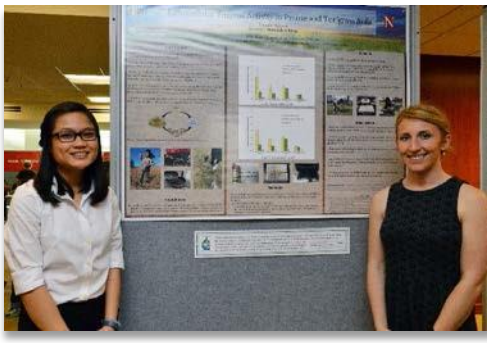
The following are a *sample* of the outreach activities that Unit staff and students participated in during the past year.

Species Distribution Modeling Using R Workshop

Staff and students receiving instruction from Dr. Edwards.
Photo: NECRU Staff

The Nebraska Cooperative Fish and Wildlife Research Unit and the Nebraska Game and Parks Commission hosted Dr. Tom Edwards (Utah CFWRU) for a one–week workshop in Species Distribution Modeling in Lincoln, Nebraska. Twenty people participated in the workshop, including students, faculty and staff from the Nebraska Coop Unit and the University of Nebraska, as well as professionals from the Nebraska Game and Parks Commission. The curriculum integrated both theory and practical application of species distribution modeling, with a mixture of lecture and hands–on group exercises using R as a platform for both modeling and generating predictive maps. Dr. Edwards led participants through the theory and provided in–depth analysis exercises in R for a series of approaches including logistic regression GLM, additive logistic regression GAM, maximum entropy MAXENT, random forests, boosted regression trees, and concluding with a discussion and demonstration of ensemble species distribution models. The interactive setting allowed collaboration between professionals and students with a diversity of modeling and research backgrounds, providing a unique learning experience and opportunities for future collaboration.

EnvironMentors



Environmentee student with Birgé.
Photo: Shawna Richter Ryerson SNR media

In late fall 2015, Hannah Birgé mentored a high school student in the UNL Chapter of Upward Bound EnvironMentors program on her first research project: Enzyme activity in prairie versus turfgrass soil. The student's project tied for first place at the SNR Research Fair.

Media Coverage

Local media coverage highlighted several research projects.

- *NET, Nebraska Stories: The Swift Fox.* Nebraska Educational Telecommunications. January, 2016.
- *Swift Fox: Nebraska's Smallest Wild Dog*. Trail Tales Magazine. Nebraska Game and Parks Commission and NEBRASKAland Magazine. 2015– 2016.
- *Nebraska Invasive Species Program: Zebra Mussel Prevention*. NEBRASKAland Magazine. May 2016.
- *Lake Zorinsky Zebra Mussel Infestation.* Lincoln Journal Star, and Omaha World Herald. July 2016.
- *Invasive Plant Prevention.* Nebraska Public Radio. June 2016

Nebraska Invasive species program

The Nebraska Invasive Species Program participated in several expos and public events, and had booths with invasive species information. The program's website (neinvasives.com) has a calendar listing events that program staff attend or presentations they conduct at events. Technicians interviewed boaters at high risk Nebraska waterbodies between May and August 2016 educating the public on how to prevent the spread of aquatic invasive species. The program developed invasive species curriculum for 9–12 grade students which meet teaching standards. Traveling trunks for educators were developed and contain invasive species books and specimen for ages

K–12 and adult learners. A set of invasive species education cards were developed and will be disseminated to teachers through the state to use in tandem with lesson plans and activates available for download at the program's website.

Water Safety Training

NE Coop staff organized and provided water safety training followed by American Red Cross certification for Adult First Aid/CPR/AED for technicians and clerks during March and June 2016 in Lincoln, NE. Water safety instructors were Kevin Pope, TJ Fontaine, and Craig Allen.

RESEARCH PROJECTS

AMPHIBIAN OCCUPANCY, FUNCTIONAL CONNECTIVITY, AND RESILIENCE OF RAINWATER BASIN WETLANDS

Principal Investigator(s):	Dan D. Snow, Craig R. Allen
Graduate Student(s):	Michelle Hellman, Ph.D.
Project Duration:	April 2013 – May 2017
Funding:	National Science Foundation IGERT Program U.S. Environmental Protection Agency
Project Location:	Rainwater Basin, Nebraska

This project will seek to assess how agricultural land–use may affect resilience of a large wetland complex. Both the quantity and overall quality of wetlands have severely declined globally. Many remaining wetlands exist in landscapes dominated by agricultural production. The Rainwater Basin is a region of Nebraska characterized by shallow wetlands located in an agricultural matrix. Following European settlement in the mid–to–late 19th century, more than 90% of historic wetlands in the Rainwater Basin were filled or farmed through. The remaining wetlands exist in an intensive agricultural matrix that has further isolated wetlands and may affect their function, and reduce the resilience of the Rainwater Basin.

For the Nebraska Rainwater Basin, we are interested in the resilience of the functional connectivity among wetlands for amphibian species. Amphibians are an important taxonomic group that provide services by controlling insects, serving as food for migratory birds and other species, and integrating terrestrial and aquatic systems. Amphibians are sensitive to environmental contaminants and can be used as an indicator of water quality, system health, and resilience. Occupancy of amphibians, functional connectivity of remaining wetlands, and acute and chronic effects to amphibians from commonly applied agrichemicals will be investigated. Volunteers from the Unit, the University of Nebraska, the Nebraska Game and Parks Commission, and various other organizations performed roadside amphibian call surveys at 125 wetlands in the Rainwater Basin. Additionally, water contaminant samples continue to be collected and analyzed for a suite of agricultural contaminants. Concentrations of contaminants found in the Rainwater Basin will be replicated in laboratory conditions to assess toxicity to larval amphibians.

Private wetland in an agricultural field in the Rainwater Basin.(flooded with rainfall)
Photo: Michelle Hellman

The same wetland later in the season has contracted and surrounding land has been planted
Photo: Michelle Hellman

ANGLER BEHAVIOR IN RESPONSE TO MANAGEMENT ACTIONS ON NEBRASKA RESERVOIRS – PART II

Principal Investigator(s):	Kevin L. Pope, Christopher J. Chizinski
Research Asst. Professor:	Mark A. Kaemingk
Graduate Student(s):	Nicholas Cole, Ph.D. Alexis Fedele, M.S. Aaron Gray, M.S. Brian Harmon, M.S. Christine Ruskamp, M.S.
Project Duration:	January 2014 – December 2018
Funding:	Nebraska Game and Parks Commission
Project Location:	Statewide Nebraska
Website:	FishHunt.unl.edu

Recreational angling, a billion–dollar industry, is the most influential factor structuring fish populations in inland systems. Given its importance and the reliance in North America on sportspersons to fund conservation activities (i.e., the North American Model of Wildlife Conservation), natural resource agencies invest substantial resources to recruit and retain anglers. However, there is little understanding of the motivations to participate in angling activities or the influence of management actions on that angler participation. Further, little is known about the non–consumptive responses of fish populations to angling such as changes in behavior that affect vulnerability to angling. A greater understanding of the positive and negative feedbacks between angling participation and responses of fish populations to angling are needed to understand and properly manage recreational angling.

Project goals are to understand 1) the participation patterns of anglers on multiple spatial and temporal scales; 2) how participation patterns of anglers influence fish populations and associated communities; 3) how management actions influence angler participation patterns and, in turn, fish communities; and 4) interactions and feedback mechanisms between and among angler groups and fish communities.

The project currently has six study components.

1. *Statewide Angler Survey.* Anglers are being interviewed at Branched Oak Lake, Calamus Reservoir, Gracie Creek Pond, Harlan County Reservoir, Lake McConaughy, Merritt Reservoir, Pawnee Reservoir, and Sherman Reservoir from April through October, 2014–2018. These interviews add to long–term (>10–20 years) data sets that are valuable for assessment of temporal changes in angler participation. In particular, these extended data sets will allow for relational assessments of changes in angling participation with environmental conditions and management actions on large–scales.

2. *Individual–Based Model Describes Behavioral Feedbacks between Anglers and Sportfish.* Behavioral feedbacks between anglers and sportfish are widely recognized to be important in the management of sustainable and economically viable recreational fisheries. Quantifying these feedbacks empirically is difficult. Individual–based modeling has proven to be a powerful tool for assessing ecological processes that are difficult to quantify empirically. We used this computational–modeling form to simulate various assumptions associated with fishery–induced behavioral changes within an exploited fish population. We parameterized the angler agents using creel survey data from a new reservoir in eastern Nebraska. These simulations result in robust–emergent relationships, over many model iterations, between empirically represented anglers and hypothetical sportfish. This work provides a theoretical framework for in situ assessments of behavioral feedbacks between anglers and sportfish.

3. *Using Naïve Systems to Identify How Angling Influences Fish Populations.* Catchability of sportfish can be negatively affected by repeated capture with catch–and–release angling, which is potentially a result of learned hook avoidance. The opening of two new reservoirs in eastern Nebraska to angling provided a unique opportunity to assess this relationship. Lake Wanahoo and Prairie Queen Lake were stocked and allowed to develop without angling for several years prior to opening. Thus, we assumed that fish were naïve to angling. We hypothesized that learned hook avoidance would be more prevalent in release–oriented than harvest–oriented fish populations, resulting in a more rapid decline of angler catch per unit effort (CPUE) for release–oriented species. Creel surveys were employed through the first 30 days of angling at each location, and were used to estimate angler catch, harvest, and effort. At Wanahoo, we observed a marked decrease in the CPUE of release–oriented species, but we did not observe declines in CPUE for harvest–oriented fish. This suggests that individuals may develop learned behavior to avoid recapture and has strong implications for efficacy of management regulations and angler satisfaction. However, we did not achieve the same results at Prairie Queen, highlighting the complexities of these system and the need for continued research.

4. *Quantifying the Effect of Fish Personality on Fishing–induced Learning.* Fish populations display reduced catchability over time in catch–and–release fisheries, suggesting that individual fish have the ability to learn to avoid capture. We are investigating whether learning occurs and the potential influence an individual fish's personality has on its ability to learn. Behavioral tests and repeated fishing trials were conducted in a laboratory to determine where an individual falls along a boldness continuum, and if certain fish personality types are better able to learn to avoid a lure. Preliminary results from fishing experiments suggest that control fish, offered a worm on a hook–less wire, increase their probability of taking the worm over the seven–day fishing trials. Fish offered a worm on a simple hook display a decreasing probability of capture over time, and fish offered a worm on a lure start out at a lower probability of capture and also show evidence of decreasing probability of capture over time. Video recordings of behavioral experiments are currently being analyzed to extract personality data. If personality dictates learning, angling may select for a particular type of individual, leading to homogenous populations of fish that become "informed" about angling and develop low vulnerability to capture.

5. *Spatial Distribution of Angler Parties.* Anglers must decide where to fish within a waterbody, yet most assessments of fisheries via angler surveys provide only whole–waterbody estimates of angler pressure. Angler distribution within a waterbody is not uniform, and if anglers are not randomly distributed, then anglers are selecting for factors within a waterbody. We will describe the distribution of anglers within four Salt Valley reservoirs across an open–water season and elucidate the physical landscape features that predict their distribution. We will compare these realized preferences of anglers to their stated preferences through an online survey. Additionally, we will examine whether the presence of other anglers affects where and how anglers fish within a waterbody. Information gained by this research should improve precision for estimates of angling effort and catch in spatially complex fisheries and provide managers with information on how changes in infrastructure will alter angler distribution.

Creel clerk interviewing anglers
Photo: Nick Cole

6. *Length–based Economic Assessment of Sportfish.* Recreational fisheries are a unique industrial component to Nebraska's economy. Though they do not produce a directly valued product of traditional economics, they do provide utility to recreational anglers through social capital or enjoyment. In seeking this social capital, anglers create demand for secondary industries (e.g., tackle, media, and travel accommodations). Thus, these secondary industries are a direct result of the quality of Nebraska's aquatic resources. As such, accounting for these economic gains within any resource assessment provides a more accurate value of the resource itself.

Quantifying this valuation requires assessment of individual angler willingness–to–pay to capture a fish and for each successive capture. Willingness–to–pay is most commonly quantified through classic cost–benefit analyses. We will use contingent valuation methods to quantify anglers' stated willingness–to–pay values. This willingness–to–pay variable can then be used to set a monetary value for the capture of a fish.

Creel clerk measuring catch
Photo: Joseph Fontaine

We recognize that the unique preferences and motivations of anglers vary widely among anglers. Thus, we should expect that an angler's willingness–to–pay for different fishing trip outcomes (i.e., species and size) should also vary widely. To properly include this in our assessment, we will use a length–based valuation framework and seek to generalize the preferences and motivations of Nebraska anglers by applying seminal sociological theories, such as identity and recreational specialization theory. Thus, this assessment will provide a length–specific estimate of the value of captured sportfish in Nebraska, stratified across the unique groups of Nebraska anglers. Further, this study uses a transdisciplinary modeling approach to predict optimal relationships between social, ecological, and management arenas.

AQUATIC INVASIVE SPECIES (AIS) PREVENTION PROGRAM

Principal Investigator(s):	Craig R. Allen
Project Coordinator:	Allison Zach
Project Duration:	April 2011 – June 2017
Funding:	Nebraska Environmental Trust USFWS Aquatic Nuisance Species Taskforce Central Nebraska Public Power and Irrigation District
Project Location:	Statewide Nebraska
Website:	Neinvasives.com

The Nebraska Invasive Species Program (NISP) continues to administer a multi–institutional Aquatic Invasive Species Prevention Program with grant funding from the Nebraska Environmental Trust and the U.S. Fish and Wildlife Service.

Goals are to:

- Decrease the risk of aquatic invasive species introduction into Nebraska by implementing a boat inspection and decontamination program.
- Increase public awareness of aquatic invasive species through an integrated outreach/education program.
- Continue aquatic invasive species monitoring to help focus prevention efforts.
- Increase local and regional collaboration in the prevention of aquatic invasive species.

The NISP has conducted boater surveys and voluntary boat inspections each summer since 2012 at high–risk waterbodies throughout Nebraska to gauge public awareness of aquatic invasive species, study watercraft movements, and to educate the public on aquatic invasive species prevention. Since 2014, surveys have been collected using tablets and real time data collection software. The software allows technicians to collect boater surveys when outside of Wi–Fi range. Then once back in Wi–Fi range, the technicians sync the tablets, and the survey data is uploaded to a remote server. The program coordinator can then access data to analyze current data and adjust technician locations if necessary. Voluntary boat inspections were offered after conducting the boater survey to show the public where to inspect and clean their watercraft to prevent the spread of aquatic invasive species. In addition to conducting boater surveys and inspections, the program and the Nebraska Game and Parks Commission collected water samples from high risk waterbodies throughout the state to test for zebra mussels. Program staff analyzed the water samples using compound microscopy. In 2015 a zebra mussel infestation was confirmed at Lewis and Clark Lake and the Missouri River downstream of it. The program conducted public outreach and provided information to the media regarding the infestation and how to clean, drain and dry watercrafts to prevent the spread of aquatic invasive species. In 2016 the program sampled Lake Zorinsky in Omaha, NE and confirmed zebra mussel larvae in high concentrations at the lake's boat launch and worked with the various agencies with jurisdiction of the lake to get information to the media and coordinate management initiatives.

Technicians conducting zebra mussel sampling & watercraft inspection
Photos: Allison Zach

Assessment of Angler Use and Catch During 2016 at Sutherland Reservoir, Nebraska

Principal Investigator(s): Kevin L. Pope, Mark A. Kaemingk, Christopher J. Chizinski

Project Duration: February 2016 – January 2017

Funding: Nebraska Public Power District

Project Location: Sutherland Reservoir, Nebraska

Recreational fishing provides many socioeconomic and ecological benefits. These benefits are derived in many different forms that can lead to an increased quality of life and income generated across many different spatial scales. This importance has led to increased demands on these fisheries, often causing overexploitation, selective harvest, sub–lethal effects, and disturbance or harvest during critical reproductive periods. Consequently, there is a need to better understand social–ecological relationships and impacts between humans and fish populations.

The purpose of this study is to estimate angler use and catch at Sutherland Reservoir, Nebraska, during April through October 2016. Specifically, we will obtain monthly and yearly estimates of angler pressure, catch, and harvest. This information will allow the Nebraska Public Power District to evaluate angler use and influence of the fishery at Sutherland Reservoir. Collected data could also be used to guide management efforts between optimizing hydropower and maintaining a quality fishery at this multi–use reservoir.

AVIAN HABITAT RELATIONSHIPS ACROSS ECOLOGICAL SCALES

Principal Investigator(s): Joseph J. Fontaine

Research Asst. Professor: Erica K. Stuber

Graduate Student(s): Christopher Jorgensen, M.S. (2012)

Undergraduate Student: Victoria Simonsen, UCARE Student (2015)

Project Duration: January 2010 – May 2018

Funding: Nebraska Game and Parks Commission
University of Nebraska–Lincoln UCARE Program

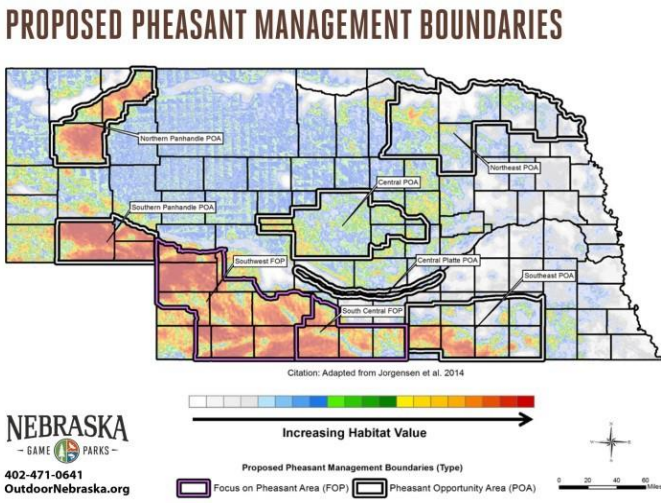
Project Location: Statewide Nebraska

Website: Prairiebirds.unl.edu

Throughout the Great Plains, changing land–use practices are resulting in large scale biodiversity loss and an ever increasing dependence on effective conservation and restoration efforts provided by private, state, and federal agencies. Yet, too often management efforts fail to demonstrate the desired outcome for wildlife populations. Understanding why management is unsuccessful is paramount, but past studies often fail to consider the importance of ecological mechanisms that act across multiple spatial and temporal scales. By exploring how grassland bird communities select habitat based on local vegetative composition as well as landscape attributes, we can gain perspective on why populations and communities fail to react to apparently suitable habitat improvements.

Using geographic information system spatial analysis tools, we are analyzing data from avian point count surveys and local vegetation assessments within a larger land cover layer of Nebraska. The resulting outputs are being employed to create species specific spatial models for Nebraska, which identify key focus areas to implement management efforts with the goal of maximizing management benefits to grassland bird communities.

Since 2011 more than 4,000 avian point count surveys have been conducted on State Wildlife Management Areas, private properties enrolled in the Open Fields and Waters program, and road transects. Analysis of habitat factors influencing upland species and other obligate grassland birds indicates that the surrounding landscape strongly affects local habitat suitability. Thus, the success or failure of conservation efforts on the ground may be determined by the landscape context. The findings from this study are now being used to help direct pheasant management efforts in Nebraska.



Priority pheasant management areas defined by the Nebraska Game and Parks Commission in the Berggrenn Plan using models developed through this study.
Graphic courtesy of the Nebraska Game and Parks Commission

Vicki Simonsen, as an undergraduate UCARE student, tested one of the mechanisms that may explain how landscapes influence pheasant populations. In the summer of 2013, we used artificial nests to test if the presence of suitable nesting habitat in the surrounding landscape reduced nest predation. Over the course of two months we put out more than 200 nests, some of which were monitored by trail cameras.

BAT MOVEMENTS ACROSS TRANSFORMING LANDSCAPES

Principal Investigator(s):	Craig R. Allen, Caroline M. Jezierski
Graduate Student(s):	Michael Whitby, Ph.D.
Project Duration:	May 2013 – June 2017
Funding:	Nebraska Environmental Trust Nebraska Game and Parks Commission
Project Location:	Platte River, Nebraska
Website:	http://snr.unl.edu/renewableenergy/wind/researchbat.asp

Bats provide critical ecosystem services across the globe, ranging from pollination and seed dispersal to insect control. In the United States, all bats are insectivorous and consume up to twice their body weight in insects every night. Their voracious appetite is estimate to replace at least $3.7 billion dollars in pesticide use across the U.S., saving farmers $74 per acre. Preserving bat populations is important for both the ecosystem and the humans who rely on the services they provide.

Michael Whitby monitoring bat movement
Photo: Mandy Lipinski

Unfortunately, the cumulative impacts of opportunistic wind energy development could have unanticipated, negative consequences in Nebraska and around the nation. Already, wind turbines kill an estimated 800,000 bats annually. As the energy sector positions itself to harness Nebraska's wind resources, we must consider and minimize the unintended consequences to Nebraska agriculture and natural resources. Potential negative impacts of wind energy development on bats can be minimized through siting and operations that consider bat presence, activity, and movement. By studying bat migratory patterns in Nebraska we will help utility companies, wind energy developers, and wind facility owners avoid, manage, and mitigate the effects of new and existing wind energy facilities.

Acoustic detector by the Missouri River
Photo: Zac Warren

To achieve this goal, we are using three methods. First, we are using bat detectors to identify when and where bats are moving in eastern Nebraska, throughout the year. These detectors record the ultrasonic acoustic signals bats use to navigate and allow us to determine the species present and activity levels at recording locations. Starting in 2014 we placed acoustic detectors on silos and grain bins around East–Central Nebraska. Currently, there are 21 detectors recording from March to November. The data are being used to identify the timing of bat migration in the area and to create a spatial map of bat activity, allowing us to determine if any migratory corridors exist in the area. Second, a separate acoustic grid of more than 50 detectors will be placed along the Missouri River floodplain during the fall migratory period to determine if and how the river and bluff lines are being used during migration. Finally, bats are being captured in order to collect fur samples. The isotope levels from these samples will help us determine the migratory period and the catchment area of migratory bats.

Information gathered will be used to further promote sound resource management practices, especially by informing new wind energy facilities of high risk areas and help all facilities identify times of greatest threats to bats. Partners on this project include the Nebraska Wind Energy and Wildlife Project, the U.S. Fish and Wildlife Service, the Nebraska Game and Parks Commission, and the University of Nebraska–Lincoln.

BETTER SOILS FOR BIRDS

Principal Investigator(s):	Craig R. Allen, Hannah E. Birgé
Graduate Student(s):	Hannah Birgé, Ph.D.
Project Duration:	June 2013 – January 2017
Funding:	National Science Foundation IGERT Program Nebraska Game and Parks Commission
Project Location:	North Central Nebraska

This project investigates how disturbance is used as a tool by managers to improve the quality of grasslands enrolled in the Conservation Reserve Program (CRP). To achieve this aim, we are tracking 1) soil, 2) plant, 3) pollinator, and 4) ground–dwelling macroinvertebrates response to the disturbances used by managers that serve as stand–ins for historical disturbance. These manager–applied disturbances are part of Conservation Reserve Program mid–contract management (MCM) and typically include burning, disking, interseeding, herbicide, or some combination thereof.

The decision to use one or many of these approaches to fulfill MCM obligations requires landowners to weigh various economic, ecological, and social tradeoffs. By combining the ecological knowledge gained from our field investigation with knowledge generated from a statewide landowner survey, this work seeks to provide valuable information to private landowners, agency personnel and scientists interested in supporting smart land management decision–making.

The two chief goals of this work are to create:

1. An understanding of how the ecosystem responds to four common MCM strategies, including soil, plant, insect, and bird attributes; and
2. Relevant information to provide to private landowners, land managers, and federal and state personnel in an effort to promote informed management decisions by:
    a. Balancing various management objectives and costs, and
    b. Providing a structured, iterative learning process to inform future management activities.

Upland sandpiper in the Lynch area
Photo: Hannah Birgé

Two results are emerging from our investigation. The first is that herbicide and disking may have less than desirable ecological tradeoffs. The second is that the effects of these treatments for biodiversity – desired outcomes in the CRP – may be ephemeral relative to other treatments. As we approach our final year of the Better Soils for Birds grant, we continue to tease apart the complex effects of these treatments on both the ecosystem, and the social system. To address the former, we will conduct an in depth analysis of our extensive plant data, explore soil carbon sequestration through an incubation, and analyze the PFLA data. To address the latter, we will examine the ecosystem services – and costs – including the financial and social risks associated with each of the management activities CRP enrollees choose to use as they balance multiple management objectives. The second result is that not all disturbances are created equal, and instead interact differently with grassland ecosystem structures and functions, which could interfere with short and long term management outcomes.

Biodiversity, Disturbance, and Resilience: Evaluating the Role of Biodiversity in Moderating Ecosystem Response to Interacting Disturbances

Principal Investigator(s):	Craig R. Allen
Graduate Student(s):	Rebecca Bevans, M.S.
Project Duration:	May 2015 – July 2017
Funding:	UNL Institute of Agriculture and Natural Resources The Nature Conservancy
Project Location:	Nebraska Platte River Prairies Restoration

Biodiversity contributes to ecological resilience (resilient systems are those that maintain, through internal processes and feedbacks, their essential structure and function when disturbed), yet experimental evidence of the relationship between resilience and biodiversity in large–scale field settings is sparse. This study, by systematically introducing multiple disturbances to research units established within large restoration plots, aims to bridge the gap between tightly controlled mesocosm experiments and uncontrolled observational studies linking biodiversity and ecosystem functioning.

During the summers of 2015 and 2016, research was conducted on a tallgrass prairie restoration owned and maintained by the Nature Conservancy of Nebraska. Disturbances were introduced to both low– and high–diversity plots in the form of rain interception (simulating drought), biomass harvesting (to simulate haying), nitrogen additions (representing nitrogen runoff from agricultural use), and paired biomass removal/nitrogen additions.

Pre–disturbance sampling from 2015 revealed a strong gradient in soil organic matter and associated differences in plant communities, rates of invasion, and soil microbial activity. This gradient illustrates one reason for researching biodiversity and resilience *in situ*; by studying how natural environmental heterogeneity influences ecosystem responses to added disturbances, we can develop a more nuanced understanding of the magnitude of the role of biodiversity in maintaining system resilience, and when the benefits of biodiversity may be more or less pronounced than suggested by more tightly controlled greenhouse experiments.

In 2016, post–disturbance data was collected for several soil and plant community characteristics in order to quantify the responses of each experimental unit to our added disturbances, and a second round of disturbances added. This study is expected to continue through 2017, with results presented to a thesis committee in the summer of 2017.

CANID DISTRIBUTION AND THE POTENTIAL IMPACTS OF ENERGY DEVELOPMENT IN NEBRASKA

Principal Investigator(s):	Joseph J. Fontaine, Larkin A. Powell, Teresa J. Frink (Chadron State College)
Graduate Student(s):	Lucía Corral, Ph.D.
Project Duration:	January 2013 – January 2018
Funding:	Nebraska Game and Parks Commission Nebraska Department of Roads
Project Location:	Western Nebraska
Website:	Swiftfox.unl.edu

Increasing conversion of grasslands throughout the Great Plains has led to significant declines in the distribution and abundance of a variety of grassland obligate species and associated increases in habitat generalists. For example, the distribution and likely densities of generalist carnivores, including coyote (*Canis latrans*) and red fox (*Vulpes vulpes*) have increased throughout much of North America, while the closely related grassland obligate, swift fox (*V. velox*) has and continues to undergo significant declines. In Nebraska, swift fox currently occupy only 21% of their historical range, while coyotes have increased both in numbers and range throughout the state. Clearly generalists such as coyotes are capable of thriving in highly altered human landscapes, thus it is not surprising that their distribution has increased. What is less clear is why swift fox fail to occupy the 42% of Nebraska that continues to contain seemingly high quality swift fox habitat.

Swift fox caught on a trail camera in western Nebraska

Lucia preparing trail cameras

As the largest canid in Nebraska, coyotes are dominant to swift fox and are often cited as an important source of mortality for swift fox populations. As such, increases in the abundance and distribution of coyotes following the development of the Great Plains may have inadvertently restricted the range of swift fox despite the availability of suitable habitats. With increasing interest in developing infrastructure in the shortgrass prairie for gas, oil and wind energy resources, there is a clear need to identify the mechanism limiting the distribution of grassland obligate species such as swift fox, and how anthropogenic change is likely to alter important ecological relationships.

We are working to identify the ecological mechanisms shaping the distribution of canid communities across Nebraska by developing and testing a series of species distribution models based on the habitat requirements and intraguild interactions between coyote and swift fox. The project goal is to understand how habitat structure, landscape attributes, and behavioral intraguild interactions, across multiple spatial and temporal scales, affect habitat use and geographic distribution of Nebraska's canids species and how energy development may alter these relationships.

Lucía and Lindsay Brown setting a camera trap station
Photos: Adela Annis

Starting in the spring of 2014, we began surveying for canids across 26,000 square miles of western Nebraska using baited camera traps. With the help of 129 private landowners, we were able to deploy cameras at 908 survey sites, for over 16,650 trap nights resulting in nearly 4.5 million photos. Over the next several years, we will continue surveying for canids in the spring and fall, working to develop a baseline model for canid species distribution in Nebraska.

Climatic Constraints on Bobwhite Quail Populations along Their Northern Extent

Principal Investigator(s):	Joseph J. Fontaine, Gwen C. Bachman
Graduate Student(s):	Amanda (Mandy) Lipinski, Ph.D. Victoria Simonsen, M.S.
Project Duration:	June 2014 – December 2020
Funding:	Nebraska Game and Parks Commission
Project Location:	South Central Nebraska
Website:	Prairiebirds.unl.edu

Northern bobwhite quail (*Colinus virginianus*) are among the most popular game birds in North America; however, the loss of suitable habitat has led to precipitous population declines throughout their range. With significant grassland and farmland habitats, Nebraska has the potential to maintain viable quail populations, but due to the climatic conditions imposed by harsh winters and periodic wet springs, quail populations in Nebraska tend to be highly variable from year to year. Local habitat management may be capable of overcoming some environmental constraints, but effective management strategies necessitate a comprehensive understanding of the impacts of large scale climatic conditions on Nebraska's quail resources.

Although there are numerous studies focused on water constraints for quail populations in arid environments, the role of climatic conditions in driving quail populations in traditional temperate environments remains limited with much of the research conducted when the landscape was more conducive to facilitating population rebounds after severe weather events. Given the current agricultural paradigm, and predicted changes in climatic conditions, it remains unknown whether effective management implementation can lead to reliable quail populations and facilitate long–term stability in hunter engagement, satisfaction, and participation. In a first step to addressing this issue, we propose to identify the mechanism by which climatic conditions impact quail and the means by which management may overcome climatic constraints.

The purpose of this project is to improve our understanding of how severe climatic events (e.g., snow storms, spring rains) alter quail physiology and behavioral decisions to impact population stability in Nebraska and to further develop management strategies aimed at offsetting these costs. Utilizing an individualistic approach that considers the inherent trade–offs in life history, physiological, and behavioral expression, we hope to identify key constrains in population growth and management strategies that many ameliorate population cycles.

Bobwhite quail
Art: Mandy Lipinski

COMPREHENSIVE EVALUATION OF THE NEBRASKA OUTDOOR ENTHUSIAST

Principal Investigator(s):	Christopher J. Chizinski, Joseph J. Fontaine, Kevin L. Pope
Project Duration:	January 2016 – January 2010
Funding:	Nebraska Game and Parks Commission
Project Location:	Statewide Nebraska
Website:	FishHunt.unl.edu

The decline in hunters and anglers is of increasing concern to natural resource management agencies nationwide. Fishing and hunting license sales and taxes on fishing and hunting equipment are vital sources of funding for wildlife management agencies, and in many cases, management objectives are met under the stewardship of sportspersons. The dependence on hunters and anglers by management agencies like the Nebraska Game and Parks Commission makes the North American Model of Conservation unique, but vulnerable to declining participation in outdoor recreation. Hunter Education programs, Family Fishing Events, Outdoor Expos, and other programs can increase participation in outdoor recreation; but to ensure the future of hunting and fishing in Nebraska we need to understand how hunters and anglers use Nebraska's fish and wildlife resources, how they perceive the outdoor opportunities available in Nebraska, and most importantly what differentiates the types of hunters, types of anglers, and movement among groups including non-participants, those that do not yet participate through license purchases (Figure 1).

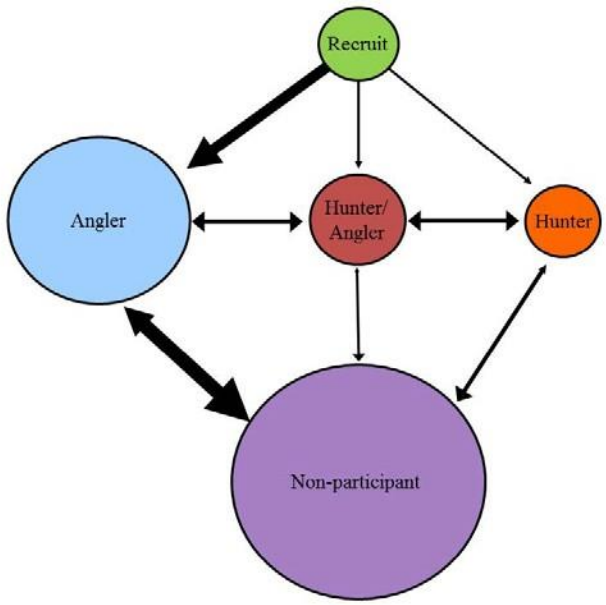


Figure 1 - A hypothetical relationship between different sporting groups including a group that has never participated (Recruit) and a group that has participated in the past but is not currently actively participating (Non-participant). The size of the circle indicates the relative size of the group that is exposed to recruitment and retention efforts and the size and direction of the arrow indicates the degree of movement between groups.

The Game and Parks Commission spends significant resources to provide instruction in firearm operations and safety, wildlife management, nature conservation, and game laws, as well as archery and shooting range facilities through the state's Hunter Education Program. In Nebraska, completion of a hunter education course is required prior to purchasing a hunting license. The Hunter Education Program works with hundreds of youth and adults each year with the anticipation that those participating in the program will eventually become license holders. Many of these Hunter Education participants have expressed an interest in hunting, but have never purchased a license (non-participants). Like many states, Nebraska currently lacks a universal system linking Hunter Education participants to the license database. Understanding who participates in the Hunter Education Program and becomes or does not become a license

holder is critical to designing and implementing effective Hunter Education programs. This information will also help us understand what licenses are most appealing and consider offering alternative opportunities to meet the needs of those not currently buying licenses (nonparticipants).

The U.S. Fish and Wildlife Service supports the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation Survey in a nationwide attempt to understand the sporting public. Conducted every 5 years, the National Survey identifies generalizations concerning patterns of outdoor enthusiast participation in the USA. Although useful for setting broad policy, the spatial and temporal scales of this National Survey limit the capacity for local fish and wildlife agencies to affect participation within their state. To overcome the limitations of the National Survey, many state agencies, including the Nebraska Game and Parks Commission, conduct surveys to individual license holders or to those participating in various hunter education programs. However, because of the extraordinary effort necessary to survey completely, State Surveys are often highly directed, limiting their applicability across user groups and state boundaries. Given the challenges of both National and State Surveys, there is a need to bridge the information gap and understand hunters and anglers, as well as hunter education participation, at spatial and temporal scales that may more directly assist in creating hunting and angling opportunities.

Working in conjunction with the Nebraska Game and Parks Commission and researchers from the School of Natural Resources and Nebraska Cooperative Fish and Wildlife Research Unit at the University of Nebraska—Lincoln, we propose to compile and analyze a comprehensive database on license holders and hunter education participants in Nebraska with the goal of helping inform and direct wildlife and fisheries management, as well as recruitment and retention efforts within the state.

Developing a Network for Invasive Species Outreach and Monitoring in Nebraska

Principal Investigator(s):	Craig R. Allen
Graduate Student(s):	Allison Zach
Project Duration:	April 2013 – June 2017
Funding:	Nebraska Environmental Trust U.S. Fish and Wildlife Service
Project Location:	Statewide Nebraska
Website:	Neinvasives.com

The Nebraska Invasive Species Program (NISP) conducts outreach on invasive species to the public, agencies and organizations and conducts aquatic invasive species monitoring throughout the state. The program coordinator travels to conferences throughout the state and works with aquatic invasive species coordinators in surrounding states to coordinate efforts and learn about current invasive species concerns. This project has developed teaching tools for K–12 grade and outdoor education instructors to teach students about invasive species.

Goals are to:

- Decrease the risk of invasive species introduction and spread through volunteer training workshops, and by targeted messaging across multiple user groups.
- Develop and implement a "next generation" invasive species education strategy.
- Evaluate the effectiveness of outreach in invasive species prevention through focused inventory and monitoring as well as through surveys designed to assess awareness.
- Increase local and regional collaboration in the prevention and control of invasive species.

Program staff presented at numerous conferences and meetings throughout the state to public and resource agency audiences on prevention and identification of invasive species. Invasive species identification guides were updated and disseminated to resource agency staff and Master Naturalists to increase invasive species monitoring efforts. The program's website received several reports of invasive species via its reporting page and that information was used to identify new invasive species infestations. Advertisements for Clean, Drain and Dry and don't move firewood were included in Nebraska Game and Parks (NGPC) fishing and hunting guides. Advertisements were placed in community news journals and other NGPC publications in 2016. Curriculum and lesson plans on invasive species were developed and placed on the program's website for download.

Youth creating Asian Long Horned Beetle Rings
Photo by: Allison Zach

In addition, a set of invasive species education cards were developed and will be disseminated to teachers in 2016. A collection of hands–on materials and books on invasive species is now available for checkout by teachers upon request. Technicians conducted boater surveys and participated in outreach events during the summer of 2016.

The NISP coordinator organized monthly meetings of the Nebraska Invasive Species Advisory Council. The program coordinator attended several invasive species conferences in 2015 and 2016 and worked with surrounding state invasive species coordinators on outreach and monitoring efforts.

DYNAMICS OF RESILIENCE IN COMPLEX ADAPTIVE SYSTEMS

Principal Investigator(s):	Craig R. Allen
Graduate Student(s):	Shana Sundstrom, Ph.D.
Project Duration:	August 2012 – May 2017
Funding:	U.S. Geological Survey, Powell Center for Analysis and Synthesis
Project Location:	Northwest United States and Nebraska

Ecosystems are a type of complex system, and as such share general rules of behavior with other types of complex adaptive systems. Research across a wide variety of disciplines has uncovered rules of system dynamics that address features of self–organization and emergence. Work in the field of ecology has proposed that resilience may be an emergent phenomenon of complex adaptive systems, and in particular, social–ecological systems. Resilience is the amount of disturbance a system can absorb or buffer while staying organized around the same key structures, processes, and functions. As our understanding of non–linear dynamics and complex systems has grown in recent years, the concept of resilience has exploded, and a great deal of work has been done to understand how resilience emerges and what system components and interactions comprise resilience.

One of the key findings is summarized in the cross–scale resilience model, which proposes that the distribution of species and the functions they represent within and across the scales of an ecosystem plays a key role in system resilience. While most previous work has been explicitly focused on social–ecological systems, there is some tantalizing evidence to suggest that resilience and the cross–scale model may also be applicable to other types of complex adaptive systems, such as economies.

In a more applied exploration of these ideas, the role of species abundance, coupled with their distribution of function, is an element of the cross–scale model that remains unexplored.

This project has two objectives:

1. Explore the discontinuity hypothesis and cross–scale model in greater detail at both ends of the research spectrum, building the theoretical foundations of the cross–scale model and thus its applicability to other complex adaptive systems, in order to expand our understanding of the cross–scale model to incorporate species' abundances and potentially use it as a tool for resource managers for identifying impending regime shifts.
2. Focus on improving our understanding of the relationship between cross–scale distributions, species abundance, and regime shifts at a system level.

ECOLOGICAL APPLICATIONS OF TIME–LAPSE PHOTOGRAPHY

Principal Investigator(s):	Craig R. Allen, Michael Farrell, Michael Forsberg
Graduate Student(s):	Emma Brinley Buckley, M.S.
Project Duration:	January 2013 – August 2016
Funding:	Institute for Agriculture and Natural Resources, UNL
Project Location:	Central Platte River Basin, Nebraska

The Platte River Basin is one of the most significant river systems in the Great Plains and an internationally important wildlife resource. It demonstrates the complexity, over–appropriation, and importance of a human–dominated ecosystem that sustains many services including water supply for municipalities, agricultural irrigation, recreation, and fish and wildlife habitat. The objective of this project is to connect environmental changes, documented by time–lapse imagery, with bioacoustic data and water quality measurements to further our understanding of ecological variability and communicate complex system changes to a public audience.

Phenology, the timing of biological events and the causes of their timing, is an increasingly valuable component in understanding ecosystems. Our goal is to identify what environmental factors influence wildlife activity and other biological phenomena. We utilized bioacoustic recordings to determine the relative activity of bat, bird and frog species, and time–lapse imagery to quantitatively assess vegetation phenophase, a proxy for primary productivity and, therefore, resource availability. Preliminary findings suggest vegetation is an influential cue for migratory bat species.

Freshwater systems are inherently complex, functioning at varying temporal and spatial scales. We installed passive sensors and collected water samples in the Platte River Basin to measure water quality variables, including nutrients and pesticides. Time–lapse image analysis was used to estimate water–inundation where hydrological information was not available. We assessed variables using a multivariate time–series modeling approach. Models captured temporal dynamics of water quality and revealed the difference in patterns between wetland and river channels.

We are also developing educational tools through the synthesis of time–lapse imagery and data visualization. Videos, stories, and interactive graphics in a new media format will communicate the phenology, water quality dynamics, and importance of the Platte River Basin and our freshwater ecosystems.

Time-lapse, Platte River, NE

ECOLOGICAL MODELS AND BIODIVERSITY CONSERVATION IN NEBRASKA LANDSCAPES

Principal Investigator(s):	Craig R. Allen
Graduate Student(s):	Daniel Uden, Ph.D.
Project Duration:	August 2012 – January 2017
Funding:	Nebraska Game and Parks Commission National Science Foundation IGERT Program
Project Location:	Nebraska

Biodiversity is increasingly threatened by an array of stressors; therefore, sustainable means of satisfying growing human resource demands while protecting the environment and at–risk species must continue to be explored and implemented. The consideration of alternative, plausible futures for, and adaptive management of, social–ecological systems have been promoted for addressing present societal, environmental and ecological challenges; however, the application of these approaches has been met with varying degrees of success at different spatial and temporal scales. Learning from the past, adjusting current strategies according to new findings, and considering alternative plausible scenarios of the future could increase preparedness and improve management outcomes, despite uncertainties.

The Nebraska Natural Legacy Project is a state wildlife action plan that aims at accomplishing the following objectives:

- Reverse declines of at–risk species
- Recover species currently listed as state or federally threatened or endangered
- Keep common species common, and conserve natural communities

The Nebraska Legacy plan identifies thirty–nine Biologically Unique Landscape(s) (BUL) within Nebraska where conservation actions will be specifically targeted. A coarse filter/fine filter approach to conservation has been adopted in the plan, with the goal of benefiting the majority of species by managing at the community (coarse filter) level. Threatened species not encompassed by community–level management are then addressed specifically (fine filter).

This project is developing distribution models for species and/or communities identified as conservation targets within Nebraska BULs, with the goal of integrating modeling into an adaptive management conservation framework for BUL management. Scenarios of 21st century landuse change will also be developed and simulated for selected BULs, in order to increase preparedness and assist decision–making in uncertain futures.

Expected products for BULs include habitat suitability ranks, assessments of functional connectivity for suitable habitat patches, baseline community area and species abundance estimates, identification of locations for focusing additional sampling and monitoring efforts, predicted community distributions and species abundances under an array of plausible management–based scenarios, simulations of future landuse change, evaluation of progress toward accomplishing established conservation objectives, and identification of suitable locations for the reintroduction of extirpated target species. Modeling techniques will be utilized according to data availability and their propriety for addressing specific research questions. Within an iterative framework, conservation objectives, management actions, and modeling techniques may be altered as additional information supporting adjustments are obtained.

EVALUATING THE BENEFITS OF HIGHER DIVERSITY CRP PLANTINGS FOR AT–RISK SPECIES

Principal Investigator(s):	Craig R. Allen
Graduate Student(s):	Hannah Birgé, Ph.D. Bethany Teeters, Ph.D.
Project Duration:	February 2013 – July 2015
Funding:	National Science Foundation IGERT Program Nebraska Game and Parks Commission
Project Location:	Holt County, Nebraska

The Nebraska Legacy Plan lists grassland loss as one of the primary conservation threats in the state. The USDA Conservation Reserve Program (CRP) provides incentives for farmers to take land out of crop production for a 10–15–year period, during which it is frequently planted to grasslands. Land enrolled in CRP covers more than a million acres in Nebraska, but it is planted to a wide range of seed mixes and little is known about how differences in plant diversity and composition may impact faunal biodiversity and conservation threats. This project compared high and low diversity CRP plantings to evaluate potential benefits for at–risk species, including habitat for butterflies, bees and birds, the exclusion of non–native species, and better water infiltration. The collected data from this project may be useful to monitor succession and the impacts of management techniques in future research. Overall, the effect of higher diversity CRP was either neutral or positive, with a few exceptions. The objectives and primary findings were as follows:

- Determine if higher diversity CRP plantings provide habitat and forage for at–risk grassland butterfly species: Higher diversity CRP planting mixes more often contained forage species for at–risk butterflies. CP38 was typically best suited for all species. The exception in all cases was the regal fritillary (*Speyeria idalia*) since no lists contained violets, which are the only source of larval forage.
- Benefits of planting diversity for native bees and at–risk grassland birds: Although bumble bees (*Bombus spp.*) responded positively to forbs in pollinator CRP plantings, the effect of forb diversity on these and other wild bees is likely to change over time as the pollinator plantings become better established at this site. This may also influence at–risk bird species by enhancing nesting suitability and invertebrate forage in high diversity plantings. During this study period, the eastern meadowlark (*Sturnella magna*) was only counted in pollinator plots, for example, and with time other species may also come to nest preferentially in the higher diversity plantings.
- Determine if higher diversity plantings drive changes in soil health and impact the colonization of non–native species: Better infiltration rates were observed in the higher diversity pollinator plantings but it was unclear whether this was an effect of disking, the weedy species of the planting type, or both. Regardless, on these sandy soils a sufficient bulk density for desirable plant growth may only be maintained with disking until the plots are better established. Similarly, although the pollinator plantings had a greater number of non–native species, this may be due to the stage of succession at which the study was done, with weedy species coming in before the deeper–rooted species. Limited spread of invasive and non–native species may be more strongly linked to planting diversity as the pollinator plots become better established. Although this research project has been completed, it has set a foundation for a variety of further work which can explore the role of the successional stages of high diversity CRP plantings.

Sensitive briar

Camphor and Five Point Evening Primrose
Photos: Hannah Birgé

EVALUATING WETLAND CONDITION ACROSS NEBRASKA

Principal Investigator(s):	Craig R. Allen, Ted LaGrange
Graduate Student(s):	Cody Drier, M.S.
Project Duration:	January 2016 – December 2017
Funding:	U.S. Environmental Protection Agency Nebraska Game and Parks Commission
Project Location:	Statewide Nebraska

Starting in 2011, the Environmental Protection Agency (EPA) initiated a program of National Wetland Condition Assessments (NWCA), with repeat sampling every five years. In addition to the National Assessment, Nebraska has participated in conducting an intensification of the project to increase the number of wetlands sampled in Nebraska. In 2011, we sampled wetlands in eleven Biologically Unique Landscapes. For the current 2016 study, the focus has been tightened onto five Biologically Unique Landscapes.

The primary goals of this project are to:

- Evaluate the overall condition of Nebraska wetlands, within five Biologically Unique Landscapes.
- Identify benchmarks for similar wetlands to be compared to in the future.

The 2016 field season started in late May and was concluded in early August. Surveys were conducted at eight national sites, two of which were revisited later in the season, and at 40 Nebraska specific intensification sites. Two Biologically Unique Landscapes were selected for the 2016 intensification: Sandhill Fens in Cherry County and Western Subirrigated Alkaline Meadows in the north west corner of Nebraska. While at each site, personnel analyzed the vegetation, hydrology, soil, water and algae within the assessment area, and the buffer zones around the assessment area. This process will be repeated in 2017 with three additional Biologically Unique Landscapes: Cottonwood–Diamond Willow Woodlands along the Loup Rivers, Eastern Bulrush Deep Marsh Community along the Central Platte, and Freshwater Seeps in north eastern Nebraska.

Botanists Bob Steinauer (left) and Frank Norman (right) evaluating vegetation while Cody Dreier (back) analyzes the buffer
Photo: Autumn Dunn

Cody Dreier determining soil horizons
Photo: Autumn Dunn

Only about 3% of Nebraska wetlands are publically owned, so it can be difficult to assess wetland condition. This study hopes to provide important base line data for managers and landowners regarding both public and private wetlands. With repeat sampling of this project every five years, wetland condition will be tracked and monitored so that they continue to provide a broad suite of ecosystem services.

GENERATION OF NOVELTY IN COMPLEX SYSTEMS

Principal Investigator(s):	Craig R. Allen
Project Duration:	January 2013 – December 2016
Funding:	James S. McDonnell Foundation
Project Location:	Global

Novelty and innovation are essential attributes for the continued success of ecological, social and other complex systems, both natural and anthropogenic. Without them, dynamic, adaptive change in response to disturbance is not possible. Novelty and innovation are required to keep existing complex systems resilient and adaptable, and to create new structures and interactions following catastrophic ecological or social failures. The importance of novelty is recognized in the management and business world, but is less explicitly recognized and appreciated in the scientific world.

Novelty refers to new "products," things or ideas which are generated through innovation, the process whereby novelty is created. Novelty and innovation are characteristic of dynamic systems—systems that are alive and changing—and are generated at multiple levels. For example, in biological systems, novelty is generated at the genetic level through random processes of mutation, at the species level through evolution and natural selection, at the community level as a result of regrouping of species combinations, and at the ecosystem level as a result of changes in key processes and interactions. Novelty is being constantly created, and extinguished. By generating potential solutions in advance of need, solutions may be readily available when problems arise.

Novelty can be either local or global. Locally novel additions are unique to that particular system, but may exist and originate from elsewhere. For example, when a species invades an ecosystem, novelty is added to that system. The invasive species is new to that system, but the species itself is not a novel or new life–form. On the other hand, globally novel additions had no prior existence. They are new not only to the particular system within which they are generated or added, but are globally unique. Speciation in an ecological system represents the addition of global novelty.

Without innovation and novelty, systems may become stagnant. Having a constant source of innovation and novelty is clearly important for systems, both following transformations and during their normal dynamics. However, novelty may be a destructive force as well. Invasive species, for example, can alter basic process and structure in ecosystems and be a source for decline or collapse. Cellular mutations can have obviously destructive consequences upon individuals and lineages—cancer is a prime example. Thus, innovation and novelty can be a double–edged sword. In ecosystems, for example, novelty in the form of new species has been a cause of major extinctions, but is also the prime source for recovery.

To explore the causes and consequences of the generation of novelty and innovation for humans, for social systems and for ecological systems, we will convene a small diverse group of researchers from diverse disciplines, with a variety of approaches and backgrounds, where we believe a deliberate focus on the concept of novelty could be fruitful. Our overall intent is to identify commonalities across disciplines. What attributes of a system are necessary if novelty is to arise? What might be the consequences, both positive and negative, of systems structured to permit novelty and innovation?

GLOBAL CHANGE, VULNERABILITY AND RESILIENCE: MANAGEMENT OPTIONS FOR AN UNCERTAIN FUTURE

Principal Investigator(s):	Craig R. Allen, Dirac Twidwell, David G. Angeler (Swedish University of Agricultural Sciences)
Graduate Student(s):	Jessica Burnett, Ph.D. Caleb Roberts, Ph.D.
Project Duration:	May 2015 – January 2019
Funding:	U.S. Department of Defense—Strategic Environmental Research and Development Program (SERDP)
Project Location:	Nebraska

Our objectives for this new project are to develop models to detect and assess ecological regime shifts in space and time, to identify components of adaptive capacity, and to identify species and techniques that may serve as leading indicators of thresholds of changing ecological regimes. We will utilize monitoring and survey data that is currently available in North America (e.g., Breeding Bird Surveys) with developing and novel statistical tools and theory to assess long–term trends in the resilience of landscapes, changes in ecological regimes in both space and time, and species vulnerable to decline and extinction, with a focus on the management of ecosystems in the Great Plains of the USA.

We will accomplish these goals using advanced spatial and time series modeling, and discontinuity analysis to quantify how core attributes of resilience (within–scale and cross–scale distributions of species and their functional traits) change over time in ecosystems and landscapes. Additionally, we will evaluate the significance of individual species to adaptive capacity, and thus the resilience of ecosystems and landscapes. We will conduct these analyses with data from the central United States with focal areas on Department of Defense managed properties, in particular Eglin Air Force Base, Florida, and Fort Riley, Kansas.

As of August 2016 we have gathered and conducted quality control on existing data from both the Breeding Bird Survey and two U.S. military bases (Eglin Air Force Base, Florida, and Fort Riley Air Force Base, Kansas). We are also collaborating with the Natural Resource Conservation Service (NRCS) to obtain their Natural Resources Inventory (NRI) grazing vegetation dataset for Nebraska to test regime shift detection techniques. We are also testing these techniques' abilities to scale from continental extents (using the North American Breeding Bird Survey data) to local extents (e.g. military bases) using the NRCS NRI data. To facilitate data collection, we conducted site visits to each of these military installations, and worked with their staff biologists and land managers to prioritize site–level goals. We have finalized transcription of code into the R language for calculating Fisher Information metrics about large, multivariate data sets, and have begun analyses in detecting continental regime boundaries and regime shifts in space and time using the Breeding Bird Survey.

HYBRIDIZATION AS A FACILITATING FACTOR IN THE BIOLOGICAL INVASION OF ASIAN CARPS

Principal Investigator(s):	Kevin L. Pope, Guoqing Lu (UNO), Sarah J. Gaughan
Graduate Student(s):	Sarah Gaughan, Ph.D.
Project Duration:	June 2016–present
Funding:	National Science Foundation EAPSI program
Project Locations:	Nebraska, Illinois, and China

There is ample evidence that hybridization stimulates invasiveness in many plant species and some animal species; yet the underlying mechanism remains poorly understood. Many emerging invasive species demonstrate evidence of rapid adaptation, challenging the prevailing prediction of reduced adaptive potential due to low genetic diversity in founding populations. Hybridization may play an essential role in successful invasive radiations by fostering rapid adaptation.
A unique situation has recently occurred throughout the Mississippi River Basin (MRB) in which two sympatric Asian carps (*Hypophthalmichthys nobilis* and *H. molitrix*) are believed to remain genetically isolated within native ranges, but have been observed rampantly hybridizing in the novel MRB environment. Both species exhibit rapid growth, high fecundity, fast age to maturity, and multiple spawns per season, which are characters that are strongly conducive for selection and adaptation, allowing for the maintenance of a strong invasion presence in the MRB. Hybridization is presumably the most effective way for Asian carps to increase genetic variation thereby increasing their potential adaptability to a novel environment. Previous research has described a variety of hybrids within the MRB including F1, F2 and advanced backcrosses (introgression); however, F1 hybrids tend to be far less prevalent. No research has yet determined the causes for the relative scarcity of F1 hybrids, although it may be due to a reduction of fitness or an inability to adapt.

The major project goals of this study are to:

- Determine the extent of hybridization between Asian carps in native environments;
- Assess the fitness of pure and hybrid Asian carps using morphological and genomic approaches, and
- Ascertain the underlying genetic components that make Asian carps successful invaders

Invasive hybrid carp collected at the Kibbe Life Science Station in Warsaw, Illinois
Photo: Sarah Gaughan

Implementing the North American Bat Monitoring Program through Citizen Science in Nebraska

Principal Investigator(s):	Craig R. Allen
Graduate Student(s):	Baxter Seguin, M.S.
Project Duration:	January 2016 – May 2018
Funding:	Nebraska Game and Parks Commission
Project Location:	Statewide Nebraska

Bats are incredibly important to both ecosystems and humans. Their significance is demonstrated through the ecosystem services they provide, which includes seed dispersal, pollination and insect population control. Within states whose economies are largely dependent on agriculture, such as Nebraska, ecosystem services provided by bats are of particular significance. Pest control services alone from bats are valued between $3.7 and $53 billion dollars each year. This is largely because bats are voracious predators of nocturnal insects, including significant agricultural and forest ecosystem pests.

Only a handful of scientists have done extensive research on bats in Nebraska. Those who have been working in the state have provided valuable information, but gaps of knowledge exist. A majority of the work that has been done previously was based on data from net–captured bats, which provides valuable information but net based approaches are logistically constrained to small sample sizes. This project is based on acoustic sampling of all species present. This is especially important now given the impending impacts of wind turbines and White–Nose Syndrome (WNS), which have the potential to negatively affect Nebraska bat populations. The more we are able to understand how Nebraska bats interact with landscape the better we will be able to manage populations and mitigate impacts of development and disease.

North American Bat Monitoring Program (NABat) is a national protocol designed to streamline data collection and encourage collaboration across ecoregions in order to allow for broad understanding of bat ecology, populations, and habitat usage. This project will use NABat to study the full range of bats found in the state of Nebraska, determining the habitat characteristics that influence bat presence and absence across Nebraska using a combination of stationary and mobile ultrasound acoustic detectors. A secondary focus of the project will be to determine the ability of mobile transects to detect shifts in bat population trends. The combined use of stationary points and mobile transects will establish a framework for determining the distribution of bat species across the state. In the second year of the project, citizen scientists will be recruited to collect data in an effort to increase public knowledge of, and involvement in, the study of bat species in Nebraska. In addition to providing data for monitoring and habitat analysis, this study will assess the effectiveness of the NABat program in Nebraska, including an estimate of the time and monetary investment required to conduct bat population monitoring over time. Since beginning our field work on June 1, we have collected data in 29 of the 38 grid cells selected for studying species distribution across the state, and have recorded high levels of bat activity in most locations. Data analysis is commencing and will continue until the end of the project.

Stationary detectors were placed to record habitat characteristics

Deploying a stationary detector in grassland habitat
Photos: Haley Blackwell

MANAGING RED CEDAR INVASION OF NEBRASKA GRASSLANDS

Principal Investigator(s):	Dirac Twidwell, Craig R. Allen
Graduate Student(s):	Brittany Dueker, M.S. Helen Tripp, Ph.D.
Project Duration:	January 2016 – December 2017
Funding:	Nebraska Game and Parks Commission
Project Location:	Statewide Nebraska

The Nebraska Conservation Roundtable lists *Juniperus virginiana* as the leading threat to conservation resources in the state. This recognition stems from clear evidence that juniper invasion is leading to the depletion of numerous ecosystem services across multiple states in the Great Plains. Overwhelming scientific evidence from Kansas, Oklahoma, and Texas documents catastrophic collapses in the biodiversity and abundance of birds, small mammals, and pollinators endemic to grasslands, and woody invasions are a primary reason for the decline and listing of the lesser prairie chicken. Losses in the southern Great Plains therefore provide a cautionary tale for the loss of iconic wildlife species in Nebraska, which is experiencing rapid increases in juniper invasion throughout the state. Collapses in the diversity and abundance of endemic grassland species following transformation to juniper woodland correspond with declines in readily identifiable social–ecological values. Juniper invasions threaten rancher livelihood options. Cattle production declines 75% after a transition from grassland to juniper woodland. Juniper invasion also reduces markedly wildfire suppression potential and has been implicated as a major reason for the increase in the number and size of wildfires at the wildland–urban interface in the southern Great Plains. Thus, managing these alternate regimes is not only important to those vested in maintaining grassland diversity, but also to the interests of the general public and prosperity of private ranchers.

Our goals are to halt the further loss of grassland habitat to invasion by red cedar (*Juniperus virginiana*), to reduce the spread of Juniperus, and to strategically transform Juniper woodlands back to grasslands where warranted. We will assess the vulnerability of Nebraska's Biologically Unique Landscapes (BULs) to Juniperus virginiana invasion, and develop predictive tools that enhance the potential to implement landscape interventions that (i) prevent the spread of juniper trees or (ii) restore degraded wildlife habitat following transformation to a juniper–dominated state. Our approach diverges from past attempts to control cedar by focusing on landscapes rather than land parcels; by using modeling to select where and how to control cedar such that effectiveness is enhanced; and by setting a goal to prevent the net loss of further grasslands to cedar encroachment.

Addressing this challenge requires an intensive programmatic effort that focuses on juniper invasions as a complex social–ecological problem – and where interactions among biophysical, social, and cultural processes dictate system dynamics and outcomes of management interventions. We are assembling a team of researchers, with stakeholder involvement, to determine the landscape and population impacts of these interventions as manifest through landowner groups, with a focus on wildlife, livestock and human/urban safety values. Further, the increasing threat of juniper invasions is a direct result of contemporary changes in land management and the loss of fire as a broad–scale structuring process in Great Plains grasslands. Because of positive reinforcement between invading woody vegetation and structuring processes such as fire, the alternative woody state of former grasslands, once fully degraded, is difficult to reverse. Therefore, active management of landscapes in transition is a valued intervention, but great uncertainty exists regarding aggregate landscape impacts of woody invasions and the relative success of the interventions designed to reverse them. Basic reservations regarding fire and its use are at the forefront of this issue, demonstrating that novel and potentially transformative approaches are needed that build capacity in landowner adoption of prescribed fire.

Outcomes of this project will include:

- Statewide vulnerability assessment of BULs to juniper invasions.
- Statewide assessment of the impact of NGPC interventions and their potential to prevent juniper invasions or restore ecosystems following conversion to juniper woodland (new and ongoing NGPC juniper removal projects will be integrated into this assessment).
- Options and strategies for ceasing the further loss of grasslands to juniper.

- Best approaches to transform invaded landscapes (juniper forests) back to grasslands.
- Response of wildlife habitat and populations (as differentiated from behavioral responses) to landowner/agency intervention activities (e.g. grouse, quail and other grassland birds, elk, American burying beetle and other carrion beetles).
- Changes in livestock production potential and wildfire risk to life/property.
- Spatiotemporal assessment of shifts in community composition and structure, including BUL–level changes in grassland and juniper woodland states.
- Impacts of flexible application of fire (i.e. annual vs. intermittent burning, burning with vs. without grazing deferral) as part of landowner management regimes on wildlife and range resources.
- Landowner adoption of prescribed fire (e.g. as a result of (1) the development of a neighbor–help–neighbor prescribed burn association in the Loess Canyons and (2) a unique cost–share program that sought voluntarily use of prescribed fire following initial mechanical clearing).
- Human dimensions of landowner commitment to intervention following initial agency or cost–share investment.
- Sociopolitical and legal statutes that facilitate juniper invasions, either directly or indirectly, or limit the potential efficacy of landowner intervention practices.
- Enhancement of prescribed fire capabilities and reduction of human injury risks through novel ignition techniques (e.g. building landscapes based on ember transport models, using aerial robotics to enhance landowner prescribed fire capabilities) that will allow more efficient use of limited resources and result in more impacted acres.

MONITORING, MAPPING, RISK ASSESSMENT, AND MANAGEMENT OF INVASIVE SPECIES IN NEBRASKA

Principal Investigator(s):	Craig R. Allen
Coordinator:	Allison Zach
Project Duration:	January 2010 – December 2019
Funding:	Nebraska Game and Parks Commission
Project Location:	Statewide Nebraska
Website:	Neinvasives.com

Funding was provided through a federal–aid grant from the Nebraska Game and Parks Commission to:

- Provide outreach to, and facilitate communication among, stakeholders regarding biological invasions, coordinate the Nebraska Invasive Species Advisory Council, and assist with any additional legislation regarding invasive species as needed.
- Develop management tools including an invasive species adaptive management plan, a risk analysis for high–risk invasive species in Nebraska, a multi–agency prevention protocol for preventing the spread of invasive species (terrestrial and aquatic), and identification of invasive species introduction pathways.

The Nebraska Invasive Species Program continues to coordinate monthly meetings for the Nebraska Invasive Species Advisory Council, which was formalized as a state council through legislation in April 2012. This seventeen–member advisory council discusses topical invasive species issues, develops management plans and Early Detection–Rapid Response (EDRR) plans, builds collaborative partnerships to address priority issues, and informs the Nebraska Legislature of the status of invasive species in the state. An adaptive management plan was written by the Council in 2015 and provided to the Governor and legislative agricultural committee. The Council was instrumental in the passage of a law in 2015 creating an aquatic invasive species prevention program within the Nebraska Game and Parks Commission. EDRR efforts were expanded through identification courses council members provided their own staff and other groups. The council updated the Nebraska weed watch list to identify key species of concern for management efforts. Nebraska Invasive Species identification guides were updated and distributed to the public at outreach events to assist in identifying invasive species and report them via the program's website. The council assisted the program in development in several new brochures to target hunters and boaters to educate them on how to prevent the spread of invasive species. Council members disseminated the brochures at district offices and parks frequented by the public. The program coordinator served on regional boards to coordinate invasive species prevention efforts with surrounding states. The program attended outreach events throughout the state disseminating invasive species prevention materials to the public. Providing these materials to the public can increase reports of new invasive species infestations and increase public knowledge of invasive species to manage. The program coordinator taught students at several events including the outdoor discovery program and the groundwater festival.

2016 lakeside outreach event
Photo: Allison Zach

NOVEL ECOLOGICAL USES FOR UNMANNED AERIAL VEHICLE-UAVS

Principal Investigator(s):	Sebastian Elbaum, Carrick Detweiler, Dirac Twidwell, Craig R. Allen
Graduate Student(s):	TBD
Project Duration:	January 2014 – present
Funding:	In process
Project Location:	Nebraska

We have established a team of ecologists, computer scientists, engineers who have been exploring novel applications of Unmanned Aerial Vehicle (UAV) technology to ecological challenges. A primary application is the use of UAVs to remotely ignite controlled burns to help with management of grasslands, including the reduction of woody invasive species such as eastern red cedar. This particular line of work has led to the development of a prototype UAV. Prototypes have been utilized to initiate internal ignitions in a large prescribed fire in the Loess Canyons of Nebraska, and a very public burn at the National Park Services Homestead National Monument of America. Both applications were successful, and funding has been secured to continue to develop this technology.

Additional uses include the development of a module to remotely sample invasive zebra mussel veligers (larvae). This application was successfully deployed for the first time at Offutt Lake, Offutt Air Force Base, Nebraska. In this case, as with prescribed fire, the development of UAV technology is enabling both more efficient and safe sampling (or burning), where safety is paramount and logistical constraints limit effort.

April 2016 Ignition controlled burn test at Homestead National Monument of America grounds, Beatrice, NE
Photos: Craig R. Allen

RAINWATER BASIN JOINT VENTURE SCIENCE

Principal Investigator(s):	Craig R. Allen, Andy A. Bishop (Rainwater Basin Joint Venture Partnership)
Science Coordinator:	Dana Varner
Project Duration:	October 2014 – June 2017
Funding:	Rainwater Basin Joint Venture
Project Location:	Nebraska

The Rainwater Basin Joint Venture's (RWBJV) mission includes science–based conservation efforts for all priority bird habitats throughout Nebraska's mixed–grass prairie region. The Management Board of the RWBJV is committed to implementing the U.S. Fish and Wildlife Service's Strategic Habitat Conservation model. This science–based model requires a commitment of resources and time to develop a strong biological foundation for delivering conservation planning and designing research and monitoring efforts. To fulfill this commitment, the University of Nebraska–Lincoln hired Dana Varner as the RWBJV Science Coordinator in October 2014. This position is the product of a partnership between the RWBJV, the Nebraska Cooperative Fish and Wildlife Unit, and the University of Nebraska–Lincoln School of Natural Resources, which provides office space and support in Lincoln. Funding for the position is provided by the RWBJV.

As science coordinator, Dana is working with RWBJV science staff to develop models and decision support tools that help identify areas where conservation is most likely to benefit migratory birds and wildlife. She works with partner researchers and scientists to expand the knowledge of the region's conservation needs and to monitor and evaluate the success of completed habitat projects. In addition, Dana helps monitor and evaluate the success of ongoing and past conservation projects and collaborates with researchers from various federal, regional, and state conservation organizations. Dana recently worked with the RWBJV's Conservation Planning Workgroup to complete an updated *Research, Inventory, and Monitoring Plan* which outlines science questions, concerns, and needs within the administrative area. Several projects are currently in progress including an assessment of National Wetland Inventory data, an evaluation of several years of wetland vegetation and management data, and a conservation acquisition prioritization model.

RANGE AND HABITAT USAGE OF NORTHERN LONG–EARED BATS IN NEBRASKA

Principal Investigator(s): Craig R. Allen

Graduate Student(s): Zachary Warren, M.S.

Project Duration: May 2015 – May 2017

Funding: Nebraska Department of Roads

Project Location: Statewide Nebraska

The listing of the Northern Long–Eared Bat (NLEB) as threatened under the U.S. Endangered Species Act in spring of 2015 highlighted the need to better understand the ecology of this species within Nebraska. This project aims to evaluate distribution and habitat usage of the Northern Long–Eared bat throughout the state. This critical information will allow managers and biologists to focus future conservation efforts on areas that will have the greatest positive impact. If federal restrictions are increased in the future, this work will also potentially limit intensive and costly consultations with the US Fish & Wildlife Service to only areas where NLEB is likely to occur, i.e., our results will result in better maps of habitat and geographic range. To achieve our objectives, this project will use a two–step process over the course of two field seasons.

Measuring tree diameter to assess environmental variables
Photo: Zac Warren

The first step of the project, implemented between late–May and Mid–August of 2015, is to better define the actual geographic range of the Northern long–eared bat within Nebraska by conducting statewide surveying. Acoustic detectors that record the echolocations of bats were deployed for six nights in 101 preselected 10km x 10km grids. Because each species of bat emits a unique echolocation, the collected recordings can be analyzed for species presence/non–detection. The acoustic detectors allow for simultaneous large–scale surveying in a variety of habitat types while requiring fewer person–hours compared to the physical trapping of bats. The results from this acoustic survey will be used to model the distribution of NLEB in Nebraska and to better understand the factors that limit occupancy.

In part two of the project, five locations within the Nebraska range were intensively sampled to better determine habitat usage. Forty–six paired detectors are currently being deployed at each of the five study sites. Site measurements taken at the recording locations will provide insight into the factors that contribute to occupancy as well as detection probability of the species.

RIVER OTTER DISTRIBUTION AND ABUNDANCE IN NEBRASKA

Principal Investigator(s):	Craig R. Allen
Graduate Student(s):	Nathan Bieber, M.S.
Project Duration:	May 2014 – December 2016
Funding:	Nebraska Game and Parks Commission
Project Location:	Nebraska

The goal of this research is to provide state furbearer managers with a more complete picture of North American river otter (*Lontra canadensis*) distribution in the state of Nebraska so that they may be better equipped to make management decisions regarding the conservation status and harvest potential of this species in the state. River otters were extirpated in Nebraska by the early 1900s, and reintroduction efforts in the 1980s have been successful. Recently completed work documented the density of river otters in the Central Platte River, and their habitat use, but was of limited geographic extent. This current project specifically aims to determine current distribution of river otters in Nebraska and to identify patterns of otter occupancy.

Two field seasons were dedicated to surveying more than 1,600km of Nebraska's rivers for otter sign. Sign was documented on the Niobrara, Elkhorn, Platte, Loup, and Cedar rivers. Two techniques were used to estimate otter distribution and occurrence patterns throughout Nebraska.

- Presence–absence data from sign surveys and data on environmental characteristics throughout the study area were used in occupancy models to estimate the likelihood of otter occupancy across the state's larger rivers. This method suggested that the central and eastern Niobrara, Elkhorn, Platte, eastern Republican, and southern reaches of the Loup River system were most likely to be occupied.

- Presence–only data were provided by the Nebraska Game and Parks Commission, which came from more than 35 years of incidental harvest reports from fur trappers and confirmed reports from around the state. These data were used in maximum entropy models to examine patterns in otter distributions. The areas identified as being most suitable for otters using this technique were on the Platte River, one section each of the western and eastern Niobrara, the southern reaches of the Loup River system, the northern Elkhorn River, and a small section of the Big Nemaha River near the Missouri convergence.

Stopover Decisions of Migratory Shorebirds: An Assessment of Habitat, Food, Behavior and Phenology

Principal Investigator(s):	Joseph J. Fontaine, Susan K. Skagen (USGS Fort Collins Science Center), Ted LaGrange (NGPC), Elizabeth B. Webb (Missouri Cooperative Fish and Wildlife Unit), Andy A. Bishop (Rainwater Basin Joint Venture)
Graduate Student(s):	Ryan Stutzman, M.S. (2012) Caitlyn Gillespie, M.S. (2015)
Project Duration:	January 2010 – October 2016
Funding:	U.S. Geological Survey, National Climate Change and Wildlife Science Center Rainwater Basin Joint Venture Great Plains Landscape Cooperative
Project Location:	Nebraska, North Dakota, South Dakota
Website:	Prairiebirds.unl.edu

The wetlands of the Great Plains are increasingly altered by anthropogenic change, but remain important stopover habitats for a variety of migratory birds, including 37 species of shorebirds. Although shorebirds use highly altered wetlands, the extent to which these habitat decisions represent true preference and are adaptive remains unclear.

To identify the influence of anthropogenic change on avian habitat preferences, surveys were conducted for migrating shorebirds from April to June of 2010 and 2011 in north–central South Dakota. Our results show that shorebirds prefer highly–altered, agricultural wetlands, which have lower invertebrate (food) abundance than do grassland wetlands. However, by examining migrant behavior, we were able to determine that individuals have a higher foraging rate and search effort at preferred habitats, indicating that foraging efficiency, rather than food availability, is the limiting factor in this system.

Caitlyn Gillespie banding shorebirds in the Rainwater Basin
Photo: Joseph J. Fontaine

We also examined the influence of local phenology on shorebird migration to identify the potential sensitivity of migratory timing to climate change. We found that shorebird migration coincides with invertebrate food resources, indicating that migrants may be sensitive to climate–driven changes in food resource phenology.

Based on the findings from this initial study, we began to assess how larger landscape attributes affect stopover decision processes and the corresponding physiological implications. In the springs of 2013 and 2014, Caitlyn Gillespie began monitoring shorebird migratory patterns through the Rainwater Basin of south–central Nebraska as well as the southern Prairie Pothole Region of South Dakota. Her findings suggest that the availability and distribution of wetlands in the landscape plays a role in shaping stopover decisions.

THE SOCIAL–ECOLOGY OF AN INTENSIVELY MANAGED ECOSYSTEM: PHEASANTS AND PHEASANT HUNTERS IN SOUTHWEST NEBRASKA

Principal Investigator(s):	Joseph J. Fontaine
Project Manager(s):	Adela Annis
Graduate Student(s):	Jessica Laskowski, M.S. (2014) Lindsey Messinger, M.S. (2015)
Project Duration:	January 2012 – May 2019
Funding:	Nebraska Game and Parks Commission
Project Location:	Southwestern Nebraska
Website:	Prairiebirds.unl.edu

Ring–necked pheasants (*Phasianus clochicus*) are a culturally and economically important game species. Across the Midwest agroecosystems have historically served as important habitat for pheasants, but the intensification of agricultural has significantly altered the landscape resulting in a long–term decline in pheasant populations. The Conservation Reserve Program (CRP) has helped to mitigate habitat loss and slow the rate of population decline, but enrollment in CRP is declining. Given the importance of pheasants to Nebraska, managers are interested in developing programs that will continue to support pheasant populations while ensuring hunting opportunities.

In southwest Nebraska, the Nebraska Game and Parks Commission has been intensively managing for pheasant habitat and pheasant hunting opportunities with the goal of producing the best pheasant hunting experience for the most hunters. Starting in 2012 we began to monitor pheasants and pheasant hunters in the region to better understand how pheasants use managed agroecosystems, how hunters perceive and use public access, and how pheasants and pheasant hunters interact.

Since the start of the project we have captured and radio collared hundreds of pheasants and recorded thousands of locations on where pheasants are roosting, eating, loafing and nesting. At these locations we have collected information on vegetation characteristics, climatic conditions, and food resources to understand the ecological needs of pheasants. To understand changing population dynamics, we monitor the survival of pheasants throughout the year and each spring we monitor 20–70 nests collecting information on reproductive investment and success. We also monitor seasonal movements of pheasants and responses to management and regulations such as the opening of the hunting season or wheat stubble management. In addition to monitoring pheasants we are collecting information on hunter movements and harvest to understand how hunters interact with pheasants in the field.

The findings from this study are helping us to understand the complex dynamics between how uncontrollable factors such as weather interact with habitat and harvest management to affect pheasant population dynamics in an intensively managed ecosystem.

Pheasant hunting, southwest Nebraska
Photo: Jessica Laskowski

Radio collared hen pheasant
Photo: Lyndsie Wszola

USE AND SATISFACTION OF PUBLIC HUNTING OPPORTUNITIES

Principal Investigator(s):	Joseph J. Fontaine
Project Manager(s):	Lindsey Messinger Michael Winkler
Graduate Student(s):	Lyndsie Wszola, M.S.
Project Duration:	January 2010 – December 2016
Funding:	Nebraska Game and Parks Commission
Project Location:	Statewide Nebraska
Website:	FishHunt.unl.edu

The retention and recruitment of hunters is of increasing concern to wildlife management agencies nationwide. A lack of access to quality hunting opportunities is often deemed as the primary reason why people quit hunting. In an effort to provide hunting opportunities for their constituency, the Nebraska Game and Parks Commission (NGPC) invests considerable time and resources into the development and management of public Wildlife Management Areas and private lands open to public access through the Open Fields and Waters Program. Although investment in these programs is assumed to fulfill the needs of the hunting community, evaluating the use of public or private land by hunters, and their overall satisfaction with the hunting experience is challenging. Currently, the majority of hunter participation, satisfaction, and harvest data are collected at coarse spatial and temporal scales, through post season surveys. Unfortunately, this data does not provide the preferred resolution needed to appropriately manage individual Wildlife Management Areas or Open Fields and Waters sites. Moreover, it does not allow managers to assess the value of their investment in particular lands. Given the limited resources available for wildlife management, managers need a better understanding of hunter participation at the scales for which management actions occur if they are expected to manage lands appropriately. The integration of research methods from fisheries and human dimensions will allow for fine–scale spatial and temporal data to be collected using proven methodology. Incorporation of fine–scale spatial and temporal patterns in hunter participation will help managers better determine appropriate site–specific management objectives given the dynamic nature of hunter participation.

A pheasant hunter being interviewed in the Rainwater Basin
Photo courtesy of NEBRASKALand Magazine

Further, fine–scale spatial and temporal patterns in hunter participation can be used to develop regional management approaches that consider the dynamic nature of hunter participation. Hunters often move among multiple sites within a region. The geographic distribution of alternative hunting locations, the respective availability of game, and the overall quality of the hunting experience plays a critical role in how people perceive and participate in outdoor recreation. Thus the effect of hunting and hunter participation on wildlife populations, hunter recruitment and retention, and local economies is likely acting at multiple scales that are currently not considered when managing wildlife resources. This regional understanding of hunter participation and satisfaction could be a considerable aid in guiding NGPC investments in public land acquisition and private land initiatives such as the Open Fields and Waters Program.

WILD BEE ASSEMBLAGES OF THE SOUTHEAST PRAIRIES BIOLOGICALLY UNIQUE LANDSCAPE

Principal Investigator(s):	Craig R. Allen, Chris Helzer (The Nature Conservancy)
Graduate Student(s):	Bethany Teeters, Ph.D.
Project Duration:	June 2009 – December 2015
Funding:	National Science Foundation IGERT Program Nebraska Game and Parks Commission
Project Location:	Southeastern Nebraska

The Southeast Prairies Biologically Unique Landscape (BUL) is part of the Southeast Nebraska Flagship Initiative (a partnership that includes The Nature Conservancy, Northern Prairies Land Trust, Spring Creek Prairie Audubon Center and the Nebraska Game and Parks Commission) which, under the Nebraska Natural Legacy Plan, implements a proactive approach to conserving non–game wildlife and biological diversity. In the Southeast Prairies BUL the overall goal is to determine how to best manage prairies while maintaining plant–insect relationships crucial for system functioning. More specifically, although previous work included taxa such as ground beetles and ants, the most recent and final project focused on wild bee abundance and diversity in grasslands of the BUL with the following objectives:

- Determine whether wild bee assemblages differ among grassland types: The dominant three types of grasslands in the BUL— remnant prairie, grazed pasture, and CRP plantings—were sampled and bee abundance, species richness, and diversity measured. Species were also categorized by sociality, foraging capacity, nesting behavior, and floral specificity.
- Examine the importance of local habitat quality to the wild bee community: The species richness, abundance, and density of blooming forbs were measured at each study site and correlations to bee species richness, abundance, and diversity were tested. The number of pollen types found on collected bees was also measured to make comparisons between grassland types and to examine similarities to the local blooming forb communities.
- Examine the importance of landscape composition to the wild bee community: The number of land cover types within four foraging ranges of the wild bee community were determined and assigned a habitat suitability score. Several habitat connectivity measurements were calculated for suitable nesting and foraging patches that lay within each foraging range. The importance of each land cover type and connectivity measure were examined and used for modeling the abundance distributions of important bee groups across the whole BUL.

All field work has been completed on this project and analyses thus far have revealed the importance of blooming forb abundance for most groups of wild bees, but varying importance of suitable nesting habitats between groups. The scale at which landscape attributes are most influential on the bee community largely corresponds to the estimated foraging capacities of the bees. Finally, upon completion of modeling bee abundance across the landscape, areas where connectivity of suitable habitat patches could be improved are being identified to aid in conservation efforts for pollination services.

A Male bumble bee (*Bombus griseocollis*) on goldenrod (*Solidago canadensis*)
Photo: Bethany Teeters

WORKING WITH RURAL STUDENTS TO DOCUMENT SWIFT FOX ON NEBRASKA RANCHES

Principal Investigator(s):	Joseph J. Fontaine, Jenny M. Dauer, Teresa J. Frink (Chadron State College)
Project Coordinator(s):	Claire Helmke
Post–Doctoral Associate:	Michelle Lute
Graduate Student(s):	Lucía Corral, Ph.D.
Project Duration:	July 2015 – July 2018
Funding:	Nebraska Environmental Trust
Project Location:	Western Nebraska
Website:	Swiftfox.unl.edu

The loss and alteration of native grasslands has resulted in significant reductions in habitat availability for grassland obligate species such as the swift fox (*Vulpes velox*). Identified as a Tier 1 at–risk species, swift fox are estimated to occupy 21% of their historic range, but the exact distribution and relative health of swift fox populations in Nebraska remains in question. The Nebraska Game and Parks Commission (NGPC), the Nebraska Department of Roads (NDOR), and the U.S. Forest Service (USFS), in collaboration with the University of Nebraska–Lincoln (UNL) and Chadron State College (CSC) have begun an effort to document the occurrence of swift fox and identify the anthropogenic and ecological factors that limit their distribution. However, in a state which is 97% privately owned, such an endeavor is extremely challenging because access to land ultimately limits inference about swift fox populations and thereby management efficacy.

Using a unique approach which incorporates landowners in the conservation process we are sending undergraduate students back to their family ranches to survey for swift fox. Many students in range management, wildlife biology, and similar conservation majors at CSC and UNL are from working ranches in Western Nebraska, which presents us with a unique opportunity to allow students to realize their conservation interests on their family lands and assist NGPC, NDOR, and USFS in facilitating the conservation of a Tier 1 species. Our project is training students and working with them to set camera 'traps' on their family lands each spring and fall. By surveying for swift fox on private lands we are adding significantly to our understanding of what is limiting this rare species in Nebraska; moreover, because camera traps attract a multitude of species we are documenting and thereby aiding in the management of other species of conservation concern here in Nebraska.

Lucía Corral teaching students at Chadron State College how to use trail cameras
Photo: Teresa Frink

PROFESSIONAL ACTIVITIES

TEACHING

CRAIG ALLEN

Spring 2016: Landscape Ecology of Biological Invasions

Landscape ecology is a bridge between applied and basic ecology, which investigates the influence of spatial heterogeneity and pattern: how to characterize patterns, how they develop and change through time, and the implications for populations, communities, and ecosystem processes. Landscape ecology explicitly considers spatial (as well as temporal) relationships among diverse ecological phenomena. Topics for this graduate level class focus on analysis of landscape factors that may affect or predict biological invasions.

JOSEPH FONTAINE

Fall 2015 and Spring 2016: Trends in Ecological Applications

This course focuses on current research in applied ecology by exploring and developing the current research programs of participating students. Through this course, students learn to develop and communicate their research by placing their questions within the scope of current ecological research.

KEVIN POPE

Spring 2016: Quantitative Fishery Assessment

This course provided information necessary to address scientific and management questions. It was designed to increase students' understanding of current fishery assessment practices. Emphasis was placed on quantitative assessments of populations (e.g., recruitment, growth, and mortality), communities (predator–prey interactions) and ecosystems (biostressors). At the completion of this course, students were able to apply current quantitative methods used in fishery data analysis, effectively communicate statistical ideas, and critique scientific studies—in particular, to identify strengths and weaknesses of statistical assessments.

GRADUATE COMMITTEE SERVICE

CRAIG ALLEN

- Bruce Stephen (Ph.D., School of Natural Resources, UNL)
- Julianne Matczyszyn (Ph.D., Department of Agronomy, UNL)
- Tonya Haigh (Ph.D., School of Natural Resources, UNL)
- Sophia Renes (Ph.D., Swedish University of Agricultural Sciences, Uppsala)

JOSEPH FONTAINE

- Nick Cole (Ph.D., School of Natural Resources, UNL)
- Teresa Ely (M.S., School of Biological Science, UNL)
- Alexis Fedele (M.S., School of Natural Resources, UNL)
- Brian Harmon (M.S., School of Natural Resources, UNL)
- Abigail Neyer (Ph.D., School of Biological Science, UNL)

KEVIN POPE

- Christina Edholm (Ph.D., Department of Mathematics, UNL, graduated August 2016)
- Alexis Fedele (M.S., School of Natural Resources, UNL)
- Jeremy Hammen (Ph.D., School of Natural Resources, UNL)
- Ryan Ruskamp (M.S., School of Natural Resources, UNL)
- Stephen Siddons (M.S., School of Natural Resources, UNL, graduated December 2015)
- Jonathan Spurgeon (Ph.D., School of Natural Resources, UNL)
- Shana Sundstrom (Ph.D., School of Natural Resources, UNL)
- Dylon Turner (M.S., School of Natural Resources, UNL)

Professional and Faculty Service

Craig Allen

- Nominated, Ecosystem Sciences working group of the NOAA Science Advisory Board
- Member, USGS Sustainability and Resilience Working Group
- Member, USGS Landscape Ecology Working Group
- Core Member, Natural Resources Climate Planning, Nebraska Climate Roundtable
- Member, scientific advisory team, integrating landscape ecology into USGS. (Serving the Senior Executive Service Subcommittee on Ecological Systems)
- Special Feature Editor, Journal of Environmental Management, Adaptive Management for Ecosystem Services

Joseph Fontaine

- Assistant Secretary, Cooper Ornithological Society
- At large representative. Editorial Advisory Board, The Wildlife Professional, The Wildlife Society
- Vertebrate Ecologist Search, University of Nebraska
- Spatial Ecologist Search, University of Nebraska
- Associate Editor, Proceedings of the 8th Quail Symposium
- Local committee, 2016 NBCI Annual Meeting, Lincoln, NE
- Scientific committee, 2017 Midwest Fish and Wildlife Conference, Lincoln, NE
- Local committee, 2017 NAAG Annual Meeting, Lincoln, NE

Mark Kaemingk

- Special Committee, Education Requirements, American Fisheries Society
- Reviewer, North American Journal of Fisheries Management, Transactions of the American Fisheries Society

Kevin Pope

- Book Editorial Advisory Board. American Fisheries Society
- International Scientific Advisory Committee, 8th World Recreational Fishing Conference
- USGS Representative, Reservoir Fisheries Habitat Partnership

Other Professional Service

Hannah Birgé

- Co–Organizer. Association for Women in Science (AWIS) Mentoring Workshop
- Guest Editor. *Journal of Environmental Management* Special Feature
- Member. University of Nebraska–Lincoln's Complexity Science Working Group
- Member. National Socio–Environmental Synthesis Center Adaptive Governance Working Group
- Member. The Nature Conservancy NE Chapter, Climate Change Policy Working Group
- Treasurer. School of Natural Resources Graduate Student Association Treasurer, 2013–2016

Becca Bevans

- Committee member. Majors Evaluation Committee, School of Natural Resources, spring 2016

Jessica Burnett

- Contributing member. Inclusive Ecology Section, Ecological Society of America (ESA)
- Founder & President. Natural Resources Diversity Initiative, University of Nebraska–Lincoln
- Member. University of Nebraska–Lincoln Complexity Science Working Group
- Member. Faculty Search Committee for Urban and Community Forester position, School of Natural Resources, University of Nebraska–Lincoln
- Reviewer: Wilson Journal of Ornithology
- Seminar Coordinator. Fall 2016 School of Natural Resources (duties began in May 2016), University of Nebraska–Lincoln
- Student Liaison. Urban Ecosystem Ecology Section, Ecological Society of America (ESA)

Caryl Cashmere

- Member. School of Natural Resources Social Committee, 2015–2017
- Fisheries Ecologists Search, University of Nebraska–Lincoln
- Administrative Assistant Search, University of Nebraska–Lincoln

Lucia Corral

- Member. Fisheries Ecologist Search, University of Nebraska–Lincoln
- Member. Spatial Ecologist Search, University of Nebraska–Lincoln
- Member. Vertebrate Ecologist Search, University of Nebraska–Lincoln

Valerie Egger

- Editor. USGS *Coop Catch–up* newsletter

Caroline Jezierski

- Member. Staff Advisory and Professional Development Committee, 2015–2016

Lindsey Messinger

- Secretary. Early Career Professional working group for The Wildlife Society
- Co–chair Education Committee. Nebraska Chapter of The Wildlife Society
- Central Mountains and Plains Section representative. Editorial Advisory Board, The Wildlife Professional, The Wildlife Society
- Board member at large. Central Mountain and Plains Section of The Wildlife Society
- Fisheries Ecologist Search, University of Nebraska–Lincoln
- Spatial Ecologist Search, University of Nebraska–Lincoln

Caleb Roberts

- Student Coordinator. Range & Forage Group, University of Nebraska–Lincoln

Erica Stuber

- UCARE Grant application evaluator, University of Nebraska–Lincoln
- SNR poster contest judge, University of Nebraska–Lincoln

Dan Uden

- Manuscript reviewer. African Journal of Environmental Science and Technology, Biological Invasions, Ecological Indicators, Ecology and Society, and Plos One

Zac Warren

- Representative. UNL Graduate Student Association

Training Assistance, Workshops and Outreach Activities

Craig Allen

- Co–instructor. Over–the–water training, March & April 2016, Lincoln, NE

Hannah Birgé

- Served as thesis adviser to an Environmental Studies senior on a project entitled *Ecosystem service tradeoffs at Lincoln, NE city parks*, spring 2016, Lincoln, NE

Jessica Burnett

- Co–founder. Affiliate Chapter of the Association for Women in Science, University of Nebraska–Lincoln
- Co–organizer. Association for Women in Science (AWIS) Mentoring Workshop
- Founder & President. Natural Resources Diversity Initiative, University of Nebraska–Lincoln

Caryl Cashmere

- Presenter. UNL Forms and Processes, Statewide Creel Clerk Workshop, March 2016, Lincoln, NE
- Presenter. UNL Forms and Processes, Hunter Survey Clerk Workshop, August 2016, Lincoln, NE

Nick Cole

- Judge. FFA District Career Development Event, Savannah, MO
- Judge. National Junior Academy of Science State Science Fair, Ashland, NE
- Instructor. NRES 450 Biology of Wildlife Populations Laboratory section, spring 2016
- Mentor. Environmental Science and Evolution student at Central Missouri State University

Joseph Fontaine

- Co–instructor. Over–the–water training, March and April 2016, Lincoln, NE

Mark Harmon

- Volunteer. Public outreach, conservation education, scuba diving of aquarium exhibits, Henry Doorly Zoo and Aquarium, Omaha, NE

Kevin Pope

- Instructor. Over–the–water training, March & April 2016, Lincoln, NE

Dan Uden

- Teaching assistant. Vertebrate Population Analysis. Spring 2016, University of Nebraska–Lincoln

Zach Warren

- Co–presented with M. Miller. STEMing into the future. Bat Education and Outreach. September 2015. Nebraska State Fair, Grand Island, NE
- Co–presented with M. Whitby. *Bats!* January 2016. Izaak Walton League Annual meeting
- Presented, *Helping bats help you.* Nebraska Cattlemen Summer Grazing, June 2016, Tour, Barta Brother's Ranch, Rose, NE
- UNL Master Gardeners, *Bats!* July 2016. Lancaster Youth Services Center, Lincoln, NE

Allison Zach

- Instructor. Aquatic invasive species identification workshop, Creel Clerk Training, March 2016, Lincoln, NE
- Facilitator. Invasive species crafts at Nature Nights, spring 2016, various locations in Lincoln, NE
- Facilitator. Outreach booth at Carp–O–Rama, summer 2016, various locations
- Facilitator. Outreach Booth at Family Fishing Nights summer 2016, various locations
- Facilitator. Outreach booth at Nebraska Game and Parks Outdoor Expo, spring 2016, Kearney, NE
- Facilitator. Outreach Booth at fishing tournaments, summer 2016, various locations
- Facilitator. Outreach Booth at NESCIFEST, April 2016
- Facilitator. Outreach/Education booth. Lincoln Earth Day, April 2016, Lincoln, NE
- Presenter. Outdoor Discovery Program, spring 2016, Platte River State Park and Kearney, NE
- Presenter. Sunday with the Scientist, July 2016, Lincoln, NE
- Presenter. Invasive species technician training, May 2016, Lincoln, NE

Peer–Reviewed Publications

Allen, C.R., D.G. Angeler, C. Folke, D. Twidwell, D. Uden, and G. Cumming. 2016. Quantifying spatial resilience. *Journal of Applied Ecology* 53: 625–635.

Allen, C.R., D.G. Angeler, J.J. Fontaine, A.S. Garmestani, N.M. Hart, K.L. Pope, and D. Twidwell. In press. Adaptive Management of Rangeland Ecosystems. Pages XX in Briske, D., *Management of Rangelands.* Springer.

Allen, C.R., H.E. Birgé, S.L. Bartelt–Hunt, R.A. Bevans, J.L. Burnett, B.A. Cosens, X. Cai, A.S. Garmestani, I. Linkov, E.A. Scott, M.D. Solomon, and D.R. Uden. In press. Avoiding decline: Fostering resilience and sustainability in midsize cities. *Sustainability.*

Allen, C.R., A.S. Garmestani, and D.G. Angeler. 2016. Resilience. In Wohl, E., (Ed.), *Oxford Bibliographies in Environmental Science*. Oxford University Press, New York. DOI: 10.1093/obo/9780199363445–0048.

Allen, C.R. and J.J. Fontaine. 2016. Employment with the United States Geological Survey. Pages XX in Henke, S. (Ed.), Becoming a Wildlife Professional. *Johns Hopkins University Press* and *The Wildlife Society*.

Allen, C.R., J. Slater, E. Wiggers, and H.E. Birgé. In press. The invasive ant Solenopsis invicta, reduces herpetofauna richness and abundance. *Biological Invasions.*

Angeler, D.G. and C.R. Allen. Quantifying resilience. 2016. *Journal of Applied Ecology* 53: 617–624.

Angeler, D.G., C.R. Allen, C. Barichievy, T. Eason, A. Garmestani, N.A.J. Graham, D. Granholm, M. Knutson, K. Nash, R.J. Nelson, M. Nystrom, T. Spanbauer, C. Stow, S.M. Sundstrom. In press. Management applications of discontinuity theory. *Journal of Applied Ecology* 53: 688–698.

Angeler, D.G., C.R. Allen, A.S. Garmestani, L.H. Gunderson, O. Hjerne, and M. Winder. 2015. Quantifying the adaptive cycle. *PLoS ONE* 10(12): e0146053. DOI:10.1371/journal.pone.0146053.

Angeler, D.G, S.M. Sundstrom, and C.R. Allen. 2016. Deathcore, creativity, and scientific thinking. *Research Ideas and Outcomes* 2: e8867.

Beachly, E., J. Higgins, C. Laney, S. Elbaum, C. Detweiler, C.R. Allen, and D. Twidwell. In press. A micro–UAS to amplify fire ignition capabilities and safety. *International Symposium on Experimental Robotics*.

Birgé, H.E., C.R. Allen, D.G. Angeler, S.G. Baer, R.A. Bevans, and D.H. Wall. In press. Adaptive management for soil ecosystem services. *Journal of Environmental Management*.

Birgé, H.E., R.T. Conant, R.F. Follett, M.L. Haddix, S.J. Morris, S.S. Snapp, M.D. Wallenstein, and E.A. Paul. 2015. Soil respiration is not limited by reductions in microbial biomass during long–term soil incubations. *Soil Biology and Biochemistry* 81:304–310. DOI:10.1016/j.soilbio.2014.11.028.

Birgé, H.E., K. Pope, A. Garmestani, and C.R. Allen. In press. Adaptive management for ecosystem services. *Journal of Environmental Management.*

Breeggemann, J.J., M.A. Kaemingk, A.P. Letvin, J.R. Krause, T.M. Stevens, T.J. DeBates, C.P. Paukert, D.W. Willis, and S.R. Chipps. 2016. Potential direct and indirect effects of climate change on a shallow natural lake fish assemblage. *Ecology of Freshwater Fish* 25:487–499.

Burnett, J.L., C.R. Allen, M.B. Brown, M.P. Moulton, and C.P. Roberts. In press. Passer montanus (Eurasian Tree Sparrow) range expansion in North America. *Biological Invasions.*

Burnett, J.L. and M.P Moulton. 2015. Recent trends in House Sparrow (*Passer domesticus*) distribution and abundance in Gainesville, Alachua County, Florida. *Florida Field Naturalist* 43(4):167–172.

Burnett, J.L. and K.E. Sieving. Accepted with minor revisions. Songbird distress call as a detection enhancement method and application to Red–shouldered Hawks (*Buteo lineatus*). *Florida Field Naturalist.*

Chaffin, B.C., A.S. Garmestani, D.G. Angeler, D.L. Herrmann, C.A. Stow, M. Nyström, J. Sendzimir, M.E. Hopton, J. Kolasa, and C.R. Allen. In press. Biological invasions, ecological resilience and adaptive governance. *Journal of Environmental Management.*

Chaffin, B.C., A.S. Garmestani, L.H. Gunderson, M.H. Benson, D.A. Angeler, C. Arnold, B. Cosens, R.K. Craig, J.B. Ruhl, and C.R. Allen. In press. Transformative environmental governance. *Annual Review of Environment and Resources* .

Craig, R.K., A.S. Garmestani, C.R. Allen, C.A. Arnold, H.E. Birgé, D. DeCaro, A.K. Fremier, H. Gosnell, and E. Schlager. In press. Balancing stability and flexibility in adaptive governance: The new challenges and a review of tools available. *Ecology and Society*.

DeBoer, J.A., and K.L. Pope. In press. Factors influencing recruitment of walleye and white bass to three distinct early ontogenetic stages. *Ecology of Freshwater Fish*.

DeBoer, J.A., C.M. Webber, T.A. Dixon, and K.L. Pope. 2016. The influence of a severe reservoir drawdown on springtime zooplankton and larval fish assemblages in Red Willow Reservoir, Nebraska. *Journal of Freshwater Ecology* 31:131–146.

DeWitte, S.N., M.H. Kurth, C.R. Allen, and I. Linkov. In press. Disease epidemics: Lessons for resilience in an increasingly connected world. *Journal of Public Health.*

Fontaine, J.J., R.J. Stutzman, and L.Z. Gannes. 2015. Leaps, chains, and climate change for western migratory songbirds. Pages 3–15 in E.M. Wood and J.L. Kellermann (Eds.), *Phenological synchrony and bird migration: changing climate and seasonal resources in North America*. Studies in Avian Biology Series (no. 47). CRC Press, Boca Raton, FL. ISBN: 978–1–4822–4030–6

Hodbod, J., O. Barreteau, C.R. Allen, and D. Magda. In press. Managing adaptively for multifunctionality in agricultural systems. *Journal of Environmental Management.*

Kaemingk, M.A., J.C. Jolley, C.P. Paukert, D.W. Willis, K. Henderson, R.S. Holland, G.A. Wanner, and M. Lindvall. In press. Common carp disrupt ecosystem structure and function through middle–out effects. *Marine and Freshwater Research.*

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Uden, D.R., C.R. Allen, A.A. Bishop, R. Grosse, C.F. Jorgensen, T.G. LaGrange, R.G. Stutheit, and M.P. Vrtiska. 2015. Predictions of future ephemeral springtime waterbird habitat availability under global change. *Ecosphere* 6(11):215. http://dx.doi.org/10.1890/ES15–00256.1.

PRESENTATIONS

Allen, C.R., D.R. Uden, M.L. Hellman and D.G. Angeler. December 2015. The contribution of reserves and anthropogenic habitat for functional connectivity and resilience of ephemeral wetland networks. American Geophysical Union Fall Meeting, San Francisco, California.

Annis, A.C. and J.J. Fontaine. August 2016. The carryover effects of hunting pressure on Ring–necked Pheasant nest site selection and egg volume. Annual meeting of the Central Mountains and Plains Section of The Wildlife Society, Steamboat Springs, Colorado.

Bieber, N.R. March 2016. The Nebraska River Otter: A Conservation Success Story. The Nebraska Chapter of the Wildlife Society Conference, Kearney, Nebraska.

Birgé, H.E., C.R. Allen, A. S. Garmestani, and K.L. Pope. September 2016. A cross–scale framework for analyzing ecosystem services. 13th Annual Conference on Complex Systems, Amsterdam, Netherlands.

Birgé, H.E., C.R. Allen, A.S. Garmestani, and K.L. Pope. July 2016. Adaptive management for ecosystem services. Gordon Research Seminars: Unifying Across Ecological Scales, Biddeford, Maryland.

Birgé, H.E., C.R. Allen, D. Twidwell. April 2015. Not all disturbances are created equal. American Association of Geographers Annual Meeting, Chicago, Illinois.

Burnett, J.L. November 2015. "On the once–ubiquitous House Sparrow in North America". Nebraska Invasive Species Council meeting, Lincoln, Nebraska.

Burnett, JL, C.R. Allen, C.P. Roberts, D.R. Twidwell, and A.J Tyre. August 2016. "Detecting and predicting broad–scale regime shifts using the Breeding Bird Survey data". North American Ornithological Congress VI., Washington, D.C.

Clapp, D.F., T.L. Galarowicz, J. Clevenger, E. Martin, M.A. Kaemingk, and K.E. Wehrly. January 2016. Visionary Michigan fisheries biologists: Carl Latta, Herb Lenon, and 60+ years of smallmouth bass research in northern Lake Michigan. 76th Annual Midwest Fish and Wildlife Conference, Grand Rapids, Michigan. *Legends and Legacies of Michigan's Fishery Research and Management Heritage Symposium.*

Cole, N.W., C.J. Chizinski, and K.L. Pope. February 2016. The seasonal impact of weather on recreational waterbody use. Joint Meeting between Kansas and Nebraska Chapters of the American Fisheries Society, Manhattan, Kansas.

Cole, N. W., A. D. Fedele, C. J. Chizinski, and K. L. Pope. 2016. Simulating behavioral feedbacks between human predators and fish in a recreational fishery. Animal Behavior Society Conference, Columbia, Missouri.

Cole, N.W., A.D. Fedele, C.J. Chizinski, and K.L. Pope. August 2015. Individual–based model describes behavioral feedbacks between anglers and sportfish. 145th Annual Meeting, American Fisheries Society, Portland, Oregon.

Cole, N. W., A. D. Fedele, C. J. Chizinski, and K. L. Pope. August 2016. Individual–based model describes behavioral feedbacks between anglers and sportfish. National American Fisheries Society Meeting. Kansas City, Missouri.

Cole, N.W., A.D. Fedele, C.J. Chizinski, and K.L. Pope. July 2016. Simulating behavioral feedbacks between human predators and fish within a recreational fishery. 53rd Annual Conference, Animal Behavior Society, Columbia, Missouri.

Corral, L., T.J. Frink and J.J. Fontaine. October 2015. Assessment of swift fox distribution in Nebraska. The Wildlife Society Annual Meeting. Winnipeg, Manitoba, Canada. *Invited.*

Corral, L., T. Frink, and J. J. Fontaine. April 2016. Swift Fox in Nebraska. Swift Fox Conservation Team Meeting, Fort Collins, Colorado.

Fedele, A.D., C.J. Chizinski, J.J. Fontaine, and K.L. Pope. August 2016. Fishery induced learning and behavioral syndromes in Ambloplites rupestris. 53rd Annual Conference, Animal Behavior Society, Columbia, Missouri.

Fedele, A.D., C.J. Chizinski, J.J. Fontaine, and K.L. Pope. August 2016. Behavioral syndromes and learned hook avoidance in Ambloplites rupestris. 146th Annual Meeting, American Fisheries Society, Kansas City, Missouri.

Fedele, A.D., N.W. Cole, C.J. Chizinski, and K.L. Pope. August 2015. Learned behavior as a potential factor in reduced catchability. 145th Annual Meeting, American Fisheries Society, Portland, Oregon.

Fedele, A.D., N.W. Cole, C.J. Chizinski, and K.L. Pope. February 2016. Caught–and–released fish may alter behavior in response to predatory anglers. Joint Meeting between Kansas and Nebraska Chapters of the American Fisheries Society, Manhattan, Kansas.

Fedele A.D., N.W. Cole, C.J. Chizinski, and K.L. Pope. January 2016. Caught–and–released fish may alter behavior in response to predatory anglers. Gordon Research Conferences, Predator–prey interactions, Ventura, California.

Fedele, A.D., C.J. Chizinski, J.J. Fontaine, and K.L. Pope. August 2016. Fishery induced learning and behavioral syndromes in *Ambloplites rupestris*. Animal Behavior Society Conference, Columbia, Missouri.

Fedele, A.D., C.J. Chizinski, J.J. Fontaine, and K.L. Pope. August 2016. Behavioral syndromes and learned hook avoidance in *Ambloplites rupestris*. National AFS Conference, Kansas City, Missouri.

Fricke, K.A., C.R. Allen, and J.J. Fontaine. 2015. Unwanted plant management in Nebraska. Nebraska Chapter of The Wildlife Society, Ogallala, Nebraska.

Fricke, K.A., and J.J. Fontaine. 2015. Balancing conflicting ecosystem services: adaptive management along the rangeland–woodland interface. Nebraska Natural Legacy Conference, Kearney, Nebraska.

Fontaine, J.J. 2016. A pheasant researcher's notebook: What we are learning about pheasants and pheasant hunters in Nebraska. Pheasants Forever State Habitat Meeting, Kearney, Nebraska.

Fontaine, J.J. 2016. Predicting the probabilities of the periodically unpredictable. Nebraska Chapter of The Wildlife Society Annual Meeting, Kearney, Nebraska.

Fontaine, J.J. 2016. Research on pheasants and pheasant hunters in Nebraska. Regional pheasant working group. Ponca, Nebraska.

Fontaine, J.J., C.J. Chizinski, N.W. Cole, C. Gillespie, A. Lipinski, J.J. Lusk, L.N. Messinger, K.L. Pope, and L. Wszola. March 2016. Climate change: Challenges for wildlife, outdoor enthusiasts, and the future of wildlife management. Annual Conference, Nebraska Chapter, The Wildlife Society, Kearney, Nebraska. *Invited.*

Fontaine, J.J., C. Gillespie, M. Lute, and D. Martin. February 2016. CRP: Landowners, you . . . and your perceptions. Partners Section Meeting, Nebraska Game and Parks Commission, Kearney, Nebraska.

Gillespie, C. June 2016. Science, Storytelling, and Shorebirds: How Digital Media Can Help Us Communicate Research to Public Audiences. Great Plains LCC Webinar.

Harmon, B.S. October 2015. Intra–waterbody angler site choice and foraging. Nebraska Cooperative Fish and Wildlife Research Unit Coordinating Committee Meeting, Lincoln, Nebraska.

Harmon, B.S., C.J. Chizinski, and K.L. Pope. February 2016. The effect of environmental features on angler fishing location: A preliminary analysis of two Nebraska reservoirs. Joint Meeting between Kansas and Nebraska Chapters of the American Fisheries Society, Manhattan, Kansas.

Harmon, B.S., C.J. Chizinski, and K.L. Pope. August 2016. Realized and stated preferences of bank angler fishing location within a waterbody. 146th Annual Meeting, American Fisheries Society, Kansas City, Missouri.

Harmon, B.S., D.R. Martin, C.J. Chizinski, and K.L. Pope. August 2015. Angler distribution in response to rainbow trout stocked in a put–and–take fishery. 145th Annual Meeting, American Fisheries Society, Portland, Oregon.

Harmon, B.S., C.J. Chizinski, and K.L. Pope. February 2016. Catchy Places. Annual Meeting of the Nebraska Chapter of the American Fisheries Society, Manhattan, Kansas.

Harmon, B.S., D.R. Martin, C.J. Chizinski, and K.L. Pope. September 2015. Intra–waterbody angler site choice. Annual Meeting of the Organization of Fish and Wildlife Information Managers, Williamsburg, Virginia.

Hurley, K.L., C.J. Chizinski, and K.L. Pope. September 2015. Here we go. Annual Meeting of the Organization of Fish and Wildlife Information Managers, Williamsburg, Virginia.

Hurley, K.L., C.J. Chizinski, and K.L. Pope. September 2015. Nebraska's creel survey system: Putting the pieces together. Annual Meeting of the Organization of Fish and Wildlife Information Managers, Williamsburg, Virginia.

Kaemingk, M.A. February 2016. The paradigm of amphidromy – a fresh (pun intended) perspective. Joint Kansas and Nebraska Chapter Annual Meeting, Manhattan, Kansas.

Lepczyk, C., F. LaSorte, and J.L. Burnett. 2016. Advancements in the Future of Big Data Ornithology. North American Ornithological Congress VI, Washington, D.C.

Lipinski, A. and J.J. Fontaine. October 2015. Land use and climatic influences on northern bobwhite populations: A long–term analysis. The Wildlife Society Annual Meeting, Winnipeg, Manitoba, Canada.

Messinger, L.N. and J.J. Fontaine. October 2015. Should we care about fear in wildlife populations? The Wildlife Society Annual Meeting, Winnipeg, Manitoba, Canada.

Messinger, L.N., and J.J. Fontaine. February 2016. Hunter use of public–access lands in the Rainwater Basin and beyond. Rainwater Basin Joint Venture Informational Meeting, Grand Island, Nebraska.

Messinger, L.N., and J.J. Fontaine. July 2016. Public land use by hunters in Nebraska. Nebraska Game and Parks Commission, Management Section meeting, Fairbury, Nebraska.

Messinger, L.N. and J.J. Fontaine. August 2016. Factors driving hunter site selection between and within regions of concentrated hunting opportunities. Annual meeting of the Central Mountains and Plains Section of The Wildlife Society, Steamboat Springs, Colorado.

Pope, K.L., J.J. Fontaine, and C.J. Chizinski. June 2016. Managing ecosystem services for sportspersons while managing sportspersons for ecosystem services. International Symposium on Society and Resource Management, Houghton, Michigan. *Invited.*

Roberts, C., Cox, R., Cain, J. W. 2016. Fine–Scale Temporal Modeling of Elk (*Cervus canadensis*) Habitat Selection. Society for Range Management 69th Annual Meeting, Corpus, Texas.

Roberts, C., Cox, R., Parmenter, R., Myers, O., Barnes, W. 2015. Effects of Ungulate Herbivory on Riparian Plant Communities. Society for Range Management 68th Annual Meeting, Sacramento, California.

Stuber, E.F., L.F. Gruber, and J.J. Fontaine. August 2016. A Bayesian model for assessing multiscale species–habitat relationships. North American Ornithological Conference, Washington, D.C.

Uden, D.R. December 2015. Pine Ridge BUL scenarios. Pine Ridge BUL meeting, Chadron, Nebraska.

Uden, D.R. February 2016. Predictions of future waterbird stopover habitat. Rainwater Basin Joint Venture Informational Seminar, Grand Island, Nebraska.

Uden, D.R. and N.M. Hart. September 2015. What is growing? Where? And why? Oak seedlings and tree communities in Indian Cave State Park. Nebraska Natural Legacy Conference, Kearney, Nebraska.

Uden, D.R. and M.L. Hellman. January 2016. The role of ecological reserves and anthropogenic habitats for the functional connectivity and resilience of ephemeral wetlands. Nebraska Natural Resources District Legislative Conference, Lincoln, Nebraska.

Warren, Z.W. February 2016. Northern long–eared bat distribution and habitat use. Presented at the Inaugural Nebraska Bat Working Group Meeting.

Warren, Z.W., Whitby, M.D., and Allen, C.R. October 2015. A scalable and reproducible acoustic site selection framework for the northern long–eared bat. 45th Annual Symposium on Bat Research, Monterey, California.

Winkler, M.T., L.N. Messinger, and J.J. Fontaine. August 2016. Effects of sportspersons on local rural economies. Annual meeting of the Central Mountains and Plains Section of The Wildlife Society, Steamboat Springs, Colorado.

Wszola, L.S. and J.J. Fontaine. January 2016. Does Habitat Structure shape predator foraging decisions? Gordon Conference on Predator Prey Interactions, Ventura, California

Wszola, L.S. and J.J. Fontaine. August 2016. Anthropogenic predation risk and habitat structure interact to shape avian spatial decisions. North American Ornithological Conference, Washington, D.C.

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