

## Annual Report

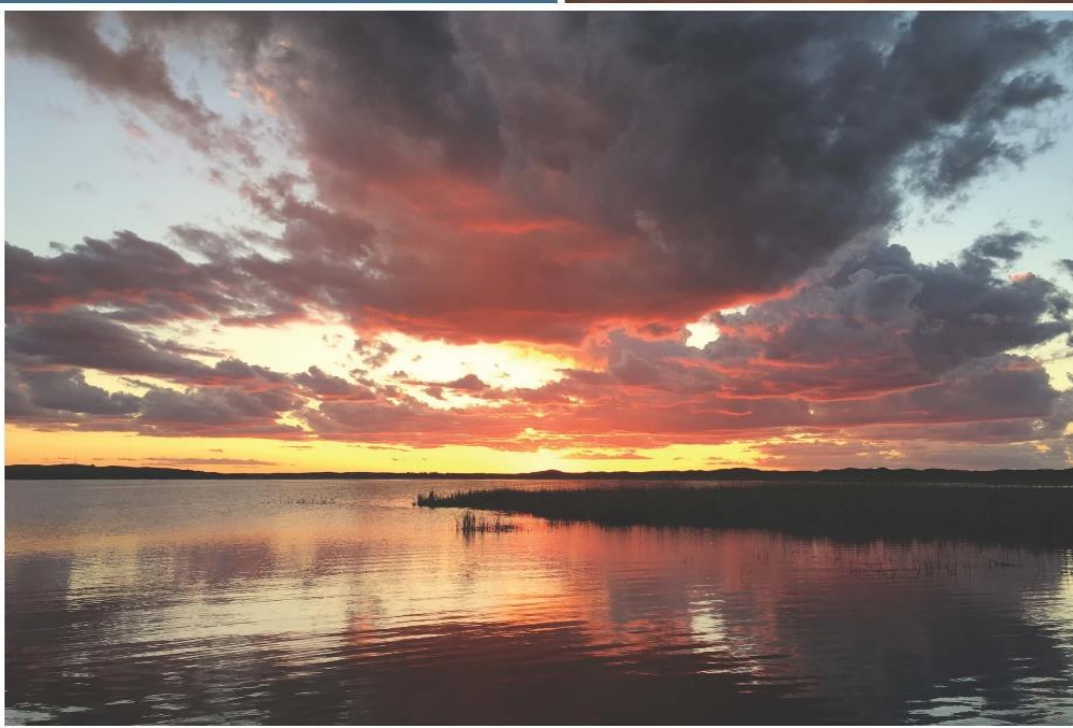
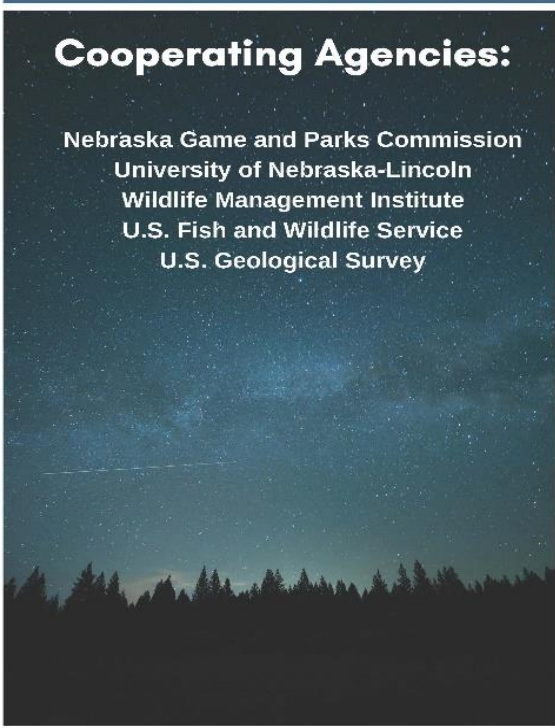
# *Nebraska Cooperative Fish and Wildlife Research Unit*

**October 2017 — September 2018**



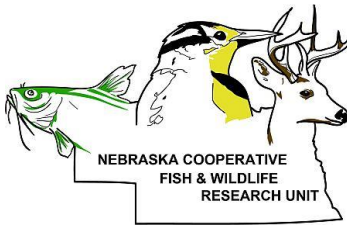
### **Cooperating Agencies:**

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 2017 – September 2018**



## **Nebraska Cooperative Fish and Wildlife Research Unit**

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## INTRODUCTION

The U.S. Geological Survey (USGS) Cooperative Research Units Program has been in existence for more than 80 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 USGS, 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

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## UNIT PERSONNEL

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

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

### STAFF – UNIVERSITY OF NEBRASKA–LINCOLN

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Caryl Cashmere, Unit Staff Assistant  
David Damsky, Field Crew Leader  
Alexis Fedele, Research Assistant  
Wilma Gerena, Unit Administrative Assistant  
Lutz Gruber, Post-Doc  
Mark Kaemingk, Research Assistant Professor, Aquatic Biologist  
GengXin Ou, Post-Doc (April 2017- May 2018)  
Tyler Reed, Field Crew Leader  
Amanda Sorenson, Post-Doc (June 2017-June 2018)  
Shana Sundstrom, Post-Doc  
Erica Stuber, Research Assistant Professor, Wildlife Ecologist (September 2015- September 2018)  
Dan Uden, Post-Doc  
Dana Varner, Science Coordinator, Rainwater Basin Joint Venture  
Lyndsie Wszola, Research Assistant (September 2017- September 2018)  
Allison Zach, Coordinator, Nebraska Invasive Species Program

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#### RESEARCH TECHNICIANS

Aaron Aguirre	Katie Hammond
Allison Ashby	Drake Hardman
Danielle Berger	Joshua Luft
Peyton Burt	Michael Ocasio
Autumn Dunn	Matthew Rahko
Alex Engel	Zachary Slick
Jenny Foggia	Doug Tosoni
Hallie Halstead	

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#### CREEL CLERKS

Cody Barker	Gerald Ryschon
Logan Dietrich	Clara Stobbe
Jeremy Johnson	Rayma Volkmer
Derek Kane	

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#### STUDENT WORKERS

Stephanie Endrulat	Anastasia Madsen
Iman Farid	Vimal Roy Chowdary Nagalla
Jessie Hall	Tristan Powell
Laura LeCuyer	James Rutledge
Hannah Lionberger	Chance Vondetrasse

## GRADUATE DEGREE CANDIDATES

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### *Master of Science*

Olivia DaRugna, School of Natural Resources  
January 2018 – present

Brittany Dueker, School of Natural Resources  
August 2016 – present

Hugh Ellerman, School of Natural Resources  
August 2017 – present

Christopher Fill, School of Natural Resources  
January 2018– 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

### *Doctor of Philosophy*

Christine Bielski, School of Natural Resources  
January 2017 – 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

Dillon Fogarty, School of Natural Resources  
January 2017 – present

Sarah Gaughan, School of Natural Resources  
August 2016 – present

Michelle Hellman, School of Natural Resources  
May 2013– May 2018

Katharine Hogan, School of Natural Resources  
January 2018 – present

Amanda Lipinski, School of Natural Resources  
August 2014 – present

Caleb Roberts, Department of Agronomy  
August 2015 – present

Nicholas Smeenk, School of Natural Resources  
August 2010 – present

Chad Smith, School of Natural Resources  
August 2007 – present

Bruce Stephen, School of Natural Resources  
January 2018 – present

Bethany Teeters, School of Natural Resources  
August 2012 – present

Helen Tripp, School of Natural Resources  
August 2016 – July 2018

Michael Whitby, School of Natural Resources  
January 2014 – present

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## GRADUATES

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CODY DREIER, M.S., AUGUST 2018

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*Nebraska Wetland Condition Assessment: Intensification of the National Wetland Condition Assessment Throughout Nebraska*  
University of Nebraska–Lincoln, Natural Resources. Advisor, Craig R. Allen

ALEXIS PARK, M.S., DECEMBER 2017

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*Assessing Relationships Between Angling Effort and Larval Trematodes in Small Bluegill*  
University of Nebraska–Lincoln, Natural Resources. Advisor, Kevin L. Pope

SHANA SUNDSTROM, PH.D., MAY 2018

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*Complex Adaptive Systems: Cross-Scale Structure and Resilience*  
University of Nebraska–Lincoln, Natural Resources. Advisor, Craig R. Allen

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## COORDINATING COMMITTEE MEMBERS

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### U. S. GEOLOGICAL SURVEY

Barry Grand, Regional Supervisor  
Cooperative Research Units Program  
Dadeville, AL 36853  
(334) 200-8458

### UNIVERSITY OF NEBRASKA-LINCOLN

Mike Boehm, 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

Bill Moritz, 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

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## COOPERATING ORGANIZATIONS

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Central Nebraska Public Power and Irrigation District  
Chadron State College  
Emory University, Georgia  
Iowa State University  
    Natural Resource Ecology and Management  
James S. McDonnell Foundation  
National Socio–Environmental Synthesis Center  
National Science Foundation  
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  
Rainwater Basin Joint Venture Partnership  
Swedish University of Agricultural Sciences, Sweden  
The Nature Conservancy  
University of Calgary  
    Department of Biological Sciences  
University of Montana  
    W.A. Franke College of Forestry and Conservation  
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 at Omaha  
    Department of Biology  
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  
    National Park Service  
    U.S. Fish and Wildlife Service  
    U.S. Geological Survey  
        Climate Adaptation Science Center  
        Fort Collins Science Center  
U.S. Environmental Protection Agency  
Wyoming Game and Fish Department

## AWARDS AND RECOGNITIONS

Vicki Simonsen was one of 31 students named to the Franco's List. Awardees demonstrate characteristics essential to being a person of integrity and outstanding agents of character. The list, named for the late Juan Franco, vice chancellor for student affairs from 2006-2017 recognizes students who represent the six building blocks of character: caring, citizenship, commitment, dependability, open-mindedness and respect. All recipients were nominated by a university community member and selected by a council of peers, and the vice chancellor for student affairs' Character Council.

Christine Ruskamp was a finalist for the Janice Lee Fenske Memorial Award, 2018. The Janice Lee Fenske Memorial Award conferred to undergraduate and graduate students for achievements in the field of fisheries with a focus on involvement in the American Fisheries Society and in the Midwest Fish and Wildlife Conference. It also encourages students to become leaders in the field of fisheries management.

Joseph Fontaine, assistant unit leader, received the 2018 Best Presentation Award from the South Dakota Chapter of the Wildlife Society.

Amanda Sorensen, Post-Doc in the Fontaine Lab received the 2017 Best Presentation Award at UNL's Science Slam.

### SNR MERITORIOUS GRADUATE STUDENT AWARD



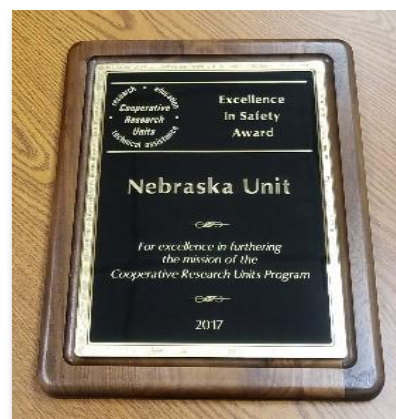
**Simonsen receiving award from School of Natural Resources associate director Paul Hansen**  
Photo: Shawna Richter-Ryerson

Vicki Simonsen and Jessica Burnett were selected to receive the 2018 School of Natural Resources Meritorious Graduate Student Award. The award is given annually to one master's and one doctoral student in the School of Natural Resources. This year, the committee chose to recognize Simonsen, a master's student, and Burnett a doctoral student for their academic achievements, research, and teaching contributions, leadership accomplishments, service and personal qualifications. Simonsen and Burnett each received a \$500 stipend and their names are included on a plaque that hangs in Hardin Hall.

It is worth mentioning that for a third straight year a Coop Unit student is the recipient of the SNR Meritorious Award. Last year, Coop Unit student Hannah Birgé received the doctoral level and Lyndsie Wszola received the masters level award.

### EXCELLENCE IN SAFETY AWARD

The Nebraska Cooperative Fish and Wildlife Research Unit received the Cooperative Research Unit Safety (CRU) Award for 2017 in recognition of the exemplary safety record and exceptional detail given to the safety needs of Unit students and technicians. The NE Coop Unit, led by Craig Allen, has shown a long-term commitment of staff and students at all levels to the safety program of the Unit. The unit supported training of two Motorboat Operator Certification Course (MOCC) instructors, Kevin Pope and Chris Chizinski, who routinely teach required MOCC training to their staff and students, students at nearby Units, and personnel of their state agency cooperators. In addition, Craig, Kevin and Joseph Fontaine, assistant unit leader, offer Over-the-Water Training several times a year to their staff and students, as well as students at nearby Units, as needed. The NE Coop Unit fully embraced the CRU's Personal Hazard Analysis (PHA) system where the administrative staff has done an outstanding job of ensuring all staff and students



**Excellence in Safety Award 2017**  
Photo: NECFWRU

actively participate in the PHA process by maintaining safety training records and documentation, and tracking compliance with training requirements. The Nebraska Cooperative Fish and Wildlife Safety Program has extremely high compliance statistics for the staff and students, and warrants recognition of the collective efforts.

## SCHOLARSHIPS, FELLOWSHIPS & GRANTS

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Nadya Mirochnitchenko, received the Chancellor's Fellowship for a second year in a row. This fellowship is awarded annually to superior graduate student recruits. Nadya also received the Graduate Assistantship for Research and Teaching Assistantship, University of Nebraska–Lincoln.

Earth Observation for Science, Society, and Sustainability Graduate Fellowships for the 2018 – 2019 academic year were awarded to Sarah Gaughan and Michael Whitby. This fellowship funded by the National Science Foundation through the Research Traineeship Program (NRT) supports coursework in interdisciplinary science encouraging a research project relate to aeroecology. The fellowship includes a stipend, subsistence funding, travel expenses, and tuition for the academic year.

## TRAVEL AWARDS

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Jessica Burnett received the Irvin A. and Nelson E. Memorial Fellowship award from the University of Nebraska–Lincoln and the National Academy of Sciences travel award for travel to International Institute for Applied Systems Analysis (IIASA). This summer she worked at IIASA in Laxenburg, Austria, in a highly competitive research program where 53 out of 293 applicants were accepted as part of the Young Scientists Summer Program (YSSP). During this program Drs. Craig Allen and Dirac Twidwell (UNL), Brian Fath (IIASA), and Elena Rovenskaya (IIASA) supervised Burnett as she researched advanced novel methods for detecting rapid changes in communities via dimensionality reduction.



**Jessica Burnett (far left) with IIASA director Pavel Kabat (center), Joanne Byers Young Scientists Summer Program Director, and other research group YSSP peers**  
Photo: Jessica Burnett

## MILESTONES AND HIGHLIGHTS

### AMERICAN FISHERIES SOCIETY MEETING

How far are you willing to travel to reach a desirable destination? More importantly, what factors do you consider before making this decision? Undoubtedly, this decision process is complex. Hence this is why Christine Ruskamp, MS student; co-advised by Mark Kaemingk and Kevin Pope set out to answer this question (and more) within recreational fisheries. Her work attempts to explain why certain waterbodies attract anglers from a wide geographic range compared to other waterbodies that only attract anglers from a limited geographic range.

Christine recently presented a portion of this research in a symposium entitled “Coupled Social-Ecological Dynamics in Fisheries” at the 148<sup>th</sup> Annual American Fisheries Society Meeting in Atlantic City, New Jersey. She described to national and international professionals how local, landscape, and angler attributes should be considered if we are going to explain landscape dynamics in angler participation. For example, local or waterbody-specific conditions (e.g., precipitation at the waterbody) were important for some waterbodies while landscape features (e.g., fuel prices or travel cost) were important for other waterbodies. Her presentation was well received, even sparking conversation well after the symposium with both national and international professionals.



**Christine Ruskamp**  
Photo: Mark Kaemingk

Nebraska was well represented in this symposium with two other speakers, in addition to Christine, that presented research pertaining to complex patterns in angler behavior within Nebraska fisheries. Seems Nebraska is gaining momentum, currently viewed as a leader in understanding fishery dynamics by treating them as coupled social-ecological systems. This distinction is certainly a testament of strong collaboration and support among Nebraska Game and Parks Commission, the University of Nebraska, and the Nebraska Cooperative Fish and Wildlife Research Unit.



**Christine Ruskamp**  
Photo: Kevin Pope

### MIDWEST FISH AND WILDLIFE CONFERENCE

The Nebraska Chapter of the American Fisheries Society held its annual meeting February 2018 in Lincoln. Two NE Cooperative Fish and Wildlife Research Unit students, Nicholas Cole and Christine Ruskamp, gave oral presentations on their graduate research. Christine's presentation on “anglersheds” was especially well received, and resulted in an invitation to present on her research during a “brown-bag” session at Nebraska Game and Parks Commission's headquarters to administrators from several divisions.



Nicholas was also recognized by the Nebraska Chapter of the American Fisheries Society with the Outstanding Fishery Student award. The aim of this award is to honor the best students and recognize their outstanding contributions to fishery science. Nicholas is respected by members throughout the natural resource profession, especially for his ability to formally and informally teach others. He thinks “outside the box” and has an incredible ability to ask interesting questions, which is a hallmark of a great scientist.



**Nicholas Cole**  
Photo: Kevin Pope

## CHARTING PATHWAYS TO PROSPERITY

Six Cooperative Research Unit (CRU) scientists and the Chief of the CRU program participated in a workshop to Promote Science-Based Infrastructure Standards in the Amazon. The workshop, entitled “Charting Pathways to Prosperity” was hosted by the U.S. State Department Bureau of Oceans, International Environmental and Scientific Affairs, U.S. Embassy in Lima, and the U.S. Geological Survey (USGS). The USGS CRU scientists in attendance included, Allison Roy (Maine), David Fulton (Minnesota), Francisco Vilella (Mississippi), Kevin Pope (Nebraska), Tom Edwards (Utah), and John Organ (Headquarters).

The workshop was held August 2018 in Iquitos, Maynas, Peru, at the Peruvian Amazon Research Institute (IIAP). Importantly, the workshop featured simultaneous translation in English and Spanish. Goals of this workshop were (a) identification of multilateral scientific research projects to evaluate potential impacts of infrastructure projects planned for the Peruvian Amazon in Loreto region, (b) building scientific capacity in the region. Opening remarks for this workshop were provided by Fernando Melendez Celis, Governor of Loreto Region, by Krishna R. Urs, U.S. Ambassador to Peru, and by Dr. Thomas Lovejoy, U.S. Science Envoy.



**U.S. State Department invite.**  
Image: Kevin Pope

As part of the workshop, the USGS scientists were graciously provided tours of some of the scientific facilities in Iquitos, as well as short tours on the river and into the jungle. Time will tell which of the seeds of international collaboration germinated in favorable environments. Kevin’s travel was funded by U.S. Geological Survey, the University of Nebraska–Lincoln’s School of Natural Resources, and University of Nebraska–Lincoln’s Agricultural Research Division Strategic Funding.

## EASTERN REDCEDAR SCIENCE LITERACY PROJECT



**Christine Bielski**  
Photo: Eastern Redcedar Science Literacy Project

The Eastern Redcedar Science Literacy Project seeks to provide the most comprehensive resource on the spread and impacts of Eastern redcedar. The project extends from a collaboration between Dirac Twidwell, Assistant Professor in the Department of Agronomy and Horticulture, and Craig Allen, Unit Leader at the Nebraska Cooperative Fish and Wildlife Research Unit (NECFWRU).

The project site provides information that should be used to question existing land management practices, to critique existing government policies and future proposals, and to hopefully create a more literate and informed society. Scientists have reached clear consensus about the problems posed by Eastern redcedar invasions. Christine Bielski is the Science Literacy Coordinator, actively involved in many stakeholder groups working towards developing solutions to effectively manage Eastern redcedar invasion throughout the Great Plains. Christine is a Ph.D. student in the NECFWRU, co-advised by Craig Allen.

## KEVIN POPE, NATIONAL CONSERVATION LEADERSHIP INSTITUTE FELLOW

We are in a new era. The organizational guardians of our natural resource legacy face unprecedented challenges in a rapidly changing landscape. The urgent need for significantly increasing leadership capacity within natural resource organizations is unparalleled. The National Conservation Leadership Institute (NCLI) is one of the most far-reaching professional development initiatives ever undertaken within the natural resource conservation community, providing an unparalleled experience for developing extraordinary leadership at that right moment in history.

Kevin's right moment in history occurred this year, with his selection and participation as a NCLI fellow of Cohort 12. Kevin was one of 36 fellows in this cohort, which came from all over the country and from all kinds of organizations. The first residency of this cohort was held October 2017 in Shepherdstown, West Virginia, and the second residency was held June 2018 on the South Rim of the Grand Canyon. Kevin is most appreciative of the opportunity with the support of the U.S. Geological Survey.

The immersive training in the core tenants of Adaptive Leadership was powerful and provocative...more importantly, it was empowering. One of the most tangible outcomes of Kevin's experience was a life-renewal of self-care. A less tangible, but nonetheless important, outcome of Kevin's experience was a new vision and understanding of the CRU Program. There are always opportunities to exhibit leadership!



Kevin Pope with NCLI peer group in Arizona  
Photo: Kevin Pope

## NEBRASKA INVASIVE SPECIES PROGRAM



Education and outreach continues as the principal purpose of the Nebraska Invasive Species Program (NISP). Program coordinator, Allison Zach, attended over 50 events in 2018 and presented or had a table at each. The program disseminated over 1,000 sets of invasive species education cards to K-12 grade teachers and provided educators across the state invasive species education backpacks for classroom use at no cost.



Nebraska Invasive Species Education Cards  
and table at the State Capitol Building  
Photo: Allison Zach

With increased invasive species awareness projects, the NISP employed one technician who over the summer conducted boater surveys and inspected watercrafts at waterbodies educating the public on how to prevent the spread of aquatic invasive species. The technician also attended family fishing nights and fishing tournaments disseminating program information. To facilitate ease of boater and watercraft inspection surveys and data collection the NISP developed, built and hosted a tablet platform also used by the Nebraska Game and Parks Commission to conduct surveys statewide. Looking towards an efficient data storage stage and technology support the NISP updated its website host to the University of Nebraska-Lincoln's servers, established an invasive plant species, and updated aquatic invasive species information. In the service of the state of

Nebraska, the NISP served on regional aquatic invasive species panels and served as the chair of the Western Regional Panel on Aquatic Invasive Species Outreach Committee. The program will continue outreach, management and prevention efforts for aquatic and terrestrial invasive species working with the Nebraska Invasive Species Advisory Council, Nebraska Game and Parks Commission and other agencies and organizations. Looking forward, the NISP will have an invasive species display in the new 4<sup>th</sup> floor exhibit section of Morrill Hall Museum in the University of Nebraska–Lincoln when it opens in 2019.

## NEBRASKA SPORTSPERSON SUMMIT

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The Nebraska Cooperative Fish and Wildlife Research Unit in conjunction with the University of Nebraska–Lincoln, and the Nebraska Game and Parks Commission hosted the Nebraska Sportsperson Summit, a two-day event held at the Lied Lodge in Nebraska City, NE, July 31-August 1, 2018. The purpose of the Nebraska Sportsperson Summit was to bring together a wide-range group of professionals to discuss three important questions:



**Christine Ruskamp at the Nebraska Sportsperson Summit**  
Photo: Mark Kaemingk

- What is the value of understanding sportspersons to natural resource management?
- What do we know about sportspersons in Nebraska and beyond?
- What more do we need to know about sportspersons?

The Summit was composed entirely of invited presentations with attendees representing a diversity of natural resource professionals, including participants from:

- Kansas Department of Wildlife, Parks and Tourism
- Lower Platte South Natural Resource District
- Missouri Cooperative Fish and Wildlife Research Unit
- National Wild Turkey Federation
- Nebraska Cooperative Fish and Wildlife Research Unit
- Nebraska Game and Parks Commission
- North Carolina Wildlife Resources Commission
- Rainwater Basin Joint Venture
- University of Nebraska–Kearney
- University of Nebraska–Lincoln

Presentations were designed to inform, and provoke participants to engage in discussion. Broad topics of discussion included Vision of Sportspersons, Sportsperson's Identities and Values, Sportspersons as Predators (predator-prey dynamics), Sportspersons Across the Landscape, and Managing Sportspersons. The Summit comprised of more than 60 attendees. In addition to thought-provoking discussions, attendees were provided demonstrations on utilities of several, recently developed apps, including the Pheasant Habitat App and the Sportsperson Database App. The planned, next step is to develop a Sportsperson Working Group to build on the success of the Summit and further explore the three key questions.

## PHEASANT PROJECT WEB-BASED APP

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A new web-based application from the University of Nebraska–Lincoln will allow the state's wildlife managers to examine how virtually manipulating land cover in a region could affect pheasant populations and how much such efforts might cost. Although the Pheasant Habitat Simulator was created to help the Nebraska Game and Parks Commission bridge the gap between game-bird habitat research and land management for the species, Lyndsie Wszola and her colleagues built it as an open-source app.

“This is not just a pheasant app,” said Wszola, research associate with the Nebraska Cooperative Fish and Wildlife Research Unit in the School of Natural Resources at Nebraska. “It is a framework. Because it is open-source, we’re interested in seeing people use it in new ways. We want to see how it grows and progresses.”

The Pheasant Habitat Simulator allows users to manipulate various factors to show habitat suitability. It also shows each Nebraska county as a pixelated grid, representing six land-cover types and accounting for how suitable the land cover is to pheasant populations. Users can manipulate the ratios while in the background; the app uses a statistical model of pheasant-habitat relationships in Nebraska to translate the change in land cover to that of pheasant suitability. On the user side, a visual representation of their decisions' consequences is displayed. A second tab shows the estimated costs of those actions, which are tied to average land-use values based on county-level data.

Traditionally, building this type of app would cost an organization thousands of dollars, rendering it unaffordable for many organizations. But manipulating the open-source application requires only time and ingenuity. The app was designed using Shiny, a software package for the open-source statistical programming language R, and it will be updated based on user feedback as long as the tool is useful. Lyndsie Wszola completed her graduate program with the NE Coop Unit. Her advisor was Joseph Fontaine, Assistant Unit Leader.



**Lyndsie Wszola, Research Associate, and former Coop student, helped develop the open-source Pheasant Habitat Simulator**  
Photo: Shawna Richter-Ryerson, SNR



**L-R: Mary Bomberger-Brown, Jessica Burnett, Hannah Birgé, Amanda Sorensen, Devarati Bhattacharya, and John Carroll.**

Photo: School of Natural Resources

## WOMEN IN SCIENCE

NE Coop Unit student Jessica Burnett and graduate Hannah Birgé were among those included in the 2017 winter edition of the Association for Women in Science-AWIS magazine. The group aims to identify, develop, and support female leaders and underrepresented groups in the natural resource sciences by providing professional advancement opportunities through workshops, mentorships and interdisciplinary collaborations. Another goal is to build department and faculty hiring opportunities for the collectives and develop better communication among its members using listservs, newsletters and social media. The University of Nebraska-Lincoln is an institutional partner of the Association for Women in Science



## OUTREACH ACTIVITIES

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

### 14<sup>TH</sup> NORTH AMERICAN ARCTIC GOOSE CONFERENCE

The Nebraska Cooperative Fish and Wildlife Research Unit co-hosted with the Nebraska Game and Parks Commission, Rainwater Basin Joint Venture, University of Nebraska–Lincoln, University of Nebraska–Kearney, and Ducks Unlimited–Nebraska, the North American Arctic Goose Conference. The conference is the largest goose-focused meeting in North America and is an international event devoted to research and management of geese and their habitats.



Image: Rainwater Basin Joint Venture

### MEDIA COVERAGE

Local media coverage highlighted several research projects.

- *Study angles for new tactics for fishing, water management.* Nebraska Today. May 2018
- *Pheasant project has potential to advance land management research.* PHYS.ORG. January 2018
- *Nebraska Invasive Species Program: KZUM 89.3 FM, Lincoln.* June 2018
- *Understanding the Nebraska Invasive Species Program: Pure Nebraska, KOLN/KGIN Channel 10/11, Lincoln.* May 2018

### NATO SCIENCE FOR PEACE AND SECURITY PROGRAMME

Dr. Craig Allen, NE Coop Unit Leader, represented the U.S. Geological Survey and the University of Nebraska at a Department of Defense (DOD)/North Atlantic Treaty Organization (NATO) sponsored research workshop focused on Security and Resilience of Information Systems Affected by Hybrid Threats. The weeklong workshop in Parnu, Estonia, brought together NATO member country representatives to focus on issues of cyber and cyber-infrastructure resilience. Representatives had expertise in cyber security and warfare, engineering infrastructure resilience, resilience, and more. The workshop will result in a NATO resource book on the subject of the workshop.

### NSF SUPPORTED WORKSHOPS ON CONVERGENCE AND RESILIENCE IN THE NEW ARCTIC

In 2018, NE Coop unit leader, Craig Allen, along NE Coop graduate, Hannah Birgé, and University of Nebraska–Lincoln Faculty, Martha Shulski, initiated a series of workshops focused on understanding rapid change in the arctic, and arctic- mid-latitude connections. These workshops brought together natural, physical, social, and information scientists with indigenous scholars and communities to advance understanding of how rapid socioecological change poses resilience and food security challenges for Arctic indigenous communities. A spring meeting was held in Fairbanks, AK, a summer meeting in Lincoln, NE, and we will complete the workshop series in October with a final workshop in Anchorage, AK. Themes of the workshop included: Resilience of local Arctic variables to global-scale drivers; Indigenous Traditional Knowledge to inform Arctic system framework; Biogeochemical cycling; Identifying spatial regimes; Arctic–Mid-latitude connections; and Novel tools for convergence.



Convergence and Resilience in the New Arctic group in Fairbanks, Alaska.  
Photo: Martha Shulski

## TROUT IN THE CLASSROOM

In the spring of 2018, Christine Ruskamp participated in Trout in the Classroom. This program is offered at local Lincoln schools providing fourth and fifth grade students the opportunity to explore and learn about aquatic resources through hatching and raising rainbow trout. Sponsored by the Nebraska Game and Parks Commission field trips occur over a span of a month at the end of the school year. Volunteers like Christine Ruskamp, M.S., NE Coop Unit student, assisted students this spring with fishing activities, as well as, during their end of the year, half-day field trip.

## TWITTER MOMENTS



## SAFETY TRAINING

The NE Coop Unit staff organized and provided two water safety trainings followed by American Red Cross certification for Adult First Aid/CPR/AED for technicians and clerks during March and April 2018 in Lincoln, Nebraska. Water safety instructors were Kevin Pope, Joseph Fontaine, and Craig Allen.



Technicians, students, unit leaders, and university staff obtained Cardiopulmonary Resuscitation training at the University of Nebraska-Lincoln Recreation Center facilities. American Red Cross Instructor Jessica Varlack applies First Aid methods to assistant unit leader Joseph (TJ) Fontaine  
Photos: Kevin Pope





## RESEARCH PROJECTS







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## 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 2018

Funding: National Science Foundation IGERT Program  
U.S. Environmental Protection Agency

Project Location: Rainwater Basin, Nebraska

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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 19<sup>th</sup> 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 effects of proximity of intensive agriculture and widespread landscape change on the remaining wetlands and the amphibian population. Specifically, we are investigating how thousands of irrigation reuse pits, now the most numerous of wetland types in the region, are utilized by breeding amphibians. 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.



**An automated recording device used to sample Anuran calling activity at an irrigation reuse pit**  
Photo: Michelle Hellman



**An overwintered bullfrog tadpole pulled in dipnetting used to assess Anuran breeding at irrigation reuse pits**  
Photo: Michelle Hellman

Irrigation re-use pits and restored wetlands in a large agricultural complex were sampled for Anuran presence at several crucial reproductive stages: adult advertisement, oviposition, larval hatching, and metamorph emergence. A combination of automated recording units, dip-netting, and visual encounter surveys were used to measure reproductive activity at ten sites between May 12th and July 27th. Additionally, sediment samples were collected to be analyzed for a suite of likely agricultural contaminants. With our ongoing analysis we hope to gain a better understanding of how agricultural proximity affects Anuran reproduction and what role irrigation reuse pits play in their continued persistence in the Rainwater Basin.

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## 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.	Olivia DaRugna, M.S.
	Alexis Fedeale, M.S. (2017)	Brian Harmon, M.S. (2017)
	Alexis Park, M.S. (2017)	Christine Ruskamp, M.S.

Project Duration: January 2014 – December 2018

Funding: Nebraska Game and Parks Commission

Project Location: Statewide Nebraska

Website: [fishhunt.unl.edu](http://fishhunt.unl.edu)

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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 nine 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, Sherman Reservoir, and Lake Wanahoo 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. *Recreational use of Valentine National Wildlife Refuge.* Understanding participation patterns is critical for effective resource management. A combination of cameras and surveys will be used to understand 1) how much time visitors spend on the refuge and 2) what types of recreational activities occur on the refuge. Spatial and temporal recreational information will aid in optimizing resources at this multi-use refuge.



**Ten pound Northern Pike at  
Lake McConaughy, Nebraska**  
Photo: Logan Dietrich

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. 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 the system and the need for continued research.



**Walleye Spawn Angler**  
Photo: Logan Dietrich

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 investigated the effect of a fish's personality 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. Fish offered a worm on a hook-less wire increased their probability of taking the worm over the seven-day fishing trials. Fish offered a worm on a simple hook displayed a decreasing probability of capture over time, and fish offered a worm on a lure started out at a lower probability of capture and also showed evidence of decreasing probability of capture over time. Learning ability did not differ between bold and shy phenotypes; however, bold individuals did demonstrate a greater initial probability of capture across treatments. Therefore, anglers may disproportionately affect bold individuals through angling activities.
5. *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. We used this computational-modeling form to simulate various assumptions associated with fishery-induced behavioral changes within an exploited fish population. These simulations result in robust-emergent relationships, over many model iterations, between empirically represented anglers and hypothetical sportfish. This provides a theoretical framework for in situ assessments of behavioral feedbacks between anglers and sportfish.
6. *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. Behavior for anglers fishing from the shoreline was recorded for entire, individual, fishing trips, and behavior was compared to angler-perceived fishing objectives. Angler objectives had little influence on behavior, and behavior had little influence on outcome. However, anglers that failed to capture a fish were more likely to shift to a non-catch-related objective during their fishing trip. Further, ease-of-access had the greatest effect on angler densities. By measuring within-trip angler behavior and site choice, we may be able to more effectively manage recreational fisheries at greater scales.
7. *Catchment dynamics in recreational fisheries.* An angler's mobile nature, driven by a desire to participate in angling, coupled with the seasonality of a year, creates assumed fluctuations in participation at a waterbody. Despite

this, there is little understood about angler behavior, especially spatiotemporal participation dynamics on patch and ecosystem scales. We are completing an investigation into creel survey data specifically regarding spatial and temporal dynamics of angler participation using anglersheds (catchments) to quantify participation patterns. An initial investigation into angler participation revealed dynamic patterns that can be linked to local, angler, and landscape attributes. The goal of this research is to create a link between the dynamic patterns and resource attributes to provide managers with a greater understanding of where anglers are coming from to visit a waterbody, and to inform scientists about attributes that are potentially driving an angler's decision to participate in recreational fishing.

8. *Length-based Economic Assessment of Sportfish.* Recreational fisheries are a unique industrial component to Nebraska's economy. Anglers derive value in a variety of forms by taking part in recreational fisheries. Quantifying this value requires assessing individual angler's willingness-to-pay to capture a fish and for each successive capture. Anglers also express unique preferences and motivations. Thus, we expect angler's willingness-to-pay to vary widely for different angling-trip outcomes (i.e., species and size). We are using a length-based valuation framework that generalizes the preferences and motivations of Nebraska anglers across a variety of sociological metrics. This assessment provides a length-specific value of captured sportfish (channel catfish, crappie, largemouth bass, and walleye) stratified across Nebraska's angling groups.
9. *Moral domains of anglers.* Cross-participation of outdoor recreational activities is increasingly being studied within the context of participation and recruitment efforts. We hypothesized that perceptions of legitimate use of fish and wildlife would be predicative of the types of activities recreators choose to participate. We limited the study population to Nebraska fisherman and assessed whether their position on the moral extensionalism continuum would be predicative of their reported alternate activities and found that fisherman who also preferred to participate in hunting were dominated by the anthropocentric position on the continuum. Similarly, non-consumptive outdoor activities were dominated by the pathocentric position on the continuum. The results of this experiment suggest that certain individuals may be predisposed or restricted to certain outdoor activities based their environmental philosophies and perceptions of the use of wildlife.



**Angler with 27.5 inch Wiper at Lake McConaughy, Nebraska**  
Photo: Logan Dietrich



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## AQUATIC INVASIVE SPECIES PREVENTION PROGRAM

Principal Investigator(s): Craig R. Allen

Project Coordinator: Allison Zach

Project Duration: April 2011 – December 2019

Funding: USFWS Aquatic Nuisance Species Taskforce

Project Location: Statewide Nebraska

Website: [neinvasives.com](http://neinvasives.com)

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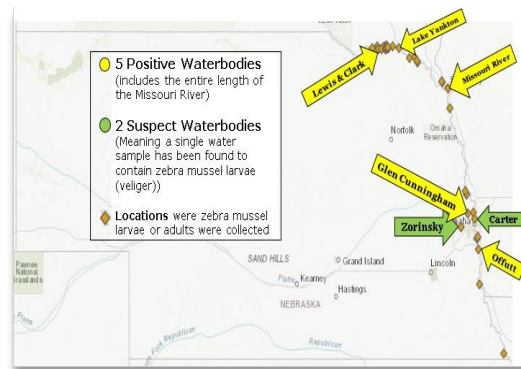
The Nebraska Invasive Species Program (NISP) continues to administer a multi-institutional Aquatic Invasive Species (AIS) Prevention Program with grant funding from the U.S. Fish and Wildlife Service.

Goals are to:

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

The NISP has conducted boater surveys and boat inspections each summer since 2012 at high-risk waterbodies throughout Nebraska to gauge public awareness of AIS, study watercraft movements, and to educate the public on AIS prevention. Since 2014, surveys have been collected using tablets. In 2018, the NISP employed one full time technician to conduct boater surveys and inspect watercrafts at high-risk waterbodies in the Lincoln and Omaha areas. The technician also attended fishing tournaments and family fishing events to provide the public with guidance on AIS prevention. NISP built and hosted the tablet survey used by the NISP technician and the six Nebraska Game and Parks Commission technicians to interview

boaters and inspect watercrafts. A total of 2,378 surveys were conducted in 2018 indicating that the majority of boaters were implementing AIS prevention methods. Ninety-eight percent of boaters reported pulling plugs and drying out watercrafts completely after its last use. During watercraft inspections, technicians found 98% of watercrafts had no risk factors to introducing AIS into a waterbody. These survey results are encouraging in preventing the spread of AIS into Nebraska waterbodies. A new infestation of zebra mussels, a small mollusk that clogs pipes, was discovered at Glenn Cunningham Lake in Omaha, NE. In conjunction with Nebraska Game and Parks Commission, the US Army Corps of Engineers, the Papio Missouri River Natural Resource District, and the City of Omaha the NISP is developing a rapid response action plan to contain the infestation. The program purchased large banners which were placed at entrances to the lake and at nearby waterbodies to alert the public of the infestation, and what steps to take to prevent the spread of zebra mussels. Nebraska now has five waterbodies infested with zebra mussels, which include Lewis & Clark Lake, Lake Yankton, the entire length of the Missouri river, Offutt Air Force Base Lake (Bellevue, NE) and Glenn Cunningham Lake (Omaha, NE). Zebra mussel larvae were sampled at Lake Zorinsky in 2016, and at Carter Lake in 2017, both waterbodies are in Omaha, NE. No larvae or adult zebra mussels were found at either waterbody since the initial positive sample so they remain suspect waterbodies. In addition, the NISP coordinator worked with the Nebraska Lake Association (which includes 39 lakes) to provide outreach materials to members and help develop guidelines their members use for preventing the spread of AIS. The NISP ran ads in the Nebraska Game and Parks boating and fishing guides to promote cleaning, draining and drying watercrafts to prevent the spread of AIS. The NISP coordinator serves on regional panels and works with AIS coordinators in other states to coordinate AIS prevention efforts.



**Zebra Mussel Waterbodies in Nebraska**  
Image: Allison Zach

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## ASSESSMENT OF ANGLER USE AND CATCH DURING 2018 AT SUTHERLAND RESERVOIR, NEBRASKA

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

Project Duration: March 2018 – January 2019

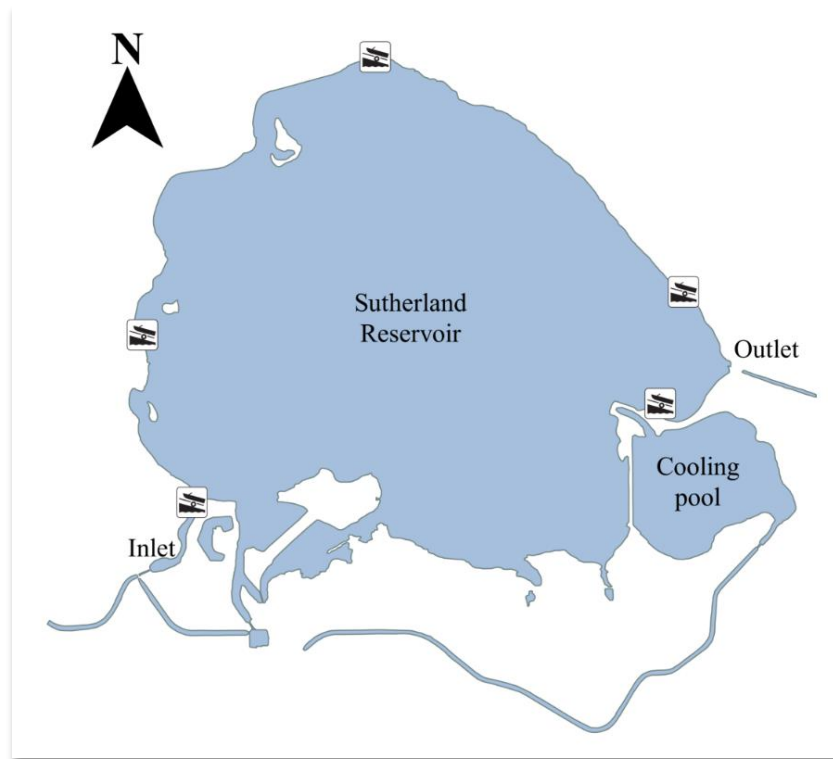
Funding: Nebraska Public Power District

Project Location: Sutherland Reservoir, Nebraska

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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, from April through October 2018. Specifically, we will obtain monthly 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.



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## AVIAN HABITAT RELATIONSHIPS ACROSS ECOLOGICAL SCALES

Principal Investigator(s): Joseph J. Fontaine, Erica K. Stuber

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

Undergraduate Student: Victoria Simonsen, UCARE Student (2015)

Project Duration: January 2010 – December 2018

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

Project Location: Statewide Nebraska

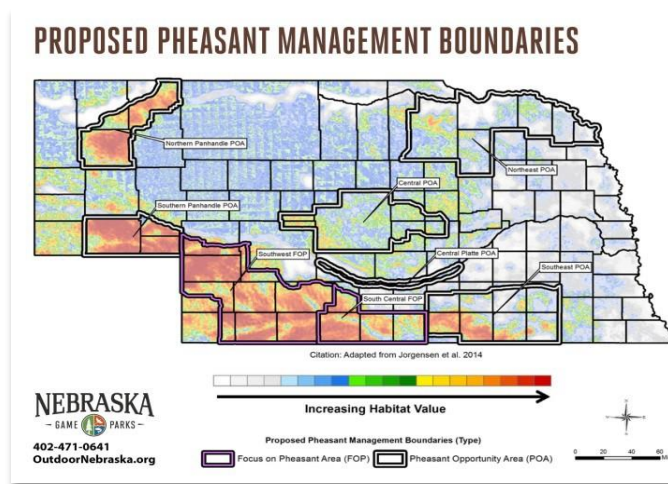
Website: [prairiebirds.unl.edu](http://prairiebirds.unl.edu)

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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. Unfortunately management efforts sometimes 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 birds associate with 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 5,000 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 on the ground conservation efforts may be determined by the landscape context. The findings from this study are now being used by the Nebraska Game and Parks Commission 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.



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## 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 2018

Funding: Nebraska Environmental Trust  
Nebraska Game and Parks Commission

Project Location: Platte River, Nebraska

Website: [wind-energy-wildlife.unl.edu/bat](http://wind-energy-wildlife.unl.edu/bat)

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Bats provide critical ecosystem services across the globe. 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.

Unfortunately, the cumulative impacts of opportunistic wind energy development could have unanticipated, negative consequences for bat populations. Across North America, wind turbines are estimated to kill over 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.



**Michael Whitby monitoring bat movement**  
Photo: Mandy Lipinski



**Acoustic detector by the Missouri River**  
Photo: Zac Warren

To achieve this goal, we used acoustic detectors to record the echolocation calls of passing bats at locations across East-Central Nebraska. Twenty-two detectors were placed on grain legs and silos with the cooperation of private landowners and recorded from April-November 2015 and 2016. We recorded almost 1 million bat passes and identified 677,000 to species. 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. 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, we captured 72 red bats and analyzed fur isotope levels to determine the catchment areas of the species during fall migration. Isotope levels between individuals caught in the summer and during fall migration were not different. This could indicate partial or limited migratory behavior of red bats in our area.

Upcoming conclusions 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.

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## CANID DISTRIBUTION AND THE POTENTIAL IMPACTS OF ENERGY DEVELOPMENT IN NEBRASKA

Principal Investigator(s): Joseph J. Fontaine, Teresa J. Frink (Chadron State College)

Graduate Student(s): Lucía Corral, Ph.D.

Project Duration: January 2013 – December 2018

Funding: Nebraska Game and Parks Commission  
Nebraska Department of Roads

Project Location: Western Nebraska

Website: [swiftfox.unl.edu](http://swiftfox.unl.edu)

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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 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 undergone significant declines. In Nebraska, swift fox is currently estimated to occupy only 21% of their historical range, while coyotes have increased in numbers and range throughout Nebraska. It is not surprising that generalists such as coyotes are capable of thriving in highly altered human landscapes, but what is less clear is why swift fox fail to occupy the 42% of Nebraska that continues to contain suitable habitat.

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. 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 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 development may alter these relationships.

From 2014 to 2016, we surveyed for canids across 26,000 square miles of western Nebraska using baited camera traps. With the help of 130 private landowners, we were able to deploy 2,300 camera trap sets, for nearly 28,000 trap nights resulting in over 5 million photos. We have used the camera trap data to develop predict models relating local and regional vegetation to the presence of various canid species.



**Swift fox caught on a trail camera in western Nebraska**



**Lucía preparing trail cameras**



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

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## CLIMATIC CONSTRAINTS ON BOBWHITE QUAIL POPULATIONS ALONG THEIR NORTHERN EXTENT

Principal Investigator(s): Joseph J. Fontaine, Gwen C. Bachman

Graduate Student(s): Amanda 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](http://prairiebirds.unl.edu)

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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. Effective management strategies necessitate a comprehensive understanding of the impacts of large scale climatic conditions and finer-scale evaluation of population responses to weather events on Nebraska's quail resources.

Given the current agricultural paradigm, and predicted changes in association with an increasingly more dynamic climate and landscape, it remains unknown whether effective management implementation can lead to reliable quail populations and facilitate long-term stability in hunter engagement, satisfaction, and participation. A first step in addressing this issue, we propose to identify the mechanism by which climatic conditions and landscape context impact quail population dynamics.



**Fitting a radio-collar on a female bobwhite quail**  
Photo: Mandy Lipinski



**Measurement of the culmen, a common morphometric measure, on a female quail**  
Photo: Mandy Lipinski

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 constraints in population growth and management strategies that many ameliorate population cycles.

Beginning in December of 2017, researchers began their last field season, following over 100 captured and radio-collared birds in south-central Nebraska. Field work concluded in early July 2018, and the project is now in the final stages of laboratory analysis of samples and statistical modeling. We are excited to examine behavioral and physiological responses during the past winter, which proved much colder and with more wintery precipitation than the previous field season.

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## COMPREHENSIVE EVALUATION OF THE NEBRASKA OUTDOOR ENTHUSIAST

Principal Investigator(s): Christopher J. Chizinski, Joseph J. Fontaine, Kevin L. Pope

Data Scientist: Nathaniel Price

Project Duration: January 2016 – January 2019

Funding: Nebraska Game and Parks Commission

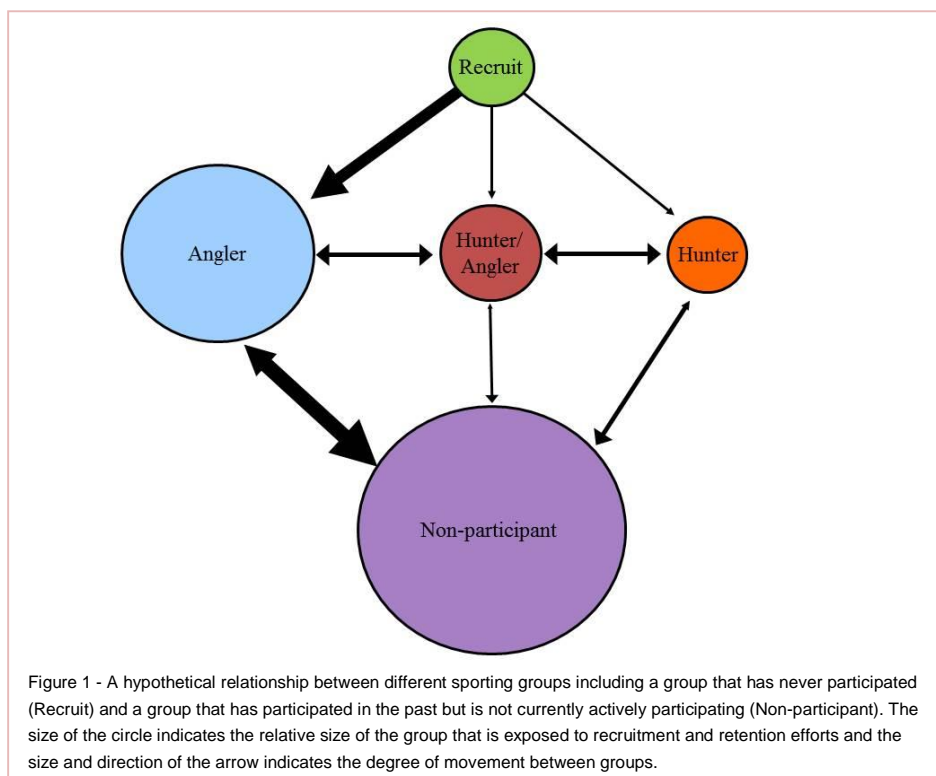
Project Location: Statewide Nebraska

Website: [fishhunt.unl.edu](http://fishhunt.unl.edu)

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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).

The Nebraska 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 assist us to 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 five 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 are analyzing 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.

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## DYNAMICS AND TRADE-OFFS AMONG SOCIAL, ECONOMIC, AND ECOLOGICAL COMPONENTS OF RESILIENCE IN WORKING AGRICULTURAL LANDSCAPES

Principal Investigator(s): Craig R. Allen, Francisco Munoz-Arriola, Nancy C. Shank

Post-Doc(s): Michael Ou  
Dan Uden (2017)

Project Duration: January 2017 – January 2018

Funding: University of Nebraska Office of Research and Development

Project Location: Global

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A grand challenge for humanity is to supply increasing food and energy demands imposed by a growing human population while preserving systems' critical services. To trace the paths of sustainable development to ultimately reach sustainability of food-energy-water systems (FEWS) nexus requires an understanding of within- and across-scale relationships among social, ecological, and economic subcomponents of social-ecological systems (SES) amidst rapidly unfolding global change.

This project applies resilience thinking and panarchy theory to questions of sustainable development at FEWS nexuses in landscapes worldwide. Expected products include frameworks for adaptively governing and managing for resilience and ecosystem services in agricultural landscapes, as well as frameworks for avoiding social-ecological traps, such as poverty and rigidity traps. Ideally, the development and implementation of these frameworks will increase sustainability and contribute to the achievement of desirable futures in diverse SES.



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## DYNAMICS OF RESILIENCE IN COMPLEX ADAPTIVE SYSTEMS

Principal Investigator(s): Craig R. Allen

Graduate Student(s): Shana Sundstrom, Ph.D.

Project Duration: August 2012 – December 2017

Funding: U.S. Geological Survey, Powell Center for Analysis and Synthesis

Project Location: Northwest United States of America and Statewide Nebraska

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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 had 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 to use 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.

This project was completed in December of 2017. Theoretical/conceptual work has focused on expanding the cross-scale resilience model to incorporate the role of abundance, and making the case that adaptive cycles and panarchy are not just a metaphor of system dynamics of change and development over time. Applied work has included identifying discontinuities in economies as complex adaptive systems and testing possible processes that would generate scale-specific attractors; looking for spatial regimes across terrestrial and aquatic systems; and will conclude with an analysis of the relationship between cross-scale resilience and degradation gradients in coral reef fish communities.

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## EVALUATING WETLAND CONDITION ACROSS NEBRASKA

Principal Investigator(s): Craig R. Allen, Theodore (Ted) LaGrange

Graduate Student(s): Cody Dreier, M.S. (2018)

Project Duration: January 2016 – August 2018

Funding: U.S. Environmental Protection Agency  
Nebraska Game and Parks Commission

Project Location: Statewide Nebraska

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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, wetlands in eleven Biologically Unique Landscapes were sampled. For the current study, the focus has been tightened onto five Biologically Unique Landscapes: Sandhill Fens in Cherry County and Western Subirrigated Alkaline Meadows in the northwest corner of Nebraska, Cottonwood–Diamond Willow Woodlands along the Loup Rivers, Eastern Bulrush Deep Marsh Community along the Central Platte, and Freshwater Seeps in northeastern Nebraska.

The primary goals of this project are:

1. Evaluate the vegetation of the vegetation, soil and water of Nebraska wetlands, within five Biologically Unique Landscapes.
2. Identify benchmarks for similar wetlands to be compared to in the future.



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



**Soil profile from a North Loup River wetland site**  
Photo: Cody Dreier

Surveys were conducted at 100 wetlands within the five Biologically Unique Landscapes during the 2016 and 2017 summers. 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.

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



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## EVALUATION FRAMEWORK FOR LARGE SCALE AQUATIC SYSTEM ADAPTIVE MANAGEMENT PROGRAMS

Principal Investigator(s): Craig R. Allen

Graduate Student(s): Chad Smith, Ph.D.

Project Duration: January 2016 – December 2018

Project Location: Platte River (Colorado, Wyoming, Nebraska); Trinity River (California); broad application to United States of America

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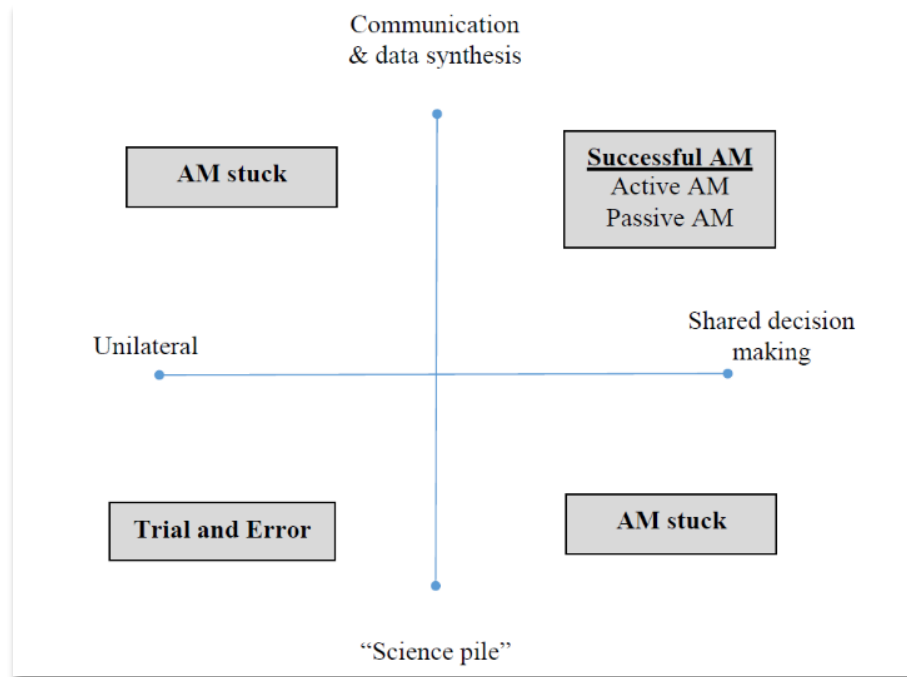
This research presents a new evaluation framework for large-scale aquatic adaptive management programs. The evaluation framework was developed by Chad Smith in response to: 1) personal experience with adaptive management failure in large-scale restoration programs, governance structure failure or absence in these programs, and observation of critical overlap between good governance and adaptive management success; and 2) recent literature and scholarship calling for more empirical case studies and analysis, particularly in U.S. river basins, of governance and adaptive management. These information sources suggest a fair exploration of the relationship between adaptive management and governance structure is warranted as it pertains to the implications for successful adaptive management at a large scale. While adaptive management is ubiquitous in most large restoration programs as the management framework of choice, few, if any, examples of successful adaptive management at a large scale exist. Given the amount of federal money spent annually on large restoration programs and the promise of adaptive management, it is curious that examples of success are in short supply. There has been a good deal of recent scholarship on governance and its components and separately on adaptive management but no examples of assessment frameworks that capture the linkages between governance structure/function and adaptive management. The evaluation framework is presented as a practical tool to assess the governance structure and operation of a large-scale program, as well as the structure and operation of adaptive management within the program. It is intended that the methodology, results, and conclusions will serve as an impetus for applying the evaluation framework to further explore the relationship between governance structure and the successful application of adaptive management in large-scale restoration programs.

The five-step Adaptive Management Program Evaluation Framework (AMPEF) was created to serve as a repeatable tool for large-scale restoration programs utilizing adaptive management to assess components/sub-components of governance and adaptive management and point to recommendations for refinement to help those programs move forward in achieving their goals and objectives. The central research hypothesis is governance of a large-scale aquatic system adaptive management program is determinative in successful implementation of adaptive management, thus predicating program success. The new evaluation framework tests this hypothesis by:

1. Specifying key governance and adaptive management components, based on a literature review, other related evaluation methods, and personal experience.
2. Conducting an assessment of these components/sub-components in two programs through program scoping, expert appraisal, interviews, and standardized electronic surveys.
3. Rating both the likelihood of success and the consequences of failure of the key governance and adaptive management components/subcomponents.
4. Assessing programs against a proposed typology for adaptive management.
5. Using the results of this rating to predict the possibility of program success or failure.
6. Prioritizing initial recommendations for reform.

The evaluation framework was developed based on a combination of scholarship and methodological application from the disciplines of risk analysis, governance analysis, and adaptive management analysis. The research also presents a proposed ideal typology for adaptive management in large-scale aquatic recovery programs that is adapted from similar work on governance structures. The typology serves as an attempt to merge governance and adaptive management components to provide qualitative insight into the hypothesis that good governance through a strong process of shared decision making and communication is likely to promote successful adaptive management at a large scale. High levels of communication and data synthesis but unilateral decision making is expected to predict adaptive management being “stuck” in the six-step cycle well before the Adjust step. A similar condition is expected for low levels of communication

and data synthesis even in shared decision-making contexts. Little communication and data synthesis (resulting in a “science pile” where data is collected but not analyzed, synthesized, or otherwise communicated to decision-makers) and unilateral decision-making is expected to promote conditions that do not enable adaptive management and instead revert management back to trial and error.



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## GENERATION OF NOVELTY IN COMPLEX SYSTEMS

Principal Investigator(s): Craig R. Allen

Post-Doc(s): Shana Sundstrom, Ph.D. (2017)

Project Duration: January 2013 – December 2018

Funding: James S. McDonnell Foundation

Project Location: Global

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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?

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## 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: Statewide Nebraska

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Our objectives for this 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 are utilizing monitoring and surveying data that is currently available in North America (e.g., Breeding Bird Surveys) with 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.

We are employing various analytical and statistical techniques 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. Techniques used include, but are not limited to, stochastic modelling, information theory, and discontinuity analysis. Additionally, we will evaluate the significance of individual species to adaptive capacity, and thus the resilience of ecosystems and landscapes. We are conducting 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.

In addition to the abovementioned goals, which are aimed specifically at informing the Department of Defense of potential threat to military readiness, two dissertations will be produced under this grant.

As the Anthropocene progresses, examples of global ecological uncertainty are on the rise: many systems are undergoing ecological regime shifts into novel, often undesirable, states. Estimating systems' vulnerability to ecological change and regime shifts can provide policy makers, land managers, and researchers the ability to prioritize land management to possibly avoid regime shifts or at least mitigate negative impacts. Using discontinuity analysis approaches to long-term continental-scale North American Breeding Bird Survey data, northward shifts have been detected in spatial ecological regime boundaries in central North America from 1970 to 2014. The results suggest that the methods used can detect direction and magnitude of ecological regime shifts in space that also implies a potential method for estimating a given ecosystem's ecological vulnerability to change: proximity to an approaching change in spatial regimes may indicate greater ecological vulnerability for ecosystems in the path of the change.

As a part of additional projects, first-authored manuscripts have been submitted to peer-reviewed journals in which undocumented ecological legacies from a 27-year-old wildfire in an eastern ponderosa pine system are identified along with identified policy and ecology mismatches in the management of a native invader (eastern redcedar).

We are also exploring the use and sensitivity of multivariate metrics in identifying, and potentially predicting, regime shifts and boundaries in space and time. Specifically, we are testing the use of the Fisher Information metric, a sound, statistical estimation of the amount of information available in observations. Fisher Information metric has been used to estimate the orderliness, or information available, within a complex system. The Fisher Information metric is well-grounded in mathematics and statistics but the sensitivities of using Fisher Information on noisy and non-Gaussian ecological data is not well-understood (non-experimental, observational data gathered about ecological systems are often noisy).

Rapid environmental change may alter the ability of the Department of Defense to maintain readiness, and require costly remediation and mitigation when formerly abundant species become rare. The uncertainties associated with global change support the need for a framework that allows the explicit incorporation of non-linear responses of complex systems. Our project addresses this uncertainty by identifying ecosystems with potential current high vulnerability to global change (risk of an impending regime shift). Here, we identified spatial regimes in avian community data and track their movements over 46 years (1970 – 2015) in the North American Great Plains biome. In 46 years, we found the northernmost spatial regime boundaries moved >590 km northward, the southernmost boundary moved >260 km northward. We demonstrate an eminent biome-level regime shift in the Great Plains and how tracking spatial regimes provides spatially and temporally explicit estimates of vulnerability to ecological change. Spatial regimes provided early warnings of regime shifts >10 years prior to the regime shift, suggesting that spatial regimes can provide decades worth of ecological planning horizons.

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## 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 – November 2018

Funding: Nebraska Game and Parks Commission

Project Location: Statewide Nebraska

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Bats are incredibly important to both ecosystems and humans. Their significance is demonstrated through the ecosystem services they provide, which include seed dispersal, pollination, and insect population control. Within states whose economy is largely dependent on agriculture, such as Nebraska, ecosystem services provided by bats are of particular significance. Pest control services from bats are valued between \$3.7 and \$53 billion dollars each year in savings for the agricultural industry. 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 the bats of Nebraska. Those who have been working in the state have provided valuable information, but gaps of knowledge do exist in the state. With a majority of the work that has been done being focused on netting-based data collection, the state could benefit from a wide scale acoustic analysis of all of the species present. This is especially important now given the impending impacts of wind turbines and White-Nose Syndrome (WNS) that have the potential to negatively affect the bats of Nebraska. The more we are able to understand how the bats of Nebraska live within the landscape the better prepared we will be able to protect their habitat, lower the impacts of WNS, and wind energy development.

The North American Bat 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 used 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 establish a framework for determining the distribution of bat species across the state.



**Seguin measuring distance to trees for stand density at a sampling location east of Lincoln, NE**  
Photo: Taylor Gosselin

The Nebraska NABat Implementation Project has been largely successful over the past two years. Completion of the 2016 and 2017 field seasons resulted in maintaining a higher number of sites and driving transects than we originally predicted. Through the winter, we began working diligently to analyze data and setup personalized materials for landowners. Each landowner received a packet of information giving them detailed information about the project, the benefits bats provide for humans, and the threats facing them in Nebraska today. We were also able to inform each landowner of the specific species we recorded on their property. These packets have been extremely popular with landowners and have helped spread valuable support and information throughout pockets of Nebraska. Last summer, citizen scientists collected data in an effort to increase public knowledge of, and involvement in,

the study of bat species in Nebraska. Through various outreach programs, contacts from conferences and with help from the Master Naturalist program we successfully recruited fourteen volunteers to help with NABat surveys. In addition to its use in monitoring and habitat analysis, this study will assess the effectiveness of the NABat program in Nebraska, including an estimate of the time and financial investments required to continue monitoring bat populations in Nebraska.

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## INTEGRATING GENETIC TOOLS INTO CONSERVATION EFFORTS

Principal Investigator(s): Kevin L. Pope, Guoqing Lu (UNO), Sarah J. Gaughan

Graduate Student(s): Sarah Gaughan, Ph.D.

Project Duration: June 2016 – present

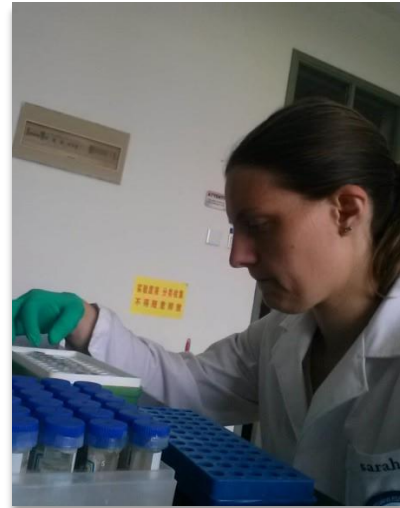
Funding: National Science Foundation EAPSI program  
National Science Foundation EO<sup>3</sup> program

Project Locations: Nebraska and China

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Evolutionary Significant Units (ESUs) are used by conservation managers to provide a rationale for prioritizing taxa for conservation efforts given limited resources. A practical extension of this approach is to identify evolutionary significant areas in which many species demonstrate phylogeographic structure. The upper portion of the Mississippi River Basin may represent an evolutionary significant area given low species-diversity and environmental-resistance values, and its unique geological history.

Genetic markers may assist current management efforts by assessing conservation units, resolving taxonomically difficult groups, detecting rare or cryptic species, and exploring evolutionary trajectories. The goal of this project is to demonstrate how genetic techniques can be integrated with other techniques to offer new management insights within the Missouri River Basin. Specifically, project objectives are to 1) determine which biological characteristics facilitate fish invasions within this region, 2) determine if hybridization occurs within other populations of bighead and silver carp or if it's driven by novel environments, and 3) establish a mitochondrial genomic repository for this region.



**Genotyping Asian carp at Shanghai Ocean University in Shanghai, China**  
Photo: Sarah Gaughan

One of the potential threats to the Missouri River Basin is the introduction of invasive species. There is considerable debate about which life-history characteristics facilitate invasion. We will explore how invasion successes of fishes in Nebraska relate to biological characteristics, including fecundity, size and propagule pressure.

Hybridization may foster invasiveness by increasing genetic diversity and ultimately enhancing adaptation in novel environments. This phenomenon may explain the successful invasion of two sympatric Asian carps, bighead carp and silver carp, in the Missouri River basin. Genetic markers have been developed that now allow us to explore the extent of hybridization of these two species. If hybridization facilitated this invasion, then we expect a greater rate of hybridization in the Missouri River Basin compared to native ranges in China.

The stability of mitochondrial genomes in addition to their high mutation rate and relatively low number of genes make mitochondrial genomes ideal markers to begin addressing some of the evolutionary questions and conservation concerns of native species. However, a major limitation for genetic studies in the Missouri River Basin is the lack of a genetic database. We will begin to develop a genetic database with a primary focus towards native fish genomes because there are relatively few native fishes in Nebraska (i.e., doable) and fishes represent the largest invasive taxa in Nebraska.



We will also include the mitochondrial genome of the Northern Long Eared Bat (*Myotis septentrionalis*) to showcase the functionality of mitochondrial genomes across diverse taxa.

Thus far, we have determined that species origin, degree of parental care, fecundity, lifespan, and propagule pressure were critical biological characteristics of invasive fishes that facilitated establishment within the USA. We have determined that hybridization rates between bighead carp and silver carp are similar in environments within native (12% in China) and non-native (13% in USA) ranges, counter to our a priori expectation that hybridization rates would be substantially greater in novel environments of the non-native range. To this point, we have collected and extracted mitochondrial DNA from 62 native species, including 61 native fishes and *Myotis septentrionalis*. These mitochondrial genomes are currently being sequenced.



**Colonic Irrigation of a pallid sturgeon  
(*Scaphirhynchus albus*) with Justin Haas of  
Nebraska Game and Parks**  
Photo: Stephanie Purcell

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## INVASION, COST-SHARE, AND PRIVATE LANDOWNERS: RESOLVING THE CHALLENGES OF SCALE WITH MANAGING *JUNIPERUS VIRGINIANA* ON NEBRASKA'S RANGELANDS

Principal Investigator(s): Craig R. Allen, Dirac Twidwell

Graduate Student(s): Brittany Dueker, M.S.

Project Duration: August 2016 – December 2018

Funding: Nebraska Game and Parks Commission

Project Location: Statewide Nebraska

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With the rise of globalization, the spread of invasive species has become increasingly prevalent and problematic. A characteristic of many biological invasions is a period of rapid population growth following introduction; management and control is most likely to be successful if it occurs prior to that period of rapid growth. By its scientific name, *Juniperus virginiana* or commonly known as Eastern Redcedar (ERC) is a woody species currently invading the Great Plains of the USA. Although it is native to Nebraska, it is spreading into grasslands and rangelands where it was not historically present and has the potential to seriously disrupt the local economy, including cattle production. Cedar can be controlled via regular burning to grasslands, which removes woody brush and revitalizes native grasses, however, public opinion of prescribed fire is uncertain.

Because so much of Nebraska is privately owned, it is critical that the public understands the seriousness of the ecological and economic costs of cedar invasion, and the importance of properly managing both private and public lands. Cost-share programs provide funding that offsets the cost of and provides technical assistance for management which improves the environment, and engaging landowners educates them on local ecological issues and solutions, potentially educating their friends and neighbors, too. Joining a cost-share program is voluntary, so to increase participation, much research has been done to determine which incentives are preferred by the majority of landowners. Although these studies have discussed the social aspect of cost-share, they overlook the ramifications of structuring a program based on landowner preferences rather than ecological science. If cost-share management is at a smaller scale than ERC invasion, management will not be successful in the long run.

The purpose of this study is to understand the perceptions of Nebraskan landowners in regards to ERC and ERC management, and the ways participation-based incentives influence the scale of management of Nebraska Game and Parks Commission cost-share programs which remove ERC, to identify where these programs are succeeding at their conservation goals and where improvements can be made.

In November of 2017, surveys were distributed to 2,262 people who owned land in rural Nebraska, asking questions about the perception of Eastern Redcedar and prescribed fire management. Data collection was completed in January 2018 and analysis and write-up is currently underway. Results show that landowners prefer smaller scales of management, even given cost-share program incentives that cover the entire monetary cost, and the amount of land that is preferred to be managed is more influenced by restrictions to land use before, during, and after management. Analysis and write-up of data from the 2015-2016 NASIS survey and the 2016 Fire Chief survey is also in progress. Results from these surveys show that cedar is seen as a problem by more landowners in the central areas of the state rather than the east or west, and that fire departments in Nebraska agree more with using prescribed fire for range management than for livestock production, even though the two are directly linked.

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## MANAGING REDCEDAR INVASION OF NEBRASKA GRASSLANDS – PART I

Principal Investigator(s): Dirac Twidwell, Craig R. Allen

Graduate Student(s): Christine Bielski, Ph. D.

Project Duration: January 2017 – January 2021

Funding: Nebraska Game and Parks Commission

Project Location: Statewide Nebraska

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Eastern Redcedar is the most rapidly expanding woody plant species in the Great Plains and is now recognized as the number one threat to Nebraska's rangelands by the Nebraska Conservation Roundtable. The impacts of redcedar invasion in grasslands are wide-ranging, including reducing grassland bird diversity and abundance, decreasing livestock production by 75%, reducing small mammal and insect diversity, and costing Nebraska Public Schools over \$2,440,000 from 2006-2016. The objective of this grant is to assess the vulnerability of Nebraska's grasslands to redcedar invasion, and develop predictive tools that enhance the potential to implement landscape interventions that (1) prevent the spread of redcedar trees or (2) restore degraded wildlife habitat following transformation to a redcedar-dominated state.

Two field experiments have been conducted since January 2018 with preliminary fire models conducted in BehavePlus, (Windows based fire management application to calculate fire behavior), and one manuscript is in its final stages before submission to a scientific journal. The first field experiment involved collecting thermal imaging data on extreme prescribed fires conducted in the Loess Canyons Biologically Unique Landscape (BUL). Information from these prescribed fires expanded on similar data collected in 2017 and will be used to validate future experimental investigations on extreme fire effects in grasslands as well as provide evidence for increased wildfire risk in juniper-invaded grasslands. The second field experiment was also conducted in the Loess Canyons BUL with the objective of quantifying rates of juniper recovery following extreme fire. This project was led by an undergrad student I advised that was enrolled in the USDA REU (research experience for undergrads) program. Data from the second field experiment show that Eastern Redcedar re-invades woodlands previously collapsed by extreme fire at surprisingly fast rates. Multiple mathematical fire models have been conducted in BehavePlus to quantify ember transport distances to better inform prescribed fire designs. Model outputs from these simulations will be used to quantify the maximum ember transport distance and likelihood of spotfire occurrence in large-scale prescribed fires.



**Eastern Redcedar in Nebraska Grasslands**  
Photo: Christine Bielski

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## MANAGING REDCEDAR INVASION OF NEBRASKA GRASSLANDS – PART II

Principal Investigator(s): Dirac Twidwell, Craig R. Allen

Graduate Student(s): Dillon Fogarty, Ph.D.

Project Duration: January 2016 – December 2020

Funding: Nebraska Game and Parks Commission

Project Location: Statewide Nebraska

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Juniper expansion is an important issue, especially in the Great Plains, because ecosystem service provisioning is altered when grasslands are invaded by juniper. However, an assessment of the impacts juniper invasion has on ecosystem service provisioning is lacking. A central aim of this thesis research is to synthesize the impacts of juniper invasion on grassland ecosystem services.

This synthesis will then be contrasted against:

- How Nebraskan's value ecosystem services
- How other invasive species in grasslands alter ecosystem service provisioning
- How natural resource professionals perceive the impact of juniper invasion relative to other invasive species

We have synthesized how ecosystem services are altered in the Great Plains when (1) juniper are used in windbreaks and (2) grassland undergo a regime shift from a grassland state to a juniper woodland. Results illustrate that a tradeoff exists between localized benefits associated with planting juniper in windbreaks and regional consequences of juniper invasion. Current research is working to develop a framework to better understand these complex tradeoffs by incorporating time and space dimensions into ecosystem service assessments. Understanding such complex tradeoffs is important to improving environmental decision making in areas that are known to be vulnerable to juniper invasion. However, in western Nebraska there is high uncertainty regarding the potential for invasion to occur. To this end, we have conducted research in Nebraska's Sandhills ecoregion to assess which areas are capable of supporting Eastern Redcedar woodlands. Preliminary results show that most of the Sandhills is susceptible to juniper invasion while a small portion remains uncertain. Findings illustrate that preventative, eradication, control and restorative management

strategies are appropriate in different regions of the Sandhills and our research has potential to help guide grassland management in this region. However, additional collaborative research conducted with other NE Coop Unit members, Caleb Roberts and Daniel Uden, on the sustainability of grassland management within Nebraska's Biologically Unique Landscapes shows that current approaches have not halted increases in tree cover. Suggesting that adaptation of current management approaches may be needed to sustain grassland resources.



**Eastern Redcedar in Nebraska Grasslands**  
Photo: Christine Bielski

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## 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](http://neinvasives.com)

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

1. 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;
2. 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 is a formalized Council created by a law in 2012. This Council is comprised of 17 appointed members and a total of 25 regularly attending members which discusses topical invasive species issues, develops management plans and Early Detection-Rapid Response (EDRR) plans and informs the Nebraska Legislature and Governor of the status of invasive species in the state. An adaptive management plan was written by the Council in 2015 and will be updated in 2018 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 guides provided to resource agencies and place on the program's website for downloads at no cost.

In addition, the council updated the Nebraska weed watch list to identify key species of concern for management efforts in 2018. The program coordinator served on regional panels to coordinate outreach, management and prevention efforts across state lines. The NISP coordinator developed the boater survey in 2018 with the Nebraska Game and Parks Commission and will analyze the 2018 data, compile results into a report that will be used for planning aquatic invasive species outreach, prevention and spread efforts in 2019.



**Lakeside outreach event**  
Photo: Allison Zach



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## NATIONAL SCIENCE FOUNDATION RESEARCH TRAINEESHIP PROGRAM

Principal Investigator(s): Craig R. Allen, Nancy Shank, Francisco Munoz-Arriola, Sebastian Elbaum, Dirac Twidwell

Graduate Student(s): January and August 2018 Cohort

Project Duration: August 2017 – September 2022

Funding: National Science Foundation

Project Location: Statewide Nebraska

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This National Science Foundation Research Traineeship (NRT) award to the University of Nebraska–Lincoln, establishes a new graduate training program that focuses upon understanding the resilience of agricultural systems. Nebraska hosts one of the world's most productive and efficient agricultural systems, the Platte River Basin. Like most agricultural systems characterized by high productivity and efficiency, its resilience to change is unknown. This training program builds upon strengths at the University of Nebraska, and joins the disciplines of agronomy, natural resources, computer sciences and engineering with policy studies, to enhance the resilience of agricultural landscapes to global – and local – change. Interdisciplinary training for Master's and Ph.D. students will enhance the type of team-building needed to address today's food, energy, and water problems, and trainees will engage with external partners from the agricultural industry, from state and federal government, and NGO's that have an interest and stake in maintaining productive agricultural systems. The traineeship program anticipates preparing ~50 trainees (25 Ph.D. and 25 Master's), including 23 funded trainees (9 Ph.D., 14 Master's), with a focus on hands-on experiences between the university and its industry and agency partners. Trainees will focus on key aspects of agricultural resilience specific to their interests, while receiving broad training in resilience theory as applied to working agricultural landscapes. This training will help develop a workforce and agricultural industry better capable of managing future demands on food, energy, and water systems. Currently the program is supporting ten students.

This NRT program will focus on understanding resilience in water-stressed and energy-demanding agricultural landscapes and will utilize resilience and panarchy theory, adaptive management, novel sensing technologies and modeling, and policy interventions. Such training is rare in graduate programs in the United States, but is required to prepare the next generation of natural resource scientists, producers, managers, engineers, and policymakers to better respond to the challenges created by increasing demands for diminishing and interconnected resources and the need to maintain and build resilience in stressed watersheds. The University of Nebraska is recognized as a global leader in water and agricultural sciences; this NRT will explicitly integrate these disciplines. This NRT will train students in interdisciplinary science at the nexus of theory and application, and the intersection of sometimes completing, sometimes complementary endpoints of food, water, and energy – and ecosystem services – sustainability. In addition, this NRT will serve as the innovative foundation for a permanent interdisciplinary graduate program that will create a novel education program in the resilience of agro-ecosystems and ensure students, academic programs, local-to-federal agencies, and the private sector engage in building and preserving natural and agricultural ecosystems to meet local-to-global demands of water (in quantity and quality), clean energy, food, and ecosystem services. Moreover, this NRT will develop cross-disciplinary training for multidisciplinary cohorts of graduate students focused on the complex and intertwined ecological, technical, and societal systems involved in managing resilient water resources in the 21st century, in complex landscape managed for agricultural production. Further, the program will help develop innovative tools for data collection, analytics, and synthesis for decision support, management, and restoration of water-stressed agricultural systems within local-to international contexts. The program is designed to encourage the development and implementation of bold, new potentially transformative models for STEM graduate education training. The Traineeship Track is dedicated to effective training of STEM graduate students in high priority interdisciplinary research areas, through comprehensive traineeship models that are innovative, evidence-based, and aligned with changing workforce and research needs.

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## NOVEL ECOLOGICAL USES FOR UNMANNED AERIAL VEHICLE

Principal Investigator(s): Sebastian Elbaum, Carrick Detweiler, Dirac Twidwell, Lisa Pytlik Zillig, Brittany Duncan, Justin Bradley, Craig R. Allen

Graduate Student(s): Associated with other University of Nebraska–Lincoln departments

Project Duration: January 2014 – present

Funding: National Science Foundation

Project Location: Statewide Nebraska

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We have established a team of ecologists, computer scientists, and 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.



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



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## 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 2019

Funding: Rainwater Basin Joint Venture

Project Location: Statewide Nebraska

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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 works 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. In addition, Dana helps monitor and evaluate the success of ongoing and past habitat conservation projects, collaborating with researchers from various federal, regional, and state conservation organizations. Dana recently worked with a group of partners to complete a research project looking at roosting habitat use by Sandhill Cranes and waterfowl on the North and South Platte Rivers in Nebraska. This project used aerial flock surveys during each spring from 2014–16 to pinpoint the most important river reaches for each species and the habitat traits associated with high levels of use. The manuscript for this project is currently in review. This year Dana served as co-chair of the conference organizing committee for the 14th North American Arctic Goose Conference. This event hosted almost 100 researchers, students, and managers from around the world to share the latest in goose science and conservation. Dana is involved with several other projects currently in progress including an evaluation of the effects of irrigation pit-fills on ponding efficiency of wetlands following heavy rainfall events and monitoring of spring-migrating waterfowl use of playas in the Rainwater Basin region.



**Waterfowl on a Rainwater Basin playa during a waterfowl survey**  
Photo: Evan Ward

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## 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 – August 2018

Funding: Nebraska Department of Roads

Project Location: Statewide Nebraska

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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 for increased understanding of 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 due to projected population declines, this work will also potentially limit intensive and costly consultation with the U.S. 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 implemented a two-stage process over the course of two field seasons.



**Warren recording data at a sampling location  
north of Rushville, NE**  
Photo: Catherine Berrick

The first stage acoustically sampled the entire state to better define the geographic distribution of the species. We completed this sampling in August of 2015 and used this data to predict occupancy of the Northern Long-Eared bat across the state and to understand the landscape variables associated with occurrence of the species. In part two of the project, I intensively sampled five locations within NLEB's Nebraska range to determine stand-level habitat usage. Between May and August of 2016, we deployed forty-six paired bat detectors simultaneously at each of the randomly selected locations. This resulted in >1,500 recordings nights with NLEB being detected at all locations. Combined with site measurements and remotely sensed data sources, this data will provide insight into the factors that contribute to occupancy as well as detection probability of the species. The final stage of the project was a quantitative meta-analysis of northern long-eared bat roosting studies across North America. This study enabled range-wide conclusions on roost tree characteristics selected for by the Northern Long-eared Bat.

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## SPATIO-TEMPORAL FORAGING ACTIVITY OF BATS IN THE AGRICULTURAL LANDSCAPE

Principal Investigator(s): Craig R. Allen

Graduate Student(s): Christopher Fill, MS.

Project Duration: January 2018 – May 2020

Funding: National Science Foundation Program (NRT), National Park Service

Project Location: Eastern Nebraska

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As the primary predator of night flying insects, bats play a major role in consuming insect pests. However, bat populations have been in decline from a variety of factors including white-nose syndrome, wind energy farms, and habitat loss. Areas of tree cover are important habitat for bats in modified agricultural landscapes, and in Nebraska, forest dependent tree-roosting bats in particular are affected negatively by habitat fragmentation.

For a more complete picture of bat foraging ecology in intensively managed agricultural environments, we will investigate the spatial and temporal movements of insectivorous bat species in crop fields through systematic deployments of acoustic bat detectors, from which we can: 1) examine the temporal activity patterns and trends of foraging insectivorous bats in crop fields, and 2) assess the spatial distribution, habitat use, and relative species composition of the foraging bat species in agricultural landscape settings.



**Implementation of vertical bat detector**

Photo: Baxter Seguin



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

Principal Investigator(s): Joseph J. Fontaine

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](http://prairiebirds.unl.edu)

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Ring-necked pheasants (*Phasianus colchicus*) 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, Nebraska Game and Parks Commission intensively manages 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.



**Radio collared hen pheasant**  
Photo: David Damsky



**Alex Engel taking morphometric measurements of a pheasant, specifically toe length**  
Photo: David Damsky



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## USE AND SATISFACTION OF PUBLIC HUNTING OPPORTUNITIES

Principal Investigator(s): Joseph J. Fontaine

Project Manager(s): Lindsey Messinger (August 2014 - October 2016)  
Michael Winkler (August 2015 - August 2016)

Graduate Student(s): Lyndsie Wszola, M.S. (2017)

Project Duration: January 2010 – December 2019

Funding: Nebraska Game and Parks Commission

Project Location: Statewide Nebraska

Website: [fishhunt.unl.edu](http://fishhunt.unl.edu)

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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 access 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, traditional data sources do 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. 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. 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.

From 2014-2017 we worked on more than 500 individual properties from eight focal areas spread across Nebraska. In total, we conducted more than 110,000 point-surveys that identified in excess of 11,000 cars. We also interviewed more than 7,000 users of publically accessible lands in Nebraska. Users represented an array of outdoor enthusiasts from 44 different states, with upwards of 80% of the fall users being hunters. We are currently analyzing data to understand how users of publically accessible lands distribute on the landscape in the hopes of helping managers identify effective strategies for providing opportunities for outdoor enthusiasts in Nebraska.



**A pheasant hunter being interviewed**  
Photo: Joseph Fontaine

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## 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 (March 2016 - December 2016)

Post-Doc(s): Amanda Sorensen (July 2017- July 2018)  
Michelle Lute (November 2015 – October 2016)

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](http://swiftfox.unl.edu)

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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.

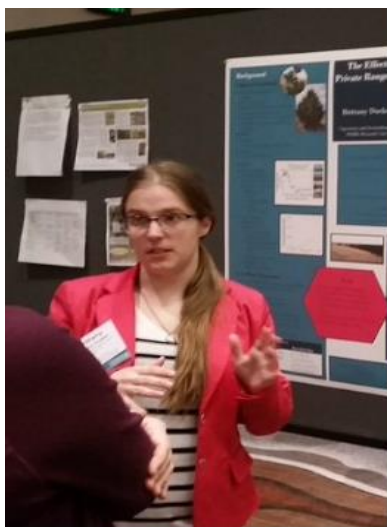
Using a unique approach which incorporates landowners in the conservation process we are sending undergraduate students back to their family ranches to survey for swift fox. Many students in range management, wildlife biology, and similar conservation majors at CSC and UNL are from working ranches in 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





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## TEACHING

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### CRAIG ALLEN

#### Fall 2017: NRES 896

Biological invasions are an accelerating global phenomenon with potential far-reaching economic and ecological impacts. This course is intended to increase students' understanding of invasions and their impacts. It draws from plant, invertebrate and vertebrate examples. The focus is primarily upon animal invasions and understanding the effects on structure, process and function of native and ecological systems. Towards the latter part of the semester, time is devoted to developing and testing hypotheses related to invasions. Some areas covered include which species invade, which communities are invaded, invasion processes, control and management, invasions and extinctions, impacts on native species, impacts on ecosystems, economic impacts, global comparisons, community and ecosystem assembly. A class manuscript, with all students as coauthors, is expected.

### JOSEPH FONTAINE

#### Fall 2017 and Spring 2018: Trends in Ecological Applications

Co-taught with Dr. Erica Stuber, 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.

#### Spring 2018: Science Writing

The purpose of this course is to help students learn the intricacies of scientific writing from developing proposals and writing manuscripts, to participating in the peer review process.

### KEVIN POPE

#### Spring 2018: Quantitative Fishery Assessment

This course provides information necessary to address scientific and management questions. It is designed to increase students' understanding of current fishery assessment practices. Emphasis is 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 are 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.

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## GRADUATE COMMITTEE SERVICE

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### CRAIG ALLEN

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

### JOSEPH FONTAINE

- Laura Vander Meiden (Ph.D., School of Biological Science, UNL)
- Nicholas Cole (Ph.D., School of Natural Resources, UNL)
- Connor Gearin (M.S., Dept. of Biology, UNO)
- Alisha Grams (M.S., School of Natural Resources, UNL)
- Abigail Neyer (Ph.D., School of Biological Science, UNL)



#### MARK KAEMINGK

- Lindsay Ohlman (M.S., School of Natural Resources, UNL)
- Garrett Rowles (M.S., School of Biology, UNK)

#### KEVIN POPE

- Henry Hansen (M.S., School of Natural Resources, UNL)
- Matt Reichenbach (Ph.D., Department of Mathematics, UNL)
- Ryan Ruskamp (M.S., School of Natural Resources, UNL)
- Shana Sundstrom (Ph.D., School of Natural Resources, UNL, graduated May 2018)
- Kyle Wilson (Ph.D., Department of Biological Sciences, University of Calgary, graduated August 2018)

#### ERICA STUBER

- Nadya Mirochnitchenko (M.S., School of Natural Resources, UNL)
- Christine Ruskamp (M.S., School of Natural Resources, UNL)

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### PROFESSIONAL AND FACULTY SERVICE

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#### CRAIG ALLEN

- Associate Editor. Ecology and Society
- Core Member. Predicting the next high-impact insect invasion: Elucidating traits and factors determining the risk of introduced herbivorous insects on North American native plants. USGS Powell Center for Analysis and Synthesis Working Group, Fort Collins, CO. 2015-2017
- Executive Board. The Nature Conservancy Nebraska
- Executive Board. The Resilience Alliance
- Member. Nebraska Conservation Roundtable
- Special Issue Editor. Frontiers in Ecology
- Subject Matter Expert. U.S. Global Change Research Program and the American Geophysical Union's Thriving Earth Exchange: Resilience Dialogues.

#### JOSEPH FONTAINE

- Core Member. Local committee, 2018 Sportsman Summit, Nebraska City, NE
- Member. Local committee, 2018 North American Arctic Goose Conference Annual Meeting, Lincoln, NE
- Representative. School of Natural Resources Graduate Committee
- Scientific committee. 2017 Midwest Fish and Wildlife Conference, Lincoln, NE

#### MARK KAEMINGK

- Presentation Judge. Nebraska American Fisheries Society Conference
- Presentation Judge. Parent Society American Fisheries Society Conference, Atlantic City, NJ
- Reviewer and Judge. Parent Society American Fisheries Society Conference, Education Section Student Writing Competition, Atlantic City, NJ

#### KEVIN POPE

- Member. Nebraska Conservation Roundtable
- Member. Book Editorial Advisory Board. American Fisheries Society
- Chair. 2018 Sportsman Summit, Nebraska City, NE
- USGS Representative. Reservoir Fisheries Habitat Partnership

#### ERICA STUBER

- Member. Natural Resources Diversity Initiative Leadership Team

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## OTHER PROFESSIONAL SERVICE

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### JESSICA BURNETT

- Contributing member. Inclusive Ecology Section, Ecological Society of America
- Contributor. Envirobites (Environmental science research for everyone)
- Co- founder. Natural Resources Diversity Initiative, University of Nebraska–Lincoln
- Co-founder. Affiliate Chapter of the Association for Women in Science (AWIS), University of Nebraska–Lincoln
- Member. Faculty Search Committee for Urban and Community Forester position, School of Natural Resources, University of Nebraska–Lincoln
- Member. University of Nebraska–Lincoln Complexity Science Working Group
- Invited blogger. Resilience 2017 Conference in Stockholm, Sweden, The Resilience Alliance
- Reviewer. Wilson Journal of Ornithology
- Seminar Coordinator. Fall 2017 School of Natural Resources, University of Nebraska–Lincoln
- Student representative. Faculty Advisory Committee, School of Natural Resources

### CHRISTINE BIELSKI

- Reviewer. LANDFIRE Biophysical Settings Models, LANDFIRE Project
- Member. Eastern redcedar Working Group, University of Nebraska–Lincoln
- Reviewer. Conservation plan for the Loess Canyons Biologically Unique Landscape, Nebraska Game and Parks Commission, North Platte, NE
- Reviewer. Nebraska Cedar Crisis, Nebraska Conservation Roundtable

### DILLON FOGARTY

- Member. Conservation plan for the Loess Canyons Biologically Unique Landscape, Nebraska Game and Parks Commission, North Platte, NE
- Coordinator. Allen Lab Group meeting, University of Nebraska–Lincoln
- Coordinator. Eastern Redcedar Working Group, University of Nebraska–Lincoln
- Coordinator. UNL Agro-Hort Range and Forage Group, University of Nebraska–Lincoln

### NADYA MIROCHNITCHENKO

- Member. Safety Committee. School of Natural Resources

### KEVIN POPE

- USGS Detail. Landscape Science Coordinator

### BAXTER SEGUIN

- Representative. School of Natural Resources Secondary Representative and Academic Affairs Committee member, ASUN Graduate Student Association

### ZACHARY WARREN

- Nebraska State Representative. Western Bat Working Group
- Representative. School of Natural Resources and Academic Affairs Committee member, Association of Students of the University of Nebraska–Lincoln, Graduate Student Association
- Mentor. Undergraduate Creative Activities and Research Experience, UCARE student, Northern long-eared bat Activity Patterns

### ALLISON ZACH

- Representative. Western Regional Panel on Aquatic Invasive Species
- Representative. Mississippi River Basin Panel
- Representative. Missouri River Basin Panel
- Member. Eastern Red Cedar Summit
- Coordinator. Nebraska Invasive Species Advisory Council

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## TRAINING ASSISTANCE, WORKSHOPS AND OUTREACH ACTIVITIES

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### CARYL CASHMERE

- Presenter. UNL Forms and Processes, Statewide Creel Clerk Workshop, Lincoln, NE, March 2018

### DILLON FOGARTY

- Teaching Assistant: Great Plains Ecosystems (AGRO 440), UNL Spring 2018.
- Presenter. Wildlife education in the classroom, Everett Elementary School, Lincoln, NE, May 2017

### KEVIN POPE

- Instructor. Over-the-Water training, Lincoln, NE, March 2018

### ALLISON ZACH

- Facilitator. Invasive species crafts at Nature Nights, various locations in NE, Spring 2018
- Facilitator. Outreach booth at Carp-O-Rama, various locations in NE, Summer 2018
- Facilitator. Outreach Booth at Fishing Tournaments, various locations in NE, Summer 2018
- Facilitator. Outreach booth at Family Fishing Nights, various locations in NE, Summer 2018
- Facilitator. Outreach booth at Nebraska Game and Parks Expos, Kearney & Ponca, NE, May & September 2018
- Instructor. Aquatic invasive species identification workshop, Creel Clerk Training, Lincoln, NE, April 2018
- Instructor. Lauritzen Garden's Arbor Day Festival, Lincoln, NE, April 2018
- Presenter. Archie's Late Night Party at Morrill Hall, Lincoln, NE, June 2018
- Presenter. Fontenelle Forest S.U.N, Bellevue, NE, April 2018
- Presenter. Nebraska American Fisheries Society, Lincoln, NE, February 2018
- Presenter. Nebraska Weed Control Association Conference, Norfolk, NE, February 2018
- Presenter. Nebraska Lake Association Annual Meeting, Lincoln, NE, April 2018
- Presenter. Outdoor Discovery Program, Platte River State Park, NE, April 2018
- Presenter. Outdoor Discovery Program, Kearney, NE, May 2018
- Presenter. Siouxland Garden Show, Sioux City, IA, April 2018
- Webinar Facilitator. Invasive Mussel Collaborative Presenter, January 2018

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## PEER-REVIEWED PUBLICATIONS

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- Abbey-Lee, R., Y. Araya-Ajoy, A. Mouchet, E.F. Stuber, B. Kempnaers, and N. Dingemanse. 2018. Does perceived predation risk affect patterns of extra-pair paternity? A field experiment in a passerine bird. *Functional Ecology*. 32:1001-1010.
- Allen, C.R. and J.J. Fontaine. 2017. Employment with the United States Geological Survey. Pp. 58-60 in S.E. Henke and P.R. Krausman, editors. *Becoming a Wildlife Professional*. Johns Hopkins University Press and The Wildlife Society. Baltimore, MD.
- Allen, C.R., D.G. Angeler, J.J. Fontaine, A.S. Garmestani, N.M. Hart, K.L. Pope, and D. Twidwell. 2017. Adaptive management of rangeland ecosystems. Pages 373-394 in D. D. Briske, editor. *Rangeland systems: processes, management and challenges*. Springer, New York.
- Allen, C.R., H.E. Birgé, D. Angeler, C. Anthony, T. Arnold, B.C. Chaffin, D. DeCaro, A.S. Garmestani, L.H. Gunderson. *Uncertainty and Trade-Offs in Resilience Assessments*. 2018. Pages 243-268 in Gunderson, L.H. and B. Cosens, Eds. *Practical Panarchy for Adaptive Water Governance*. Springer.
- Angeler, D.G., C.R. Allen, A.S. Garmestani, K.L. Pope, D. Twidwell, and M. Bundschuh. Draft. (in press). Resilience in environmental risk and impact assessment concepts and measurement. *Integrated Environmental Assessment and Management*.
- Barichievy, C., D.G. Angeler, T. Eason, A.S. Garmestani, K.L. Nash, C.A. Stow, S. Sundstrom, and C.R. Allen. (in press). 2017. A method to detect discontinuities in census data. *Methods in Ecology and Evolution*.
- Beachly, E., J. Higgins, C. Laney, S. Elbaum, C. Detweiler, C.R. Allen, and D. Twidwell. (in press). 2018. A micro-UAS to Amplify Fire Ignition Capabilities and Safety. *International Symposium on Experimental Robotics*.
- Bielski, C.H., B. Dueker, F. Fogarty, H. Tripp, D. Twidwell, and C.R. Allen. 2018. Eastern redcedar Common Questions and Curiosities. University of Nebraska-Lincoln Extension Circular, EC3031.
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## PRESENTATIONS

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Camp, E.V., K.L. Pope, R.N.M. Ahrens, and W.M. Potts. 2018. Socio-ecological regimes in recreational fisheries. 148<sup>th</sup> Annual Meeting, American Fisheries Society, Atlantic City, New Jersey.

Chizinski, C.J., N. Price, J.J. Fontaine, and K.L. Pope. 2018. Cross-buying behavior and future purchase tendencies of Nebraska anglers. Annual Meeting, Nebraska Chapter, American Fisheries Society, Lincoln, Nebraska.

Chizinski, C.J., N. Price, M.P. Hinrichs, J.J. Fontaine, and K.L. Pope. 2018. Transitions among sportsperson permit holders and the influence of cross-buying behavior. Pathways 2018 Conference, Goslar, Germany.

Cole, N.W., C.J. Chizinski, and K.L. Pope. 2018. Moral domains of Nebraska fishing-permit holders: implications for participation in outdoor recreation. Annual Meeting, Nebraska Chapter, American Fisheries Society, Lincoln, Nebraska.

Fogarty, D.T., D. Twidwell, and C.R. Allen. 2018. Juniper invasion alters grassland ecosystem services in the Great Plains. Great Plains Grassland Summit, Denver, Colorado.

Fogarty, D. T., D. Twidwell, and C.R. Allen. 2017. Nebraskans' well-being and eastern redcedar driven conflicts of interest. Nebraska Natural Legacy Project Annual Conference, Nebraska City, Nebraska.

Fontaine, J.J. 2018. Advancing our understanding of pheasant agroecosystems. Pheasants Forever National Board Meeting, Sioux Falls, South Dakota.

Fontaine, J.J. 2018. Drought and pheasants: understanding the mechanisms of population responses to extreme climatic events. South Dakota Chapter of The Wildlife Society, Chamberlain, South Dakota.

Fontaine, J.J. 2018. Living on the edge: pheasants in our new agricultural landscape. South Dakota Wildlife Society. Oacoma, South Dakota.

Fontaine, J.J. 2018. Some thoughts on the people of the Rainwater Basin. Rainwater Basin Joint Venture Informational Seminar. Hastings, Nebraska.

Gruber, L.F., E.F. Stuber, L.S. Wszola, J.J. Fontaine. Estimating the Use of Public Lands: Integrated Modeling of Open Populations with Convolution Likelihood Ecological Abundance Regression. 2018 ISBA World Meeting. Edinburgh, United Kingdom.

Gruntorad, M.P., C.J. Chizinski, N. Price, J.J. Fontaine, and K.L. Pope. 2018. Permit buying behavior of Nebraska paddlefish anglers. Annual Meeting, Nebraska Chapter, American Fisheries Society, Lincoln, Nebraska.

Hansen, H., M. Pegg, and K. L. Pope. 2018. Exit here: strategies and considerations for dealing with aging dams. 78<sup>th</sup> Annual Meeting, Midwest Fish and Wildlife Conference, Milwaukee, Wisconsin.

Hurley, K.L., K.L. Pope, and M.A. Kaemingk. 2018. Machine learning and the catch-harvest decision. Annual Meeting, Nebraska Chapter, American Fisheries Society, Lincoln, Nebraska.

Kaemingk, M.A., C.J. Chizinski, C.R. Allen, and K.L. Pope. 2018. Size matters: waterbody size shapes social-ecological relationships in a regional recreational fishery. Annual Meeting, Nebraska Chapter, American Fisheries Society, Lincoln, Nebraska.

Madsen, A., L. Corral, and J.J. Fontaine 2018. Weather and length of deployment period affect detection rates at camera traps. International Society for Behavioral Ecology, Minneapolis, Minnesota.

Mech A.M., T.D. Marsico, K.A. Thomas, D A. Herms, C.R. Allen, and P.C. Tobin. 2017. Predicting the impact of non-native specialist insects feeding on North American host plants. ESA Annual Meeting, Portland, Oregon.

Mirochnitchenko, N., E.F. Stuber, and J.J. Fontaine. 2018. Phylogenetic and functional diversity of grassland bird communities across an alter landscape. Central Mountains and Plains Section of the Wildlife Society, Kearney, Nebraska.

Price, N.B., C.J. Chizinski, K.L. Pope, and J.J. Fontaine. 2018. Retention of youth deer hunters in Nebraska. 78<sup>th</sup> Annual Meeting, Midwest Fish and Wildlife Conference, Milwaukee, Wisconsin.

Pope, K.L., C.J. Chizinski, and M.A. Kaemingk. 2018. Time-lapse and motion-detection photography to assess recreational fisheries. Canadian Conference for Fisheries Research, Edmonton, Alberta, Canada.

Pope, K.L., C.J. Chizinski, and M.A. Kaemingk. 2018. Vehicle detections by time-lapse and motion-detection cameras. Annual Meeting, Nebraska Chapter, American Fisheries Society, Lincoln, Nebraska.

Ruskamp, C.N., M.A. Kaemingk, C.J. Chizinski, and K.L. Pope. 2018. Angler behavior: a landscape perspective. 148<sup>th</sup> Annual Meeting, American Fisheries Society, Atlantic City, New Jersey.

- Ruskamp, C.N., M.A. Kaemingk, C.J. Chizinski, and K.L. Pope. 2018. Anglersheds: spatial dynamics of anglers on the landscape. Annual Meeting, Nebraska Chapter, American Fisheries Society, Lincoln, Nebraska.
- Ruskamp, C.N., M.A. Kaemingk, C.J. Chizinski, and K.L. Pope. 2018. Bridging the social-ecological gap with anglersheds. 78<sup>th</sup> Annual Meeting, Midwest Fish and Wildlife Conference, Milwaukee, Wisconsin.
- Simonsen, V., and J.J. Fontaine. 2018. Large or small patches? How patch size and nest density influence nest survival and conservation in grasslands. Central Mountains and Plains Section of the Wildlife Society, Kearney, Nebraska.
- Simonsen, V., A. Fedele, and J.J. Fontaine. 2018. Large or small patches? How patch size and nest density influence nest survival and conservation in grasslands. South Dakota Chapter of The Wildlife Society, Chamberlain, South Dakota.
- Sorensen, A.E., L. Corral, J.M. Dauer, and J.J. Fontaine. 2018. Authentic scientific data collection in support of an integrative model-based class: A framework for student engagement in the classroom. Ecological Society of America, New Orleans, Louisiana.
- Sorensen, A.E., L. Corral, J.M. Dauer, and J.J. Fontaine. 2017. Authentic scientific data collection in support of an integrative model-based class: A framework for student engagement in the classroom. American Geophysical Union, New Orleans, Louisiana.
- Stuber, E.F. and J.J. Fontaine. 2018. Human-induced rapid environmental change and spatial mismatches in species distribution. International Association for Landscape Ecology, Chicago, Illinois.
- Stuber, E.F. and J.J. Fontaine. 2018. Human-induced rapid environmental change and spatial mismatches in species distribution. Central Mountains and Plains Section of the Wildlife Society, Kearney, Nebraska.
- Stuber, E.F. and J.J. Fontaine. 2018. "Navigating trade-offs when managing for multi-species avian communities" Rainwater Basin Joint Venture Information Seminar. Grand Island, NE, USA.
- Stuber, E.F. and J.J. Fontaine. 2017. "Multi-scale habitat selection: characteristic scales and scaling relationships" Behavioural Ecology Group Seminar. Ludwig-Maximilians University of Munich. Munich, Germany.
- Tripp, H., D.T. Fogarty, D. Twidwell, and C.R. Allen. 2018. Classification of woody cover from aerial imagery. Great Plains Grassland Summit, Denver, Colorado.
- Tripp, H., D.T. Fogarty, D. Twidwell, and C.R. Allen. 2017. Tree cover classification in SE Nebraska. Nebraska Prescribed Fire Council Annual Meeting, Kearney, Nebraska.
- Wszola, L.S., L.N. Messinger, and J.J. Fontaine. 2017. Estimating the economic benefit of the hunting access program in Nebraska. The Wildlife Society Annual Meeting. Albuquerque, New Mexico.
- Wszola, L.S., E.F. Stuber, L.F. Gruber, and J.J. Fontaine. 2018. Hunter distribution in a unique public access landscape. South Dakota Chapter of The Wildlife Society. Chamberlain, South Dakota.
- Warren, Z.A., Seguin, B., Whitby, M.D., and Allen, C.R. 2017. Looking back to more forward: A quantitative meta-analysis of *Myotis septentrionalis* roost selection. North American Symposium on Bat Research, Knoxville, Tennessee.





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