

ANNUAL REPORT OCT 2019 - SEPT 2020

# NEBRASKA COOPERATIVE

## FISH & WILDLIFE RESEARCH UNIT

Exploring the foraging activity  
of bats in the agricultural  
landscape



### Also See

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Managing Redcedar  
Invasions on Nebraska  
Grasslands

Using Genetic  
Markers to Enhance  
Conservation Efforts

We extend our appreciation to the staff and students of the Nebraska Cooperative Fish and Wildlife Research Unit, University of Nebraska–Lincoln for photographs and images.

Editor and Design Production: Wilma Gerena  
Reviewers: Caryl Cashmere and Kevin Pope  
Layout Design: Abigail Ahmed



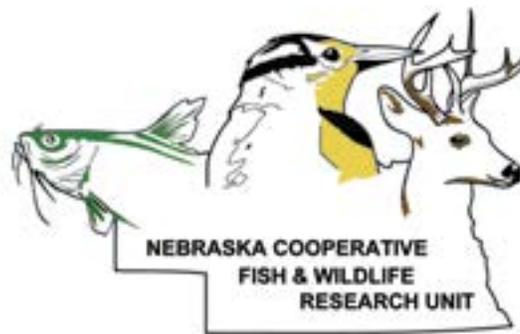
Scan this QR code with your smart phone for an electronic copy of this report.

**Cover Photo: Spatio-Temporal Foraging Activity of Bats in the Agricultural Landscape Project, Beatrice, NE**  
*Photo: Tristan Powell*

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# NEBRASKA COOPERATIVE

## FISH & WILDLIFE RESEARCH UNIT



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Social media: [@NECFWRU](https://twitter.com/NECFWRU)





**Telemetry equipment set up, Pheasant Project, Broken Bow, NE**

*Photo: Tristan Powell*

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# INTRODUCTION

## What is the Nebraska Cooperative Fish and Wildlife Research Unit?

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*A simple answer:* The Nebraska Cooperative Fish and Wildlife Research Unit (NECFWRU) is a formal partnership between the University of Nebraska-Lincoln (UNL), Nebraska Game and Parks Commission (NGPC), U.S. Geological Survey (USGS), U.S. Fish and Wildlife Service (USFWS), and the Wildlife Management Institute (WMI).

*A more profound answer:* The NECFWRU is a complex system comprised of people working across difficult-to-define scales within difficult-to-define boundaries. A complex system has many interacting components with no central control or global communication, and the interactions give rise to emergent behaviors. The NECFWRU has a tripartite mission: technical assistance, applied research, and graduate education. This mission carries with it some implied temporal scales (e.g., M.S. students generally operate on a 2-3 year scale), but does not define all temporal or spatial scales in which the unit is to operate. The NECFWRU is one of 40 units that compose the national Cooperative Research Unit (CRU) program. The CRU program is poised to address natural-resource issues on regional and national scales.

Components of the NECFWRU include three federal scientists, two state administrative assistants, and grant-funded graduate students, postdoctoral associates, and technicians. Also included are some biologists, managers, and decision makers of government agencies, some faculty members, administrators of universities and colleges, and some personnel of non-governmental agencies.

Oversight on broad direction of NECFWRU is provided by a five-member (representative from each signatory agency) coordinating committee. Oversight on safety is provided by CRU Headquarters and UNL safety committees. Oversight on publications is provided by USGS. Oversight on laboratories is provided by each scientist, though broad oversight of research is generally provided by granting agencies and university review boards (i.e., IACUC and IRB). Oversight on each graduate project is provided by graduate committees.

You are, in some way big or small, part of the Nebraska Cooperative Fish and Wildlife Research Unit. We thank you for your valuable contributions. You are what makes us great.



Nebraska Cooperative Fish and Wildlife Research Unit Students



Cooperator field site visit, Pheasant Project, Broken Bow, NE  
Photo: Tristan Powell

# PERSONNEL & COOPERATORS



# UNIT PERSONNEL

## Staff – U.S. Geological Survey, Cooperative Research Units Program

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Kevin Pope, Unit Leader

## Staff – University of Nebraska–Lincoln

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Caryl Cashmere, Unit Staff Assistant

David Damsky, Field Crew Leader  
(October 2017 – December 2019)

Wilma Gerena, Unit Administrative Assistant

Christopher Fill, Coordinator  
North American Bat Monitoring Project

Mark Kaemingk, Research Assistant Professor  
Aquatic Biologist (March 2016 – August 2020)

Baxter Seguin, Coordinator  
North American Bat Monitoring Program  
(May 2019 – June 2020)

Dana Varner, Science Coordinator  
Rainwater Basin Joint Venture

Allison Zach, Coordinator  
Nebraska Invasive Species Program

## Research Technicians

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Olivia DaRugna

Anna Oetting

Michelle Hellman

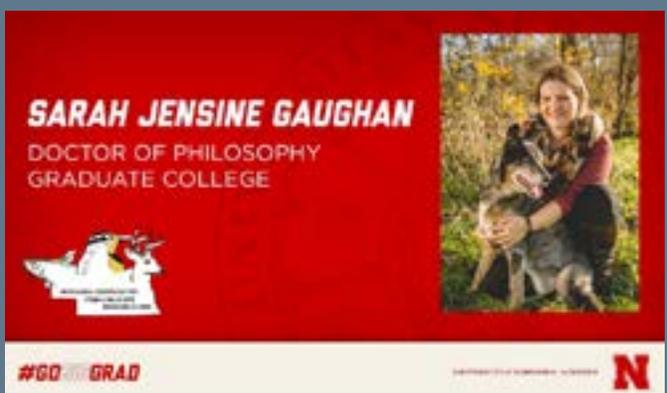
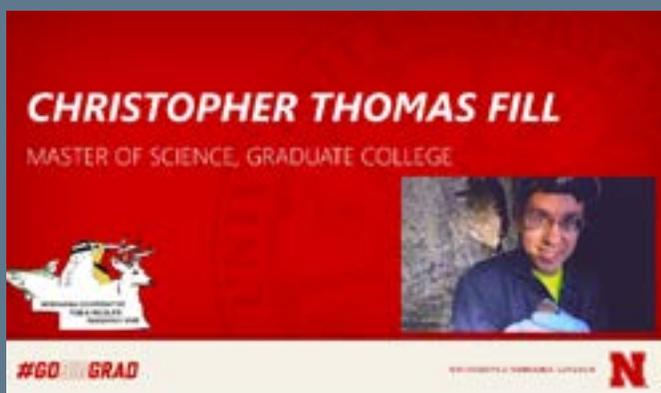
## Student Workers

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Tristan Powell



Olivia DaRugna, M.S. Photo: Submitted



The University of Nebraska-Lincoln conducted virtual commencement ceremonies in May and August  
Photos: UNL Social Media

# GRADUATE DEGREE CANDIDATES

## Master of Science

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Brandon Barlow  
School of Natural Resources  
August 2020 – present

Hugh Ellerman  
School of Natural Resources  
August 2017 – present

Derek Kane  
School of Natural Resources  
January 2019 – present

Brittany Dueker  
Department of Agronomy  
August 2016 – May 2020

## Doctor of Philosophy

---

Dillon Fogarty  
Department of Agronomy  
January 2017 – present

Katharine Hogan  
School of Natural Resources  
January 2018 – March 2020

Michael Whitby  
School of Natural Resources  
January 2014 – present

# THESES AND DISSERTATIONS

## Olivia DaRugna, M.S., May 2020

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*Recreational Activity Dynamics at Valentine National Wildlife Refuge*  
University of Nebraska–Lincoln, Natural Resources. Advisor(s), Kevin L. Pope, Mark Kaemingk.

## Christopher Fill, M.S., August 2020

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*Spatial and Temporal Patterns of Bat Activity in a Southeast Nebraska Agricultural Landscape*  
University of Nebraska–Lincoln, Natural Resources. Advisor(s), Craig R. Allen, Dirac Twidwell.

## Sarah Gaughan, Ph.D., May 2020

---

*Using Genetic Markers to Enhance Conservation Efforts*  
University of Nebraska–Lincoln, Natural Resources. Advisor(s), Kevin L. Pope.

## Bethany Teeters, Ph.D., August 2020

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*The Role of Resource Availability and Habitat Quality in Structuring Prairie Bee Communities*  
University of Nebraska–Lincoln, Natural Resources. Advisor(s), Craig R. Allen, Stephen D. Danielson.

# COORDINATING COMMITTEE MEMBERS

## U. S. Geological Survey

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

## Wildlife Management Institute

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Bill Moritz, Midwest Field Representative  
1608 Packwood Road  
Fairfield, IA 52556

## University of Nebraska-Lincoln

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Mike Boehm, Vice Chancellor  
Institute of Agriculture and Natural Resources  
202 Agriculture Hall  
Lincoln, NE 68583-0708  
(402) 472-2871

## U.S. Fish and Wildlife Service

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Greg Watson, Chief  
Office of Landscape Conservation  
Region 6, Mountain-Prairie Region  
134 Union Blvd, PO Box 25486  
Denver, CO 80225  
(303) 236-4602

## Nebraska Game and Parks Commission

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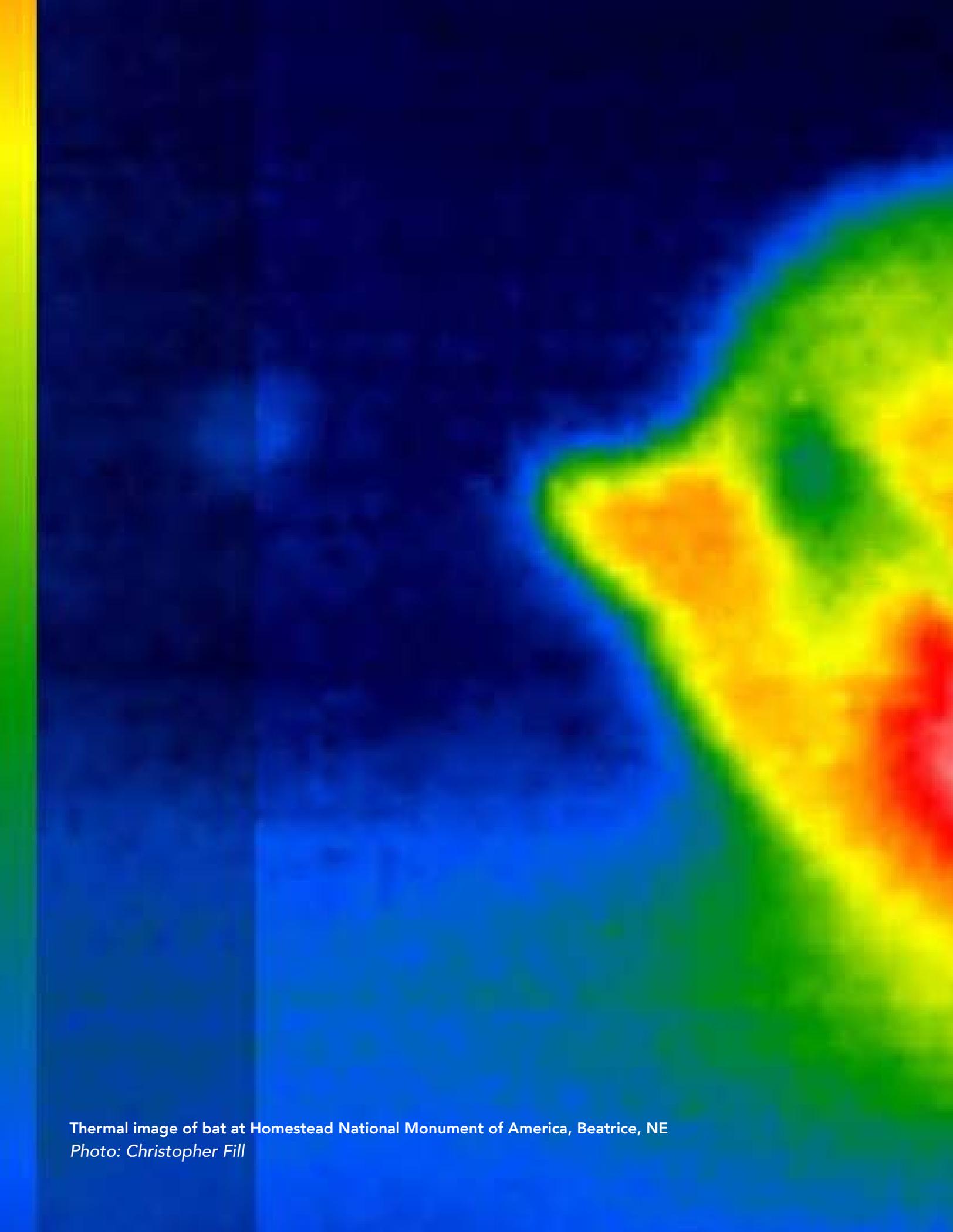
Jim Douglas, Director  
2200 N. 33rd Street  
Lincoln, NE 68503-0370  
(402) 471-0641

Sandhills at Valentine National Wildlife Refuge, Valentine, NE  
*Photo: Olivia DaRugna*

# COOPERATING ORGANIZATIONS

Carleton University  
Centre for Environment, UK  
Ducks Unlimited  
Freshwater Fisheries Society of British Columbia  
Kansas State University  
Iowa State University  
Leibniz-Institute of Freshwater Ecology and Inland Fisheries  
McGill University  
Miami University  
Michigan State University  
Midwest Association of Fish and Wildlife Agencies  
National Institute of Water and Atmospheric Research, Ltd.  
National Science Foundation  
Nebraska Association of Resource Districts  
Nebraska Department of Agriculture  
Nebraska Department of Environment and Energy  
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  
North Carolina State University  
Pheasants Forever, Inc.  
Platte River Recovery Implementation Program  
Platte River Whooping Crane Maintenance Trust  
Princeton University  
Rainwater Basin Joint Venture Partnership  
The Nature Conservancy  
Universidad Autónoma del Estado de Morelos  
University of Arkansas at Pine Bluff  
University of Calgary  
University of California, Santa Cruz  
University of Florida  
University of Massachusetts Amherst  
University of Melbourne  
University of Montana

University of Nebraska at Kearney  
University of Nebraska at Omaha  
University of Nebraska–Lincoln  
*Center for Grassland Studies*  
*Center for Resilience in Agricultural Working Landscapes*  
*Bureau of Sociological Research*  
*Daugherty Water for Food Institute*  
*Nebraska Water Center*  
*Department of Agricultural Leadership, Education and Communication*  
*Department of Agronomy and Horticulture*  
*Department of Computer Science*  
*Platte Basin Timelapse*  
*School of Biological Sciences*  
*School of Natural Resources*  
University of North Dakota  
University of Rhode Island  
University of Tasmania  
University of Victoria  
U.S. Department of Agriculture  
*Animal and Plant Health Inspection Service*  
U.S. Department of Interior  
*National Park Service*  
*Homestead National Monument of America*  
*U.S. Fish and Wildlife Service*  
*Aquatic Nuisance Species Task Force*  
*Branch of Migratory Bird Surveys*  
*Valentine National Wildlife Refuge*  
*U.S. Geological Survey*  
*Arizona Cooperative Fish and Wildlife Research Unit*  
*Kansas Cooperative Fish and Wildlife Research Unit*  
*National Climate Adaptation Science Center*  
*Northern Prairie Wildlife Research Center*  
U.S. Environmental Protection Agency  
Victoria University of Wellington  
Washington State University–Vancouver  
Wyoming Game and Fish Department



Thermal image of bat at Homestead National Monument of America, Beatrice, NE  
*Photo: Christopher Fill*

# AWARDS & RECOGNITIONS



## Scholarships, Fellowships & Grants



Dillon Fogarty  
*Photo: UNL Dept. of Agronomy and Horticulture*

Dillon Fogarty was awarded the Arthur Sampson Fellowship for the academic year 2020-2021. This \$5,000 fellowship is through the Center for Grassland Studies at UNL in support of research and conservation of rangeland ecosystems.

The Best Student Presentation Award at the 2019 Nebraska Natural Legacy Conference held in October 2019 was awarded to unit student Dillon Fogarty. The mission of the Natural Legacy Project in Nebraska is to refine and implement conservation designs for the state's flora, fauna and natural habitats through the proactive voluntary conservation actions of partners, communities and individuals as part of a nationwide effort to address the needs of declining wildlife populations. The conference is sponsored by the Nebraska Game and Parks Commission.

In a team category, Dillon Fogarty and Katharine Hogan received the Educational Aids Blue Ribbon Award in 2020 at the American Agriculture and Biological Engineers annual meeting in July. The conference was a virtual event to present and expand awareness of industry trends, promote ideas and acknowledge innovation in design and technology. Dillon and Katharine were part of a team that received the award for the learning module in Ecological Resilience. The award honors excellence in the development of out-of-the-classroom teaching aids.



Katharine Hogan  
*Photo: University Communications*

Katharine Hagen received the J.E. Weaver Competitive Grants Program Conference Research award in the amount of \$1,000 in support of graduate student research that enhances our understanding of Great Plains species or ecosystems and their conservation.

Derek Kane was awarded the Shimano Varsity Program Scholarship. A \$2,000 award developed in conjunction with the Bass Anglers Sportsman Society (B.A.S.S) Conservation to assist students in their pursuit of conservation degrees in fish or wildlife. This is the second year in a row Derek received this competitive scholarship which is awarded to 12 individuals yearly.



Derek Kane  
*Photo: Taylor Richert*



Olivia DaRugna  
Photo: Submitted

Olivia DaRugna was awarded the Outstanding Fishery Student Award for the Nebraska Chapter of the American Fisheries Society at their annual meeting this February.

## Travel Awards

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Dillon Fogarty received the Short Course Travel Award – Teaching socio-environmental synthesis with case studies from the National Socio-Environmental Synthesis Center (SESYNC) in Annapolis, MD. Dillon led a team of graduate students and one post doc that were awarded \$5,000 to attend a 3-day workshop and develop a case study for teaching socio-environmental synthesis.

## University Service Awards

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The 2019 Celebration of Service at the University of Nebraska-Lincoln honored the dedication of its employees including Caryl Cashmere and Wilma Gerena from NECFWRU. Caryl is our part-time staff assistant who has served the unit and UNL for 10 years. Wilma is our administrative assistant who has dedicated the last four of fifteen years at UNL serving our unit. We value their talent, expertise, and adaptability to learn new administrative methods and technology platforms during the current telework setting maintaining our unit at the top of its game and relevant. Our unit wouldn't run as smooth without Caryl and Wilma attending to our students, staff, PIs, and collaborators. We are fortunate to have them on our team.



Caryl Cashmere and Wilma Gerena  
Photo: Mark Kaemingk



Allison Zach, Nebraska Invasive Species Program  
Coordinator  
Photo: Allison Zach

## Nebraska Invasive Species Program

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Allison Zach, coordinator of the Nebraska Invasive Species Program was elected to the Executive Committee of the Western Regional Panel on Aquatic Nuisance Species in 2019. The panel is comprised of federal, state and non-governmental aquatic invasive species experts. Allison was also appointed as Chair of the Western Invasive Species Coordinating Effort in 2020. This group is comprised of 19 state aquatic invasive species coordinators.



Niobrara River, Smith Falls State Park, Valentine, NE  
Photo: Kevin Pope

# MILESTONES & HIGHLIGHTS



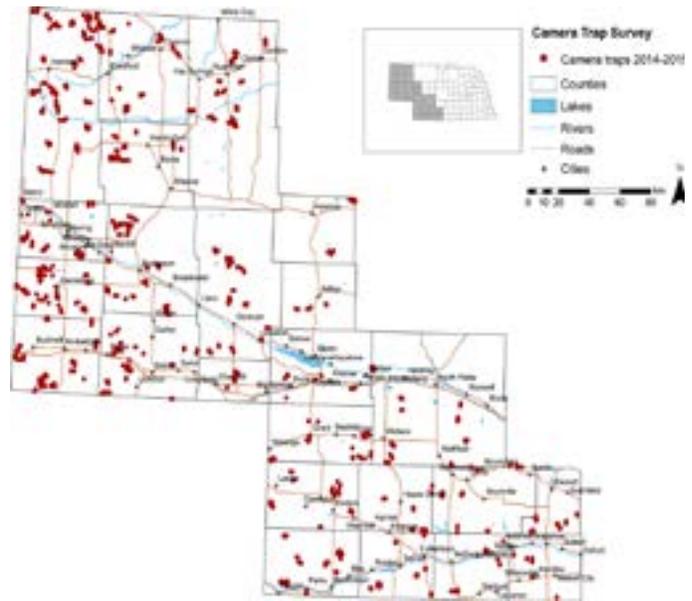
## It's a trap! Another Fontaine Lab Manuscript

As a result of the work conducted with the unit while working as a technician in the Fontaine Lab, Anastasia Madsen produced a manuscript from the Nebraska Canid Project dataset published in the Wildlife Society Bulletin. Using more than five million photos captured by skunk-scented cameras, Madsen and colleagues were able to compare coyote sightings with weather conditions. The team identified a correlation with the likelihood of capturing coyotes on camera.



Coyote captured on trail camera  
Photo: Fontaine Lab Canid Project

The findings could aid researchers to factor seasonal trends and weather forecasts when placing cameras to improve camera capturing potentially improving population estimates and the conservation plans drawn from them.



Motion triggered camera sites in western Nebraska  
Illustration: Anastasia Madsen

## Coop Students in the News

Students Katharine Hogan and Dillon Fogarty became inaugural members of the Council for Resilience Education. The council is a UNL recognized student organization aiming to impart knowledge on the concept of ecological resilience to the academic community and its global impact. The council's origin is credited to long-time unit collaborator Dirac Twidwell, associate professor in the Department of Agronomy and Horticulture. Additional details can be found on The Daily Nebraskan article, "Council of Resilience Education strives to teach ecological resilience" at <https://dailynebraskan.com/>.

Another Coop student in the news this year was Christopher Fill who completed research work with bats at the Homestead National Monument of America in Beatrice, Nebraska. The mist nets deployed by Christopher, and technician Anna Oetting captured five of eight species identified by acoustic detectors. One of the species caught, the endangered Northern Long-Eared Bat, was checked for White Nose Syndrome and then equipped with radio transmitters to track their movement, foraging and roosting habits. The U.S. News & World Report article can be found at <https://bit.ly/2SArONA/>.

## Unit Leadership Updates

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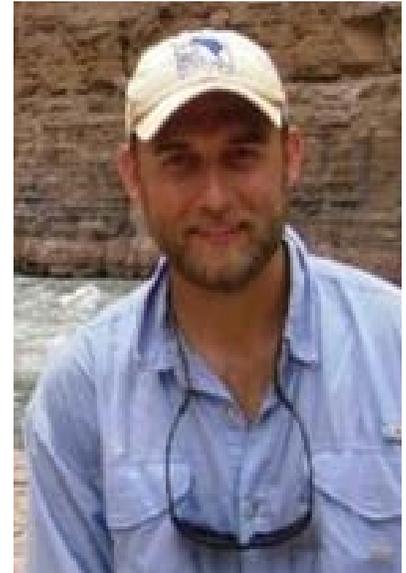
The CRU program was blessed with an increased budget in 2020, which allowed NECFWRU to replace all five federal vehicles and most importantly to initiate the process to fill vacancies of both federal scientist. Here is a huge shout out to our search committee members: John Benson, Jessica Corman, Samodha Fernando, Rick Holland, Will Inselman, Clint Krehbeil, Tim McCoy, Bill Moritz, Mark Pegg and Martha Shulski.



Sarah Sonsthagen  
*Photo: web media*

Sarah Sonsthagen is joining us as a landscape geneticist. In her most recent position, Sarah was a research geneticist with the U.S. Geological Survey Alaska Science Center where she focused on evolutionary and population genetics of vertebrates. Sarah has roots in the Midwest. We are ecstatic that she is joining the NECFWRU team.

Jonathan Spurgeon is joining us as a stream-fish ecologist. In his most recent position, Jon was an assistant professor with the University of Arkansas at Pine Bluff where he focused on aquatic habitat restoration and management. Jon is an alumnus of the Missouri Coop Unit. We are elated that he is joining the NECFWRU team.



Jonathan Spurgeon  
*Photo: web media*

## @LabUNDERwater Obtains T-ensure-track Faculty Position

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Mark Kaemingk joined the NECFWRU in 2016 as a non-tenure track Research Assistant Professor responsible for the angler survey project. The position that Mark filled was previously held by Chris Chizinski, and Tony Barada before Chris... that is to say, that Mark had gigantic shoes to fill. We are extremely pleased that Mark filled, and busted out the seams of those shoes. He discovered and marketed his professional identity creatively through a desire for extremely high-quality manuscripts that benefited the project. All those involved in the project have set the bar for the next phase of the angler survey project. Mark is genuinely interested in spatial-temporal patterns in managed systems. Mark will be missed in Hardin Hall though he remains active as co-PI and graduate co-advisor. He will pursue this interest in a tenure-track faculty position with the University of North Dakota. We are certain that he will continue to be an ambassador for NECFWRU, UNL and the CRU program.



Mark Kaemingk  
*Photo: University Communications*



Turkey on the road near the Niobrara River, Smith Falls State Park, Valentine, NE  
*Photo: Kevin Pope*

# OUTREACH ACTIVITIES



## Nebraska Invasive Species Program

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Allison Zach, Nebraska Invasive Species Program Coordinator (NISP) served as Nebraska's representative on regional invasive species panels and organizations. As the coordinator, Allison, served as Chair of the Western Regional Panel of Aquatic Nuisance Species from 2018 to 2020. Throughout 2019 and 2020, the NISP hosted meetings for the Nebraska Invasive Species Advisory Council. Additionally, the NISP coordinated with Nebraska Game and Parks Commission (NGPC) and other partners to complete documentation required to make Nebraska eligible for grant funding for invasive species prevention and research. The NISP website: <https://neinvasives.com/> was updated to include new invasive species information and ranges. Invasive species finds were reported by

the public and numerous questions regarding invasive species were asked via the NISP website. Over 500 sets of invasive species education cards were distributed to K-12 grade teachers and other educators. In addition, invasive species education backpacks were checked out to educators throughout the state to educate audiences on species of concern. Similar education bags and stickers were disseminated to independently owned fish stores throughout the state to educate the public not to release unwanted pets into the wild. Outreach, management and prevention efforts for aquatic and terrestrial invasive species will continue working with the Nebraska Invasive Species Advisory Council, NGPC and other partners.

## Volunteering with Scouts

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Dr. Chad Brassil, associate professor at the School of Biological Sciences at UNL is grateful for the assistance provided by unit student Sarah Gaughan, and former unit student Lyndsie Wszola during the Cub Scout event titled Night at the Museum. Dr. Brassil reported everyone had a great time and the varied activities were a huge part of that experience impacting 87 youth and 62 adults in attendance. It was a phenomenal opportunity for Sarah and Lyndsie to engage a different audience.



Sarah Gaughan talking to Cub Scouts about fish behavior and anatomy  
*Photo: Chad Scouter*

# Twitter Moments

Mark Kaemingk  
@LabUNDerwater

My home #UNLSNR office and assistant (who says he absolutely loves fish). @UNLSNR @NECFWRU



3:02 PM - Mar 18, 2020 - Twitter Web App

Mark Kaemingk  
@LabUNDerwater

Our graduate student @YaBoyDKane gave an excellent talk at the IA AFS meeting about cross-scale patterns in angler effort.

@NECFWRU @UNLSNR



Nebraska Coop F&W RU  
@NECFWRU

Hands-on data management with @NEGameandParks Keith Hurley. We are fortunate to pull in his expertise for our students in @UNLSNR and @NECFWRU



5:00 PM - Mar 10, 2020 - Hoobastick Inc.

Nebraska Coop F&W RU  
@NECFWRU

Friday am mtg msg. "We really, really, really are working diligently to achieve success during these challenging times, especially w/ graduate Ed, applied research, and technical assistance." it's been a heck of a week. #WeekendHereWeCome



5:17 PM - May 3, 2020 - Twi...

Mark Kaemingk  
@LabUNDerwater

Super proud of Olivia DaRugna, who successfully defended her thesis today. It went so well that KP appears to be giving a fist pump halfway through. I was also joined by two honorary committee members. #proudadvisor @NECFWRU @NEGameandParks



Nebraska Coop F&W RU  
@NECFWRU

Presenters: @mark\_kaemingk, @chriszinski, Kevin Pope and Keith Hurley are ready to meet you at the #Catfish2020 Sponsored Workshop; Creel Surveys: Designing Complex Solutions to Simple Questions, Lafayette Room. @USGSCoopUnits @UNLSNR @NEGameandParks



7:03 AM - Feb 27, 2020 - Hoobastick Inc.



Mark Kaemingk inspecting education sign at Valentine National Wildlife Refuge, Valentine, NE  
Photo: Olivia DaRugna

# RESEARCH PROJECTS



# ANGLER BEHAVIOR IN RESPONSE TO MANAGEMENT ACTIONS ON NEBRASKA RESERVOIRS - PART III

**Principal Investigator(s):** Kevin L. Pope, Christopher J. Chizinski, Mark A. Kaemingk  
**Graduate Student(s):** Brandon Barlow, M.S., Olivia DaRugna, M.S. (2020), Derek Kane, M.S.  
**Duration:** January 2019 – December 2023  
**Funding:** Nebraska Game and Parks Commission  
**Location:** Statewide Nebraska  
**FISHHUNT.UNL.EDU**

Recreational angling, a billion-dollar industry, is the most influential factor structuring fish populations in inland systems. Given its importance and the reliance in North America on sportspersons to fund conservation activities (i.e., the North American Model of Wildlife Conservation), natural resource agencies invest substantial resources to manage angler-fish interactions to ensure long-term sustainability. Arguably, most of our current understanding and management efforts of recreational fisheries have been directed toward larger fisheries that are located in rural environments. These waterbodies are highly visible resources and often attract many anglers from long distances. However, we know less about anglers in urban environments and how they interact locally with smaller waterbodies. It is important to understand angler behavior in metropolitan areas because the distribution of people on the landscape is becoming more urbanized. We anticipate that urban fisheries function differently than their rural counterparts.

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



Leaves changing at Wehrspann Lake, Omaha, NE  
*Photo: Derek Kane*

and feedback mechanisms between and among angler groups and fish communities.

The project currently has five study components.

1. Omaha Angler Survey. We planned to interview anglers on site at Benson, Flanagan, Fontenelle, and Walnut Creek from April through October 2020, but the COVID-19 pandemic prevented us from collecting angler behavior information. These interviews are intended to add to statewide angler survey data sets that are valuable for assessment of temporal changes in angler participation. In particular, these extended data sets allow

for relational assessments of changes in angling participation with environmental conditions and management actions on large spatiotemporal scales.

2. **Omaha Angler Effort.** Anglers were counted at 22 public waterbodies in the Omaha metropolitan area from February 2019 through January 2020. Angler effort was highly variable with most angler effort occurring in west Omaha. Larger waterbodies typically received the most fishing effort. Angler effort generally peaked from May through July and remained low during winter months, likely given poor ice conditions. Most anglers accessed waterbodies from the bank rather than from a boat, which is typical of larger fisheries located in rural environments. Half of the waterbodies surveyed received more than 20,000 hours of angling effort with four of these waterbodies receiving more than 60,000 hours – comparable to some of our larger, rural fisheries in the state. Towl Pond and Halleck received the most angler effort per unit of area, with approximately 7,500 angler hours per acre. This magnitude of angler effort broke a previous record set at Bowling Lake in Lincoln, Nebraska.
3. **Omaha Recreation Survey.** We surveyed 2019 angler license holders in Omaha during February and March 2020 using mail-surveys (email and pre-paid envelopes) in collaboration with the University of Nebraska’s Bureau of Sociological Research. We intend to quantify visitation rates to the Omaha metropolitan waterbodies (and other prominent Nebraska reservoirs) during 2019, demographics, preferences and motivations, and information about their recreational budget (e.g., complementary or competing recreational activities to fishing). Data gathered in this study will be combined with historic data already collected by the Nebraska Cooperative Fish and Wildlife Research

Unit (or the Nebraska Game and Parks Commission) and used to compare patterns in angler participation between urban and rural fisheries. This information may also be used to assess responses of anglers to periodic management actions (such as fish stockings).

4. **Understanding Variation of Recreational Angler Effort.** We aim to understand 1) the relationship between the size of waterbody (i.e., surface area) and annual angler effort, and if waterbody size can predict annual angler effort and 2) how cross-scale (seasonal, daily, hourly) patterns in angler effort differ between over- and under-fished waterbodies (i.e., waterbodies that receive more or less angler effort than predicted based on their size). We conducted angler counts at 69 waterbodies across the state of Nebraska between 2007 and 2019. We hope that a better



Angler at Valentine National Wildlife Refuge, Valentine, NE

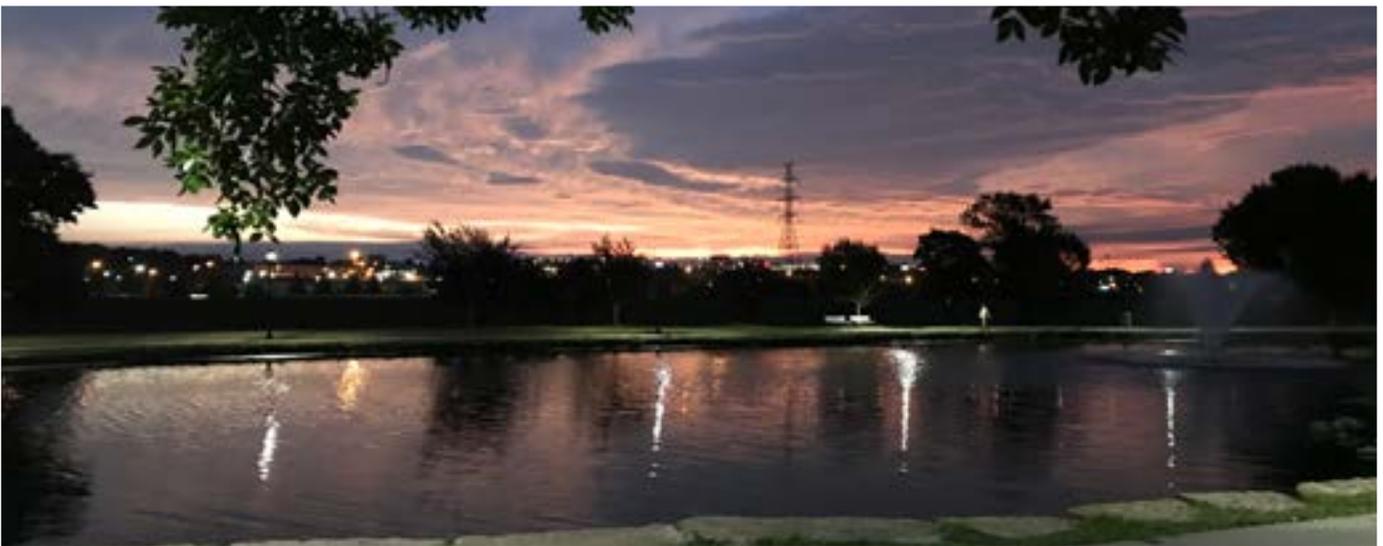
*Photo: Olivia DaRugna*

understanding of cross-scale patterns in angler effort will highlight opportunities for managing angler effort, which is currently overlooked and rarely considered by most management and conservation agencies.

5. **Recreational Use of Valentine National Wildlife Refuge.** Valentine National Wildlife Refuge is an important social-ecological system that provides a variety of recreational opportunities for visitors. However, the types and frequency of activities that occur on the refuge and the sociodemographic characteristics of visitors are poorly understood. We used 789 completed surveys (from 2,251 distributed windshield surveys; 35% response rate) to understand the frequency, sociodemographics, and potential for social conflicts and ecological impacts of consumptive (i.e., hunting), intermediate-consumptive (i.e., fishing), and non-consumptive (i.e., wildlife watching, touring, hiking, photography, and environmental education) recreational-activity groups. The intermediate-consumptive group was the predominate recreational-activity group (78%) on the refuge from July 2017 to July 2018. Social and ecological intensities varied across lake types (e.g., fishing vs.

non-fishing) and seasons, highlighting intense impact areas and periods on the refuge. Accounting for the diverse recreational activities and social and ecological intensities will allow managers of Valentine National Wildlife Refuge and other social-ecological systems the ability to concomitantly preserve ecological resources, prioritize conservation efforts, and minimize visitor conflicts.

We hypothesized that perceptions of legitimate use of fish and wildlife would be predicative of the types of activities in which recreators choose to participate. We limited the study population to Nebraska anglers and assessed whether their position on the moral-extensionalism continuum would be predictive of their reported alternate activities. Anglers 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.



Summer morning at Halleck Lake, Papillion, NE

Photo: Derek Kane

# AQUATIC INVASIVE SPECIES (AIS) PREVENTION PROGRAM

**Principal Investigator(s):** Kevin L. Pope  
**Project Coordinator:** Allison Zach  
**Duration:** April 2011 – December 2022  
**Funding:** USFWS Aquatic Nuisance Species Taskforce, Nebraska Public Power District  
**Location:** Statewide Nebraska  
**NEINVASIVES.COM**

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 (USFWS).

Goals are to:

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

Annual grant funding was secured by the NISP from the U.S. Fish and Wildlife Service to fund AIS prevention and outreach efforts in Nebraska. One method used to aid in the prevention of AIS was by conducting boater surveys annually from 2012-2018 at high-risk waterbodies to gauge AIS awareness, prevention behaviors and watercraft movements. In addition, the NISP Coordinator has annually trained Nebraska Game and Parks Commission (NGPC) AIS technicians to use tablets to document watercraft inspections and give away educational brochures and other educational materials to the public. Watercraft inspection data entered into tablets is uploaded

to the Western Data Sharing System. This data allows inspectors to review previous inspection and decontaminations that a watercraft has undergone. Another tool used by the NISP provided boat launch signs to NGPC and private lakes to be posted at the waterbodies as a reminder of how to prevent the spread of AIS. The NISP Coordinator also served on regional AIS panels to coordinate AIS prevention efforts across state lines.

Nebraska has four waterbodies that tested positive for zebra mussels which include: Lewis & Clark Lake, Missouri River, Offutt Air Force Base Lake, and Glenn Cunningham Lake. Glenn Cunningham was drawn down in 2018 to freeze and kill a newly established zebra mussel infestation. It will be regularly sampled and monitored to determine if the eradication effort was successful. NISP has many tools to educate the public and to help prevent the spread of AIS; one such tool is giving presentations to a variety of audiences throughout the state. Another tool used in AIS prevention is running ads in NGPC's boating and fishing guides. Additionally, the NISP created and continues to fund two billboards at Lake McConaughy to increase the public's knowledge of how they can prevent the spread of AIS. Another tool used to prevent AIS is the NISP's CD3 waterless watercraft cleaning station at Lewis and Clark Lake which is monitored through an online platform.



Lake McConaughy billboard  
*Photo: Allison Zach*



Boat inspections  
*Photo: Nebraska Game and Parks Commission*

# BAT CONSERVATION AND RECOVERY IN NEBRASKA AND WYOMING

**Principal Investigator(s):** Dirac Twidwell, Kevin L. Pope  
**Program Coordinator:** Baxter Seguin (February 2019 – June 2020), Christopher Fill  
**Duration:** February 2019 – January 2022  
**Funding:** Nebraska Game and Parks Commission  
**Location:** Statewide Nebraska, statewide Wyoming

There are mounting concerns for North American bats due to continuing and emerging threats from disease, habitat loss, fragmentation and wind-energy development. Though these threats are likely to increase in severity, there is an opportunity to improve our knowledge of

bat occurrence and habitat use, to learn how landscape changes impact local bat populations, and to establish regional monitoring that can inform local and national resource management decisions. We are collaborating with the Nebraska Game and Parks Commission, the Wyoming Game and Fish Department, and state and federal natural resource managers in the Midwest. With this collaboration our goal is to develop a strategic approach to bat conservation across Wyoming and Nebraska with a focus on monitoring impacts and providing decision makers with decision-support tools and a conservation plan. Data collection includes a large component of citizen science, with local volunteers helping collect data across Nebraska and Wyoming.



Acoustic detector by the Missouri River, NE  
Photo: Zac Warren

# COMPREHENSIVE EVALUATION OF THE NEBRASKA OUTDOOR ENTHUSIAST

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

**Data Scientist:** Nathaniel Price

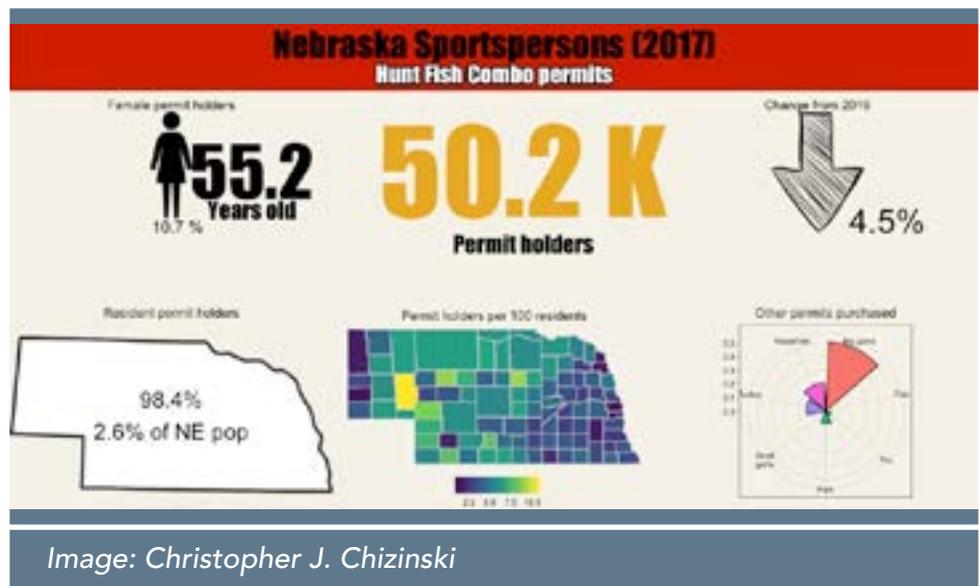
**Duration:** January 2016 – January 2021

**Funding:** Nebraska Game and Parks Commission

**Location:** Statewide Nebraska  
[FISHHUNT.UNL.EDU](http://FISHHUNT.UNL.EDU)

The decline in hunters and anglers is a 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. In order 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.

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. Many state agencies, including the Nebraska Game and Parks Commission, conduct surveys to individual license holders. State surveys are often highly directed because of the extraordinary effort necessary to survey completely, 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. 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.



# MANAGING REDCEDAR INVASION OF NEBRASKA GRASSLANDS - PART II

**Principal Investigator(s):** Dirac Twidwell  
**Graduate Student(s):** Dillon Fogarty, Ph.D.  
**Duration:** January 2016 – May 2021  
**Funding:** Nebraska Game and Parks Commission  
**Location:** Statewide Nebraska  
**CEDARLITERACY.UNL.EDU**

Eastern redcedar (*Juniperus virginiana*) invasion is a major threat to grasslands. In this project we are working with Nebraska Game and Parks Commission to answer four primary questions to better address redcedar invasion.

1. What are the consequences of redcedar invasion?
2. How vulnerable are Nebraska's landscapes to redcedar invasion?
3. How is current management performing?
4. How can management be improved?

Over the last year we have developed software to conduct real-time ecosystem service assessments, integrated field and remote sensing data to assess statewide vulnerability to redcedar invasion, assessed the performance of statewide and regional management of redcedar invasion, and conducted a series of stakeholder workshops to co-produce strategies for better managing redcedar.

In collaboration with the Department of Computer Science and Engineering, we developed the Integrative Ecosystem Service Analysis Tool (IESAT) ([ecoserve-app.com](http://ecoserve-app.com)). This web-based tool was built to create customized ecosystem service assessments that leverage stakeholder and local knowledge. An initial workshop with the Nebraska Weed Control Association showed that stakeholders associate redcedar invasion with severe consequences to rangelands in Nebraska. Our assessment of vulnerability to redcedar invasion indicates that these consequences have potential to be widespread. Remote sensing data coupled with field inventory show that redcedar invasion is occurring throughout the Sandhills and in other portions of western Nebraska where redcedar invasion was previously perceived as impossible. Key implications related to the performance of past management are that restoration-focused management is unlikely to halt or reverse trends of invasion, defensive strategies are needed to halt invasion and secure intact grasslands, and community-led, science-informed, and agency-supported approaches to managing redcedar have high potential for conserving grasslands and have proven to be successful in the Loess Canyons region of Nebraska. These implications have been a primary focus of workshops where management-science partnerships have co-produced new strategies for defending and growing intact grasslands in regions that are vulnerable to redcedar invasion.



Eastern redcedar (*Juniperus virginiana*) invasion in the Nebraska Sandhills  
Photo: Dillon Fogarty

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

**Principal Investigator(s):** Kevin L. Pope

**Coordinator:** Allison Zach

**Duration:** January 2010 – December 2024

**Funding:** Nebraska Game and Parks Commission

**Location:** Statewide Nebraska

**NEINVASIVES.COM**

The Nebraska Invasive Species Program (NISP) continues to administer a multi-institutional program with grant funding from the Nebraska Game and Parks Commission (NGPC) 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, and identification of invasive species introduction pathways.

The Nebraska Invasive Species Program (NISP) coordinated meetings of the Nebraska Invasive Species Advisory Council, which was created by a law in 2012. Council members attended a tour of the Omaha Public Power District's (OPPD) Nebraska City facility in 2019 and learned about the facility's management of zebra mussels and invasive plants. This Council is comprised of 17 appointed members and 25 regularly attending members. During meetings, the Council discusses invasive species issues, develops management plans and Early Detection-Rapid Response

plans, and informs the Nebraska Legislature and Governor of the invasive species concerns as well as management and prevention efforts.

A previously undetected invasive species in Nebraska, the Asian jumping worm, was discovered and reported via the NISP website in 2019. In order to keep the public informed about invasive species, the NISP keeps the website up to date with information on invasive species biology and ranges. The Council updated the Nebraska weed watch list in 2020 to aid in the identification of plant species of concern for monitoring. In order to keep Nebraskans informed of AIS, Allison Zach, NISP Coordinator, coordinates events, serves on regional invasive species panels, and is a member of many organizations to coordinate invasive species efforts across state lines. In addition, the NISP coordinated with NGPC education staff to include invasive species in educational materials to educate the youth of the state about AIS. In order to educate stakeholder groups, the NISP presented at numerous meetings throughout 2019 and 2020 to increase knowledge of invasive species. Also in 2019 and 2020, the NISP circulated technical assistance materials to the public and resource agencies to aid in the education and knowledge of AIS.



NIS Advisory Council at OPPD

*Photo: Allison Zach*

# PLANT FUNCTIONAL COMMUNITY DYNAMICS AND POLLINATOR RESOURCE PROVISIONS WITHIN NEBRASKA'S RESTORED PRAIRIES

**Principal Investigator(s):** David A. Wedin  
**Graduate Student(s):** Katharine Hogan, Ph.D.  
(January 2018 – March 2020)  
**Duration:** January 2018 – August 2022  
**Funding:** National Science Foundation Research Traineeship (NRT)  
**Location:** Statewide Nebraska

Prairie and pollinator restoration work and research continues along the Haines Branch Prairie Corridor slated for prairie restoration in the future by the City of Lincoln and project partners. The first field season is complete. Objectives for this project are:

1. To characterize vegetation and native bee community differences among degraded brome field, a modified pollinator restoration mix from Prairie Legacy, LLC, and a high diversity prairie mix from Prairie Plains Resource Institute;
2. To focus on characterizing the long-term plant community dynamics and trends from a restored prairie landscape owned and managed by The Nature Conservancy in south-central Nebraska.

Data cleaning and visualizations from the first field season has been completed in order to collaborate with the City of Lincoln. The preliminary results from sampling eight restored high-diversity grasslands under patch-burn grazing management for 18 years in south-central Nebraska shows consistent periods of species richness increase and then maintenance across restorations. Diversity indexes and community dissimilarity metrics revealed overall persistence and consistency in the plant community over time, following a distinct assembly period according to community correlation matrices. These restorations exhibit consistent assembly and maintenance trends regardless of installation specifics, management, and environmental variability. This suggests that heterogeneous management across restored landscapes can facilitate diverse plant community composition that is temporally persistent and contributes to landscape resilience.



Spring Creek Prairie Audubon Center, Denton, NE  
Photo: Wilma Gerena

# RAINWATER BASIN JOINT VENTURE SCIENCE

**Principal Investigator(s):** Kevin L. Pope, Andy A. Bishop (Rainwater Basin Joint Venture Partnership)

**Science Coordinator:** Dana Varner

**Duration:** October 2014 – December 2023

**Funding:** Rainwater Basin Joint Venture

**Location:** Statewide Nebraska

The Rainwater Basin Joint Venture's (RWBJV) mission includes science-based conservation efforts for all priority bird habitats throughout Nebraska's mixed-grass prairie region. The Management Board of the RWBJV is committed to implementing the U.S. Fish and Wildlife Service's Strategic Habitat Conservation model. This science-based model requires a commitment of resources and time to develop a strong biological foundation for delivering conservation planning and designing research and monitoring efforts. To fulfill this commitment, the University of Nebraska-Lincoln hired Dana Varner as the RWBJV Science Coordinator. 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.

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 fourth field season of spring waterfowl monitoring. For this project, a team of technicians collected data on waterfowl species, flock sizes, and wetland characteristics in the Rainwater Basin region. These data are being used to create a decision support tool to help guide wetland conservation efforts. Dana serves on the Executive Committee of the North American Waterfowl Management Plan Science Support Team and the Integration Steering Committee, contributing to evaluation and planning efforts outside of Nebraska as well. Dana is involved with several other projects currently in progress including a revision of the RWBJV Landbird Plan and an inventory of eastern redcedar in the Sandhills.



Sunset in the Rainwater Basin  
*Photo: Michelle Hellman*

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

**Principal Investigator(s):** Dirac Twidwell, Eric A. North

**Graduate Student(s):** Christopher Fill, M.S. (2020)

**Duration:** January 2018 – May 2020

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

**Location:** Lancaster and Gage counties, Nebraska

Intensive agriculture is associated with biodiversity loss and species decline. Yet wild species, such as bats, may provide critical ecosystem services to agriculture, even in transformed landscapes. In the United States, bats have been estimated to save the agricultural industry billions of dollars per year. However, white-nose syndrome and habitat loss have led to the decline of many bat species in North America, including the federally threatened northern long-eared bat, *Myotis septentrionalis*.

To better evaluate the effectiveness of these pest-controlling services, and to increase understanding of bat foraging behavior in these extreme landscapes, acoustic detectors were systematically placed in a variety of crop fields to record calls bats make when active at night. Bat activity was highest at sites with the most wooded edge habitat, and sites with more trees and water typically had the most species diversity.

While bat activity and species richness were low at isolated habitat fragments and sites with minimal habitat edges, overall insect availability remained abundant in fields as by field edges, suggesting less hunting pressure on insect pests in these areas. No significant negative spatial or temporal co-occurrences between species was found, despite relatively high degrees of species temporal overlap.

Capture and tracking surveys for threatened northern long-eared bats were conducted at Homestead National Monument to document roosting behavior at the western edge of this species range. Two individuals were tracked to daytime roosts, each bat using multiple structures, one selecting trees and snags two miles upstream of the park, and another using tree cavities and shadowbox fences in the park with other untagged northern long-eared bats. These results suggest that wooded areas, riparian zones, and human-built structures are important resources for this imperiled species, especially in intensively managed agricultural landscapes. Since these environments are likely to increase across the globe, more research is needed to better understand how bat species interact with one another and the landscape to allow for their persistence in these extreme ecosystems.



Left: Eastern red bat. Center: Northern long-eared bat. Right: Hoary bat, Homestead National Monument of America, Beatrice, NE

Photos: Ben Hale

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

**Principal Investigator(s):** Joseph J. Fontaine, Kevin L. Pope, Andrew R. Little  
**Graduate Student(s):** Jessica Laskowski, M.S. (2014), Lindsey Messinger, M.S. (2015)  
**Duration:** January 2012 – December 2019  
**Funding:** Nebraska Game and Parks Commission  
**Location:** Southwestern Nebraska  
**PRAIRIEBIRDS.UNL.EDU**

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

In southwest Nebraska, the Nebraska Game and Parks Commission 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. During 2019-2020 we monitored survival of pen-reared pheasants released into the wild.

Since the start of the project we have captured and radio collared hundreds of pheasants and recorded thousands of locations on where pheasants are roosting, eating, loafing and

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

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



Pheasant tracking

Photo: Tristan Powell

# USING GENETIC MARKERS TO ENHANCE CONSERVATION EFFORTS

**Principal Investigator(s):** Kevin L. Pope, Sarah J. Gaughan

**Graduate Student(s):** Sarah Gaughan, Ph.D. (2020)

**Duration:** June 2017 – May 2020

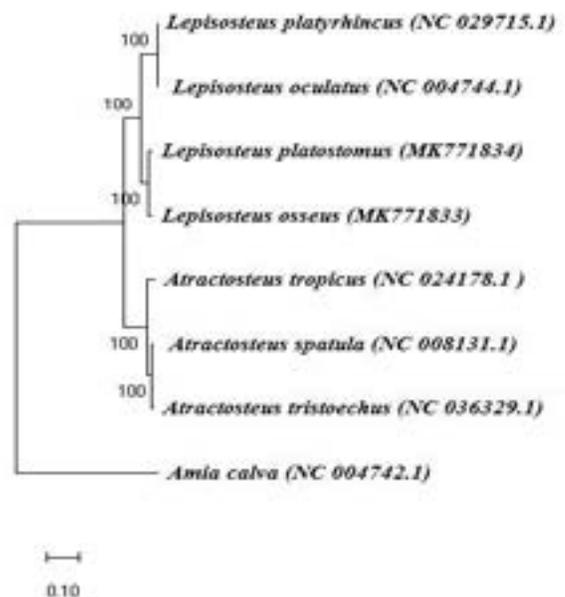
**Funding:** Nebraska Game and Parks Commission

**Location:** Statewide Nebraska

Species conservation is a fundamental goal. Every species provides an important service within its respective ecosystem. Conservation managers strive to maximize biodiversity to retain ecosystem resources. A species' genome dictates its fundamental capacity to adapt to a changing environment. Conservation geneticists can optimize management efforts for biodiversity by utilizing genetic markers, genes or short stretches of DNA to measure changes in an organism's genome across spatiotemporal scales.

We showcase how conservation managers can integrate genetic markers to quantify biodiversity at various spatiotemporal scales and retain ecosystem services. Herein, we inferred the evolutionary history of gar Lepisosteidae by conducting phylogenetic analysis on complete mitochondrial genomes of all extant gar species using the maximum likelihood method and the General Time Reversible model. We generated important genetic markers for future studies to track hybridization amongst these lineages and determined that hybridization between Cuban Gar (*Atractosteus tristoechus*) and Alligator Gar, (*Atractosteus spatula*) may provide an alternative conservation strategy to retain an apex predator within Cuba's ecosystems. We sequenced the mitochondrial 16S ribosomal RNA of bacterial species located within the gut microbiome of the endangered Pallid Sturgeon (*Scaphirhynchus albus*) and determined that the gut microbiome

of hatchery-raised Pallid Sturgeon effectively transition to the gut microbiome of wild Pallid Sturgeon. We used nuclear and mitochondrial single nucleotide polymorphisms to determine that Bighead Carp (*Hypophthalmichthys nobilis*) and Silver Carp (*H. molitrix*) exhibited hybridization in native regions and provided an important baseline for future studies to determine if new anthropogenic disturbances in China will alter evolutionary trajectories of Bighead Carp and Silver Carp. Finally, we proposed 'population' as the least inclusive category of the Linnaean classification system – a distinctive unit that can be monitored across geospatial scales and that can be compared across classes to study speciation. We further proposed a 'species spectrum' concept that represents the amalgamation of intraspecific variations observed amongst populations.



Phylogenetic tree representing phylogenetic relationships of the Nebraskan Shortnose Gar (*Lepisosteus platostomus*) and Longnose Gar (*Lepisosteus osseus*) to the other seven extant gar species Image: Sarah Gaughan

# VEGETATIVE AND LARGE CARNIVORE RESPONSES IN AN ENCROACHED LANDSCAPE

**Principal Investigator(s):** Dirac Twidwell  
**Graduate Student(s):** Hugh Ellerman, M.S.  
**Duration:** August 2017 – May 2020  
**Funding:** University of Nebraska–Lincoln, Nebraska Game and Parks Commission  
**Location:** Statewide Nebraska

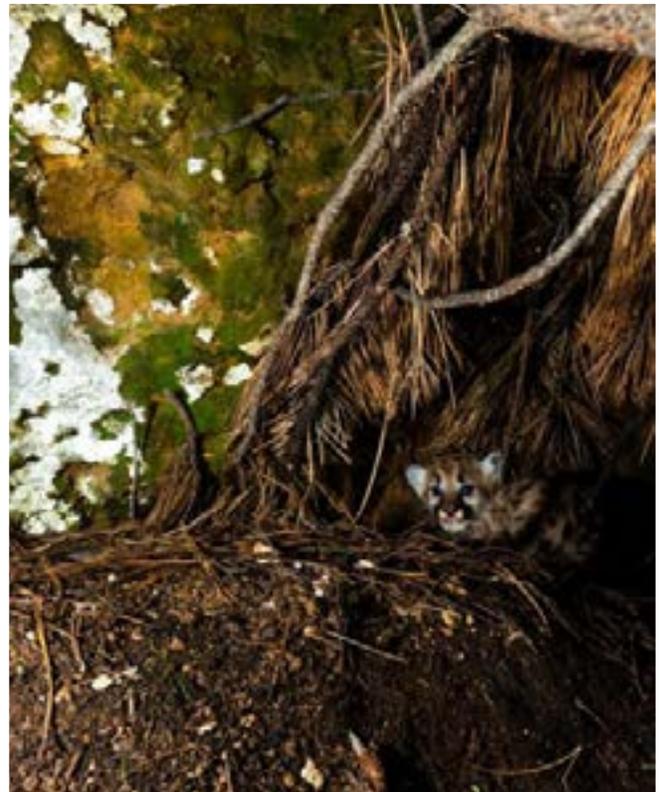
This project concerns vegetative and large carnivore responses to tree encroachment in Nebraska and is split into three parts with distinct goals.

First, the efficacy of grassland restorations by tree removal in southeast Nebraska was determined by revisiting sites where tree removals were used in grassland restorations in 2006, to determine if these sites have been re-invaded or not. Vegetative community composition (particularly invasive tree species) and structure (measured with visual obstructing readings – VOR) were quantified. Results indicate, in the absence of continued management, these sites were re-invaded in a relatively short period of time. This suggests that incentives to cost share tree removals should include requirements for future management.

Second, the efficacy of oak recruitment following tree removal in northeast Nebraska was determined to assess oak survival and subsequent tree invasion. This strategy is part of an effort to increase oak regeneration in riparian woodlands where such regeneration has suffered, particularly due to shading by encroaching invasive trees and high herbivory rates. Sites where tree removals occurred and oaks were planted along the Niobrara River were revisited a decade later to quantify oak survival and invasive tree presence to determine whether this method of tree removal followed by oak planting is effective for restoring oak presence in Nebraska’s riparian woodlands at

the sites. Herbivory led to a near complete failure of oak recruitment; cedar removal enhanced oak establishment.

The third component determined mountain lion use of encroaching Eastern redcedar (*Juniperus virginiana*) in the sandhills. Data from two mountain lions in the Niobrara Valley, were analyzed, one a probable young male without an established home range, and a second cat with an established home range. Both animals largely utilized areas in the Valley, with high topographic relief and tree cover (Ponderosa pine and cedar). Both cats also traveled out of the valley on occasion, and utilized invasive and planted red cedar, and crop center pivots, among other habitats.



Mountain lion den under a rock overhang  
Photo: Justin Haag, NEBRASKAland

# WETLANDS OF NEBRASKA: AN OUTREACH AND EDUCATION PROJECT

**Principal Investigator(s):** Kevin L. Pope, Michael Farrell, Michael Forsberg

**Producer and Project Manager:** Mariah Lundgren

**Duration:** October 2019 – September 2022

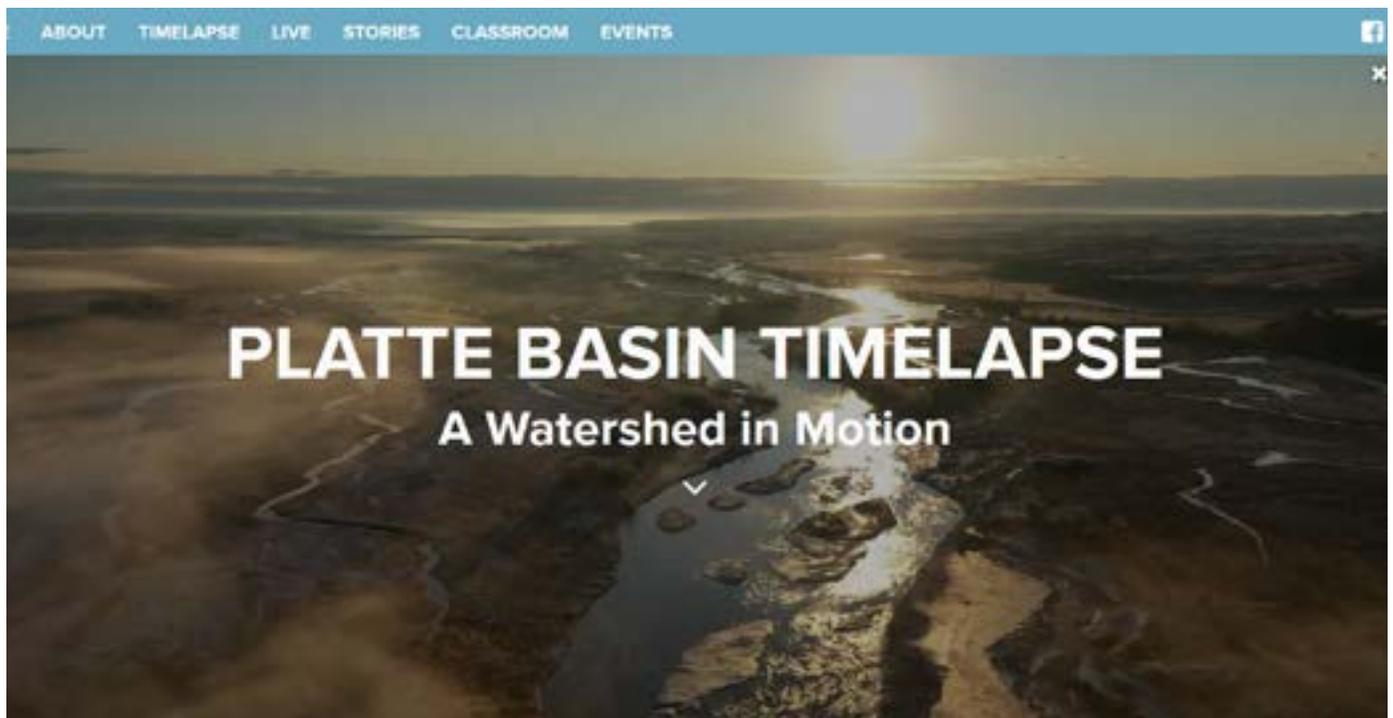
**Funding:** Environmental Protection Agency, Nebraska Game and Parks Commission

**Location:** Statewide Nebraska

**PLATTEBASINTIMELAPSE.COM**

Informing people about Nebraska’s wetland resources and the important services that they provide is a keystone to continuing to develop and refine our state’s wetland program. The main objective of this project is to produce and distribute a series of integrated wetland outreach and education products to increase awareness of the importance of wetlands in Nebraska and an understanding of the need for wetland conservation. These products will provide up-to-date information about Nebraska’s wetlands, which will be aligned with the Nebraska Statewide

education standards, and will deliver information in multi-media products that are favorable to today’s audiences. Staff from the Nebraska Game and Parks Commission’s award winning NEBRASKAland Magazine ([outdoornebraska.gov](http://outdoornebraska.gov)) and the University of Nebraska–Lincoln’s Platte Basin Timelapse project (<http://plattebasintimelapse.com>) will help produce these products. Providing these products to the public and school students across Nebraska will result in increased awareness of the importance and need for wetland conservation.



Platte Basin Timelapse website home page, <https://plattebasintimelapse.com/>

*Web photo clip*

Shall I  
harvest?

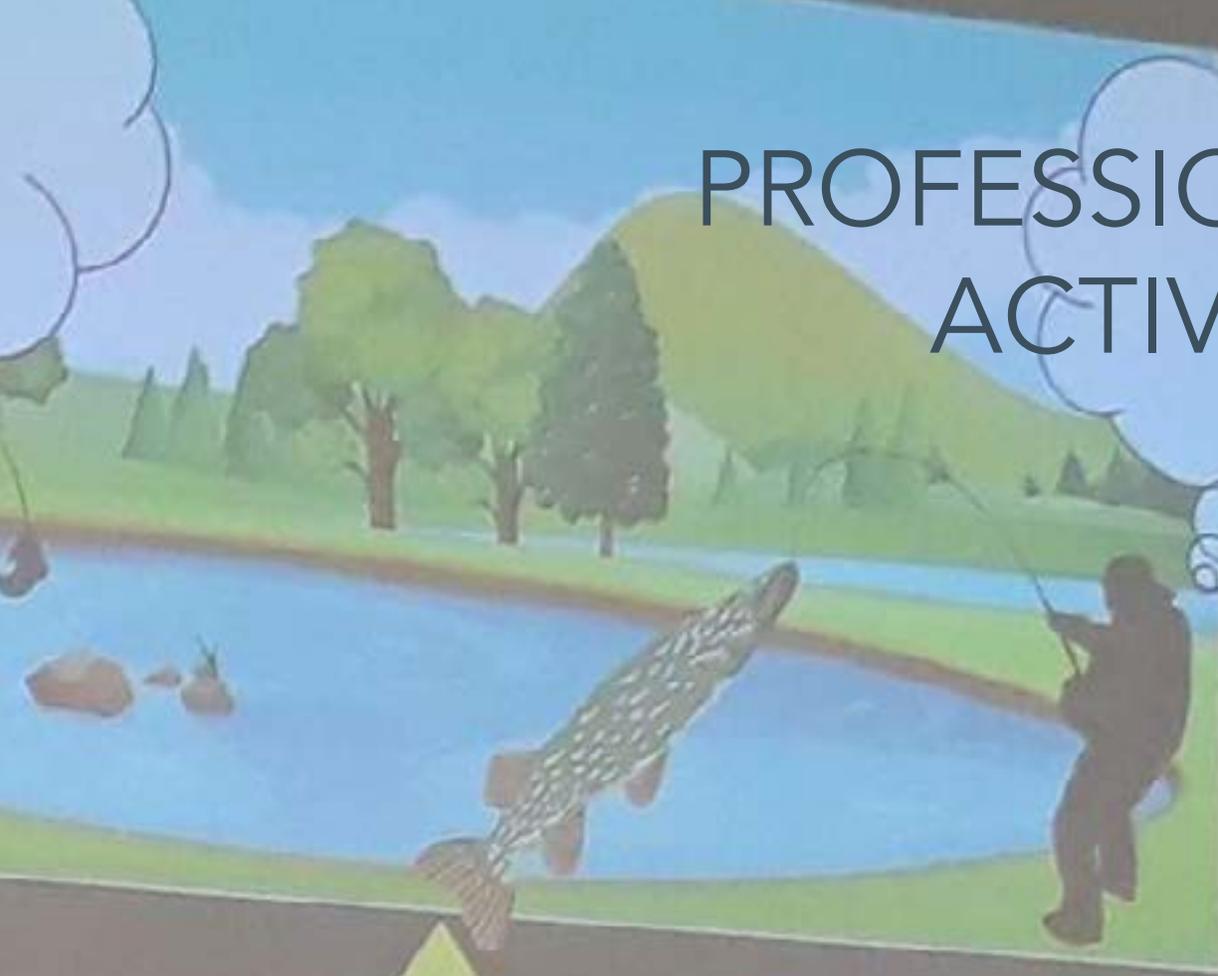


European Inland Fisheries  
and Aquaculture  
Advisory Commission

EIFAAC



# PROFESSIONAL ACTIVITIES



Cultural  
Regulating  
Supporting  
Provisioning

Mark Kaemingk at the European Inland Fisheries and Aquaculture  
Advisory Commission, Dresden, Germany

*Photo: Derek Kane*

# TEACHING

## Kevin Pope

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Spring 2020: Natural Resources (NRES) 871, Quantitative Fish Techniques

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 should be able to apply current quantitative methods used in fishery data analysis, effectively communicate statistical ideas, and critique scientific studies in particular, be able to identify strengths and weaknesses of statistical assessments.

# GRADUATE COMMITTEE SERVICE

## Mark Kaemingk

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Garrett Rowles, (M.S., School of Biology, UNK, graduated December 2019)

## Kevin Pope

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Quintin Dean (M.S., School of Natural Resources, UNL)

Matt Reichenbach (Ph.D., Department of Mathematics, UNL)

Ryan Ruskamp (M.S., School of Natural Resources, UNL)

Jake Werner (M.S., School of Natural Resources, UNL)

# PROFESSIONAL AND FACULTY SERVICE

## Mark Kaemingk

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- Co-Instructor. Creel Surveys: Designing complex solutions to simple questions, Invited workshop in conjunction with 3rd International Catfish Symposium and the American Fisheries Society Southern Division Meeting, Little Rock, Arkansas

## Kevin Pope

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- Member. UNL School of Natural Resources, Graduate Committee
- Member. Nebraska Conservation Roundtable
- Member. Book Editorial Advisory Board. American Fisheries Society
- USGS Representative. Reservoir Fisheries Habitat Partnership
- Coach. Cohort-14, National Conservation Leadership Institute

# OTHER PROFESSIONAL SERVICE

## Olivia DaRugna

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- Member. Digital First Team, School of Natural Resources

## Dillon Fogarty

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- Contributor. Nebraska Legislature on cedar invasions (LR 387)
- Coordinator. Eastern redcedar working group
- Director. Eastern redcedar science literacy video series: Overcoming misconceptions
- Founding member. Council for Resilience Education

## Katharine Hogan

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- Student Representative. National Science Foundation, National Research Trainee Project Steering Committee
- Appointee. Chancellor's Environment Sustainability and Resilience Commission, Teaching and Learning action team
- Founding member. Council for Resilience Education

## Dana Varner

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- Member. Executive Committee of the North American Waterfowl Management Plan Science Support Team

## Allison Zach

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- Coordinator. Nebraska Invasive Species Advisory Council
- Chair. Western Invasive Species Coordinating Effort
- Executive Committee Member. Western Regional Panel on Aquatic Nuisance Species
- Representative. Mississippi River Basin Panel on Aquatic Nuisance Species
- Representative. Missouri River Basin Panel on Aquatic Nuisance Species
- Representative. Missouri Asian Carp grant planning team
- Representative. Water Resources Development Act Upper Missouri and South Platte River Basin letter report planning team

# TRAINING ASSISTANCE, WORKSHOPS, AND OUTREACH ACTIVITIES

## Christopher Fill

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- Presenter. University of Nebraska State Museum Investigate Series, Lincoln, NE. October 2019
- Presenter. Howling Homestead, Homestead National Monument, Beatrice NE, October 2019

## Dillon Fogarty

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- Instructor. Rangeland Research (RNGE 496) UNL, fall 2019
- Teacher Assistant. Grassland Plant Identification (AGRO/NRES 851) UNL, spring 2020
- Teacher Assistant. Ecosystem Monitoring and Assessment (AGRO/NRES 444/844) UNL, spring 2020
- Presenter. Wildlife Education at Everett Elementary School, Lincoln, NE
- Presenter. Advanced prescribed fire workshop, Niobrara, NE
- Co-producer. Teaching Materials, Understanding ecological resilience with jenga, University of Nebraska, Council for Resilience Education teaching resources, spring 2020
- Co-producer. Alternative Stable State Theory and Regime Shifts, Plant & Soil Sciences eLibrary (PASSeL) Lesson, spring 2020
- Co-producer. Ecological Resilience. Plant & Soil Sciences eLibrary (PASSeL) Lesson, fall 2019
- Co-producer. No such thing as a free lunch: trade-offs of trees in grassy ecosystems, National Socio-Environmental Synthesis Center (SESYNC), Case Study Collection, fall 2019
- Producer. Sustaining Nebraska's Grasslands. University of Nebraska, Center for Grassland Studies, March newsletter
- Co-producer. Wildland fires and reducing smoke exposure, online FAQ document published by Nebraska Department of Environment and Energy, spring 2020
- Co-producer. New woody encroachment management strategy for Verdigre-Bazile Biologically Unique Landscape, Nebraska Game and Parks Commission. 2019-2020
- Co-host. Stakeholder workshops:
  - Guardians of the grasslands, Sandhills landowner group, Anselmo, NE
  - Guardians of the grasslands, Nebraska National Forest, Halsey, NE
  - Guardians of the grasslands, Gyp Hills Prescribed Burn Association, Medicine Lodge, KS
  - Private-lands rangeland management in Verdigre-Bazile Biologically Unique Landscape, Nebraska Game and Parks Commission, Lincoln, NE
  - Large-scale resilience planning in the Loess Canyons, Loess Canyons Rangeland Alliance, Curtis, NE
  - Managing woody encroachment on Wildlife Management Areas, Nebraska Game and Parks Commission, Lincoln, NE

**Summer morning at Branched Oak Lake, West Oak, NE**

*Photo: Derek Kane*

## Katharine Hogan

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- Guest Lecturer. Monitoring and Management of the Haines Branch Prairie Corridor, Ecosystems Monitoring and Assessment, School of Natural Resources and Agronomy and Horticulture, UNL, Fall 2019
- Guest Lecturer. Module: Ecological Restoration and Ecosystem Services, Environmental Health and Public Justice, School of Natural Resources, UNL, Fall 2019
- Facilitator. Science Communication course, University of Montana, Missoula, Fall 2019
- Interview. Council of Resilience Education strives to teach ecological resilience: Interview, Lincoln, Nebraska, February 2020
- Co-producer. Online Teaching Materials, Council For Resilience Education, online encyclopedia style modules on ecological resilience, University of Nebraska–Lincoln, 2019-2020
- Panel moderator. Prairie Corridor Summer Seminar Series: Prairie Aspirations, Haines Branch Prairie Corridor project, June 2020

## Allison Zach

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- Instructor. Aquatic Invasive Species Technician Training, Virtual Training, Lincoln, NE, May 2020
- Instructor. Master Naturalist Invasive Species Workshop, Virtual Training, Lincoln, NE, May 2020
- Presenter. Western Regional Panel on Aquatic Nuisance Species Annual Meeting, Missoula, MT, October 2019
- Presenter. Western Invasive Species Coordinating Effort Meeting, Denver, CO, January 2020
- Presenter. Lauritzen Garden's Goldenrod Festival, Omaha, NE, fall 2019
- Presenter. Various Municipal & Irrigation Water User Groups, Billings, MT, February 2020

## PEER-REVIEWED PUBLICATIONS

Angeler, D.G., B.C. Chaffin, S.M. Sundstrom, A. Garmestani, K.L. Pope, D.R. Uden, D. Twidwell, and C.R. Allen. 2020. Coerced regimes: management challenges in the Anthropocene. *Ecology and Society* 25(1):4.

Brenner, S.J., O.A. DaRugna, and S.R. McWilliams. 2019. Observations of certain breeding behaviors in a bilateral gynandromorph Eastern Towhee (*Pipilo erythrophthalmus*). *The Wilson Journal of Ornithology* 131(3): 625-628.

Brownscombe, J.W., K. Hyder, W. Potts, K.L. Wilson, K.L. Pope, A.J. Danylchuk, S.J. Cooke, A. Clarke, R. Arlinghaus, and J.R. Post. 2019. The future of recreational fisheries: Advances in science, monitoring, management, and practice. *Fisheries Research* 211:247-255.

Camp, E.V., M.A. Kaemingk, R.N.M. Ahrens, W.M. Potts, W.E. Pine, III, O.L.F. Weyl, and K.L. Pope. 2020. Resilience management for conservation of freshwater recreational fisheries. *Frontiers in Ecology and Evolution* 7:498.

Carlson, A.K., W.W. Taylor, M.R. Cronin, M.J. Eaton, L.E. Eckert, M.A. Kaemingk, A.J. Reid, A. Trudeau. 2020. A social—ecological odyssey in fisheries and wildlife management. *Fisheries* 45:238-243.

Caven, A.J., D.M. Varner, and J. Drahota. 2020. Sandhill crane abundance in Nebraska during spring migration: making sense of multiple data points. *Transactions of the Nebraska Academy of Sciences* 40:6-18.

Caven, A.J., E.M. Brinley Buckley, K.C. King, J.D. Wiese, D.M. Baasch, G.D. Wright, M.J. Harner, A.T. Pearse, M. Rabbe, D.M. Varner, B. Krohn, N. Arcilla, K.D. Schroeder, and K.F. Dinan. 2019. Temporospatial shifts in Sandhill crane staging in the Central Platte River Valley in response to climatic variation and habitat change. *Monographs of the Western North American Naturalist* 11:33-76.

Chambers, J.C., C.R. Allen, and S.A. Cushman. 2019. Operationalizing ecological resilience concepts for managing species and ecosystems at risk. *Frontiers in Ecology and Evolution* 7:241.

Chuang, W.C., T. Eason, A.S. Garmestani, C.P. Roberts. 2019. Impact of Hurricane Katrina on the coastal systems of Southern Louisiana. *Frontiers in Environmental Science*. 7:68.

Gruber, L.F., E.F. Stuber, L.S. Wszola, and J.J. Fontaine. 2019. Estimating use of public lands: Integrated model of open populations with convolution likelihood ecological abundance regression. *Bayesian Analysis* 14:1-27.

Fontaine, J.J., A.D. Fedele, L.S. Wszola, L.N. Messinger, C.J. Chizinski, J.L. Lusk, K.L. Decker, J.S. Taylor, and E.F. Stuber. 2019. Hunters and their perceptions of public access: A view from afield. *Journal of Fish and Wildlife Management* 10:589-601.

Hansen, H.H., E. Forzono, A. Grams, L. Ohlman, C. Ruskamp, M.A. Pegg, and K.L. Pope. 2020. Exit here: strategies for dealing with aging dams and reservoirs. *Aquatic Sciences* 82:2.

Hinrichs, M.P., N.B. Price, M.P. Gruntorad, K.L. Pope, J.J. Fontaine, and C.J. Chizinski. 2020. Understanding sportsperson retention and reactivation through license purchasing behavior. *Wildlife Society Bulletin* 44:383-390.

Hogan, K.F.E., K.L. Nash, E.M. Bennett. In Press. Multisystemic Resilience: Adaptation and Transformation Across Systems and Scales, M. Ungar (ed.) Adaptive management of ecosystem services for multisystemic resilience: iterative feedback between application and theory. OUP, Oxford, U.K.

Kaemingk, M.A., C.J. Chizinski, C.R. Allen, and K.L. Pope. 2019. Ecosystem size predicts social-ecological dynamics. *Ecology and Society* 24(2):17.

Kaemingk, M.A., K.L. Hurley, C.J. Chizinski, and K.L. Pope. 2020. Harvest-release decisions in recreational fisheries. *Canadian Journal of Fisheries and Aquatic Sciences* 77:194-201.

Kaemingk, M.A., S.E. Swearer, S.J. Bury, and J.S. Shima. 2019. Landscape edges shape dispersal and population structure of a migratory fish. *Oecologia* 190:579–588.

Kane, D.S., M.A. Kaemingk, C.J. Chizinski, and K.L. Pope. 2020. Spatial and temporal behavioral differences between angler-access types. *Fisheries Research* 224:105463.

Madsen, A.E., L. Corral, and J.J. Fontaine. 2020. Weather and exposure period affect coyote detection at camera traps. *Wildlife Society Bulletin* 44:342-350.

Messinger, L.N., E.F. Stuber, C.J. Chizinski, and J.J. Fontaine. 2019. Mortality, perception, and scale: Understanding how predation shapes space use in a wild prey population. *Plos One* 14:e0222272.

Perrion, M.A., M.A. Kaemingk, K.D. Koupal, C.W. Schoenebeck, and N.A. Bickford. 2020. Use of otolith chemistry to assess recruitment and habitat use of a white bass fishery in a Nebraska reservoir. *Lake and Reservoir Management* 36:64-74.

Spurgeon, J.J., M.A. Pegg, K.L. Pope, and L. Xie. 2020. Ecosystem-specific growth responses to climate pattern by a temperate freshwater fish. *Ecological Indicators* 112:106130.

Stuber, E.F. and J.J. Fontaine. 2019. How characteristic is the species characteristic selection scale? *Global Ecology and Biogeography* 28:1839-1854.

Stuber, E.F., C.J. Chizinski, J.J. Lusk, and J.J. Fontaine. 2019. Multivariate models and analyses. Pp. 32-62 in L.A. Brennan, A.N. Tri and B.G. Marcot (editors). Quantitative Analyses in Wildlife Science. Johns Hopkins University Press, Baltimore, MD.

Uphoff, C.S., C.W. Schoenebeck, K.D. Koupal, K.L. Pope, and W.W. Hoback. 2019. Age-0 walleye Sander vitreus display length-dependent diet shift to piscivory. *Journal of Freshwater Ecology* 34:27-36.

Varner, D.M., A.T. Pearse, A.A. Bishop, J.I. Davis, J.C. Denton, R.C. Grosse, H.M. Johnson, E.J. Munter, K.D. Schroeder, R.E. Spangler, M.P. Vrtiska, and A.E. Wright. 2020. Roosting habitat use by Sandhill cranes and waterfowl on the North and South Platte Rivers in Nebraska. *Journal of Fish and Wildlife Management* 11:56-67.

Verheijen, B.H.F., D. Varner, and D.A. Haukos. 2020. Future losses of Playa Wetlands decrease network structure and connectivity of the Rainwater Basin, Nebraska. *Landscape Ecology* 35:453-467.

Wszola, L.S., A.L. Madsen, E.F. Stuber, C.J. Chizinski, J.J. Lusk, J.S. Taylor, K.L. Pope, and J.J. Fontaine. 2020. Public access for pheasant hunters: Understanding an emerging need. *Journal of Wildlife Management* 84:45-55.

## PRESENTATIONS

Chizinski, C.J., N.B. Price, K.L. Pope, J.J. Fontaine, M. Rahe, and J. Rawlinson. 2020. Development and application of an open-sourced dashboard to improve our understanding wildlife recreationists. 80th Annual Meeting, Midwest Fish and Wildlife Conference, Springfield, Illinois.

DaRugna, O.A., M.A. Kaemingk, and K.L. Pope. 2019. Recreational activities on Valentine National Wildlife Refuge. Annual Meeting, Nebraska Chapter, The Wildlife Society, York, Nebraska.

DaRugna, O.A., M.A. Kaemingk, and K.L. Pope. 2019. Sociodemographic attributes of public land visitors. Pathways: Human Dimensions of Wildlife Conference, Estes Park, Colorado.

DaRugna, O.A., M.A. Kaemingk, and K.L. Pope. 2020. Insight for managing public lands as a social-ecological system. Annual Meeting, Nebraska Chapter, American Fisheries Society, Lincoln, Nebraska.

Fogarty, D.T. 2019. Eastern redcedar invasion: ecological impacts, and management. University of Nebraska Extension, Curtis, Nebraska.

Fogarty, D.T. 2020. Defending rangelands in a battle for a biome. Pheasants Forever and Nebraska Grazing Lands Coalition, Eastern Red-cedar Awareness Meeting, Enders, Nebraska.

Fogarty, D.T., D. Uden, C.R. Roberts, and D. Twidwell. 2020. Managing for resilience at biome-scales: approaches and outcomes. North American Wildlife & Natural Resources Conference, Bird Conservation Committee, Omaha, Nebraska.

Fogarty, D.T., C.R. Roberts, D. Uden, V. Donovan, D. Twidwell, and C.R. Allen. 2019. Monitoring outcomes: transitioning from local restoration projects to regional restoration of pattern and process. Society for Ecological Restoration, World Conference, Cape Town, South Africa.

Fogarty, D.T., C.R. Roberts, D. Uden, V. Donovan, D. Twidwell, and C.R. Allen. 2019. Outcomes of grassland conservation in Nebraska's bio-logically unique landscapes. The Nebraska Natural Legacy Annual Conference, Gering, Nebraska.

Mentoring Olivia DaRugna at Hardin Hall, Lincoln, NE

*Photo: Wilma Gerena*

- Hogan, K.F.E. 2019. Plant Functional Community Dynamics and Pollinator Resource Provision within Nebraska's Restored Prairies. External Advisory Board meeting, NSF Research Traineeship, Lincoln, Nebraska.
- Kaemingk, M.A., C.J. Chizinski, K.L. Hurley, and K.L. Pope. 2020. Prioritizing aquatic systems according to ecosystem size. Annual Meeting, Iowa Chapter, American Fisheries Society, Moravia, Iowa.
- Kaemingk, M.A., C.J. Chizinski, K.L. Hurley, and K.L. Pope. 2019. The allocation, use, and management of fisheries resources. Annual Meeting, Nebraska Chapter, American Fisheries Society, Nebraska City, Nebraska.
- Kaemingk, M.A., C.N. Ruskamp, C.J. Chizinski, and K.L. Pope. 2019. Social-ecological catchments. Joint meeting of American Fisheries Society and The Wildlife Society, Reno, Nevada (invited presentation).
- Kaemingk, M.A., K.L. Hurley, C.J. Chizinski, and K.L. Pope. 2019. Understanding angler harvest to optimize aquatic resources. International Symposium, Food Safety and Conservation in Inland Fisheries and Aquaculture, Food and Agriculture Organizations of the United Nations, Dresden, Germany.
- Kane, D.S., M.A. Kaemingk, and K.L. Pope. 2020. Cross-scale distributions of angler effort. Annual Meeting, Iowa Chapter, American Fisheries Society, Moravia, Iowa.
- Kane, D.S., M.A. Kaemingk, and K.L. Pope. 2020. Opportunities to manage angler effort. Annual Meeting, Nebraska Chapter, American Fisheries Society, Lincoln, Nebraska.
- Kane, D.S., M.A. Kaemingk, C.J. Chizinski, and K.L. Pope. 2019. Are boat anglers superior to bank anglers? Annual Meeting, Nebraska Chapter, American Fisheries Society, Nebraska City, Nebraska.
- Pope, K.L., K.L. Hurley, T.J. Barada, C.J. Chizinski, and M.A. Kaemingk. 2020. Fishing for understanding. Annual Meeting, Iowa Chapter, American Fisheries Society, Moravia, Iowa.
- Pope, K.L., M.A. Kaemingk, C.J. Chizinski, C.N. Ruskamp, and M.T. Porath. 2019. Social-ecological catchments for prioritizing restoration efforts. 8th World Conference on Ecological Restoration, Cape Town, South Africa (invited presentation).
- Wszola, L.S., K.F.E. Hogan, M. Khan, J.A. Fowler, C.D. Barnes, J. Castillo, C.T. Fill, J.E. Johnson, B.A. Kirsch, A.K. Ludwig, D.A. Rico, C.R. Allen, and D. Twidwell. 2019. Resilience converges. Poster, National Science Foundation 2019 NRT Annual Meeting, Evanston, Illinois.
- Wszola, L.S., M.A. Kaemingk, C.J. Chizinski, K.L. Hurley, K.L. Pope, and J.P. DeLong. 2020. Modeling fisheries-induced evolution in freshwater recreational fisheries. Annual Meeting, Iowa Chapter, American Fisheries Society, Moravia, Iowa.
- Wszola, L.S., M.A. Kameingk, C.J. Chizinski, K.L. Hurley, K.L. Pope, and J.P. DeLong. 2020. 1000 kilometers and counting: creel surveys across the Great Plains. Annual Meeting, Nebraska Chapter, American Fisheries Society, Lincoln, Nebraska.



**Christopher Fill extracting bat from net at Homestead National Monument of America, Beatrice, NE**

*Photo: Ben Hale*



**Eastern Meadowlark at Valentine National Wildlife Refuge, Valentine, NE**

*Photo: Olivia DaRugna*



