

OKLAHOMA
COOPERATIVE
FISH AND WILDLIFE
RESEARCH UNIT



TRIENNIAL REPORT 2017|19

Celebrating Our 8th Decade

IN COOPERATION WITH
Oklahoma State University
Oklahoma Department of Wildlife Conservation
Wildlife Management Institute
U.S. Geological Survey
U.S. Fish and Wildlife Service

welcome

OPPORTUNITIES FOR GRADUATE STUDY

NATURAL RESOURCE ECOLOGY AND MANAGEMENT AND BEYOND!



COVER

The ringed salamander (*Ambystoma annulatum*) is a tier II species of conservation concern in Oklahoma. These animals live mostly underground, but congregate at temporary ponds for breeding in the fall after large rainstorms. Photograph by S. Fox.

Triennial Report designed by
Oklahoma State University
Brand Management.

It is our great pleasure to circulate the **Triennial Report of the Oklahoma Cooperative Fish and Wildlife Research Unit**, which highlights graduate research and scholarship for 2017-2019.

The Oklahoma Unit of the U.S. Geological Survey's Cooperative Research Units Program has been an integral part of graduate-level research and post-graduate training in natural resources, particularly fisheries and wildlife conservation, at Oklahoma State University since 1948.

With direction from our Coordinating Committee, research is conducted on a wide variety of natural resource conservation topics in cooperation with federal and state agencies, the University, the Oklahoma Department of Wildlife Conservation, the U.S. Fish and Wildlife Service, the Wildlife Management Institute, and various private entities. Most of our research projects are problem oriented and designed to provide cooperators with useful information on time-sensitive natural resource issues.

From its establishment in 1948 to 2006, the Unit was affiliated with OSU's Department of Zoology (now Integrative Biology) in the College of Arts and Sciences. In 2006, the Unit's affiliation moved to the newly created Department of Natural Resource Ecology and Management in the Division of Agricultural Sciences and Natural Resources.

Research through the Oklahoma Unit is conducted mainly by M.S. and Ph.D. candidates. Over 400 theses and dissertations have resulted from their persistence and scholarship. Students have conducted research on fisheries management in reservoirs, ponds, and rivers; stream ecology; species of special concern including the Arkansas river shiner and Ozark big-eared bat; toxicology; and management of bobwhite quail, black bears, and smallmouth bass. While many of our

research projects occur in Oklahoma, other projects conducted by our scientists and students occurred in Georgia, Missouri, New Mexico, Nebraska, and Texas. As we enter our 8th decade, future projects will continue to emphasize applied research on the natural resources of Oklahoma and the nation.

The Oklahoma Unit and its Cooperators would be pleased to share additional information on any project summarized herein. You are welcome to contact any of the investigators listed by project through the Unit Office.

Additional information about our cooperators can be found at www1.usgs.gov/coopunits/, www.okstate.edu, www.wildlifedepartment.com, www.wildlifemanagementinstitute.org, and www.fws.gov.

James M. Long

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Coordinating Committee

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Thomas G. Coon

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Director, Oklahoma Department of Wildlife Conservation

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Chief, Cooperative Research Units, U.S. Geological Survey

Steve A. Williams

President, Wildlife Management Institute

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Cooperators and Research Personnel

Cooperating faculty from the University, resource professionals from many agencies and affiliated universities, post-doctoral researchers, graduate students, research specialists and technicians, and volunteers are the lifeblood of Unit operations and opportunity

Aquatic Resources

From mussels to smallmouth bass and with clear applications of Geographic Information System technologies, completed and ongoing Unit projects in aquatic resources explore complex resource issues focusing on conservation, recreation, recovery, and human dimensions.

Terrestrial Resources

From bobwhite to other avian assessments in prairies and forest and from conservation genetics of bears to a variety of management issues, completed and ongoing Unit projects in terrestrial resources encompass most topics in contemporary wildlife conservation.

Scholarship

The spirit of scientific contribution and scholarship of Unit participants in 2017-2019 is clear: 31 student/faculty awards, 26 theses/dissertations, 81 peer-reviewed and technical publications, and 165 presentations at professional state, regional, national, and international meetings.

**2017
2019**

The **UNIT TRIENNIAL REPORT** is a publication of the Oklahoma Cooperative Fish and Wildlife Research Unit to disseminate information about Unit research and scholarly activities at Oklahoma State University. It is intended to encourage communications among interested parties. Please contact the Unit for further information and dialog.

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OKLAHOMA STATE UNIVERSITY
**FERGUSON COLLEGE
OF AGRICULTURE**



Triennial Report

2017
2019

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Cooperators

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OKLAHOMA DEPARTMENT OF WILDLIFE CONSERVATION

Administration: J.D. Strong (Director), Andrea Crews, Corey Jager; **Fisheries:** Barry Bolton (Chief), Brandon Brown, Jim Burroughs, Ken Cunningham (Assistant Chief), Jennifer Drooby, Adam Geik, Don Groom, Kurt Kuklinski, Ashley Nealis, Steve O'Donnell, Mike Porta, Tony Rodger, Jason Schooley, Richard Snow, Matt Skoog, Trevor Starks, Curtis Tackett, Jon West; **Wildlife:** Curt Allen, Bruce Burton, Steve Conrady, Brett Cooper, Scott Cox, Jerrod Davis, Bill Dinkines (Chief), Craig Endicott, Colby Farquhar, Joe Hemphill, Melinda Hickman, Russ Horton, Mark Howery, Ron Justice, Mike O'Meilia, Scott Parry, Alan Peoples (Retired), JD Ridge, Mike Sams, Doug Schoeling, Rod Smith, Rex Umber, Derek Wiley.

U.S. GEOLOGICAL SURVEY

Columbia Environmental Research Center: Duane Chapman, Kimberly Chojnacki, Aaron DeLonay, Jeff Jolley; **Cooperative Research Units:** Shana Coulby, Barry Grand, Amanda Maslowski, Missy Thode, Tim Grabowski (Unit Leader, Hawaii), Craig Paukert (Unit Leader, Missouri); **Northern Prairie Science Center:** Ned Euliss; **South Central Climate Science Center:** Mike Langston.

U.S. FISH AND WILDLIFE SERVICE

Region 2: James Broska (Assistant Regional Director), David (Randy) Stewart; **Tulsa Ecological Services:** Ken Collins, Daniel Fenner, Ken Frasier, Jonna Polk (Field Supervisor), Kevin Stubbs; **Oklahoma Fisheries Resource Office:** Brent Bristow; **Tishomingo National Fish Hatchery:** Kerry Graves, Ralph Simmons; **Region 4:** Cynthia Williams; **Lower Rio Grande National Wildlife Refuge:** Bryan Winton and staff; **Ozark Plateau National Wildlife Refuge:** Richard Stark and staff; **Southwestern Native Aquatic Resources and Recovery Center:** Mike Schwemm; **Gulf Coast Prairie Landscape Conservation Cooperative:** Bill Bartush.

U.S. NATIONAL PARK SERVICE

Chattahoochee River National Recreation Area: Paula Capece, Ann Couch, Deanna Greco.

U.S. DEPARTMENT OF DEFENSE

Corps of Engineers, Construction Engineering Research and Development Laboratory: Kurt Gust; **Kansas City District Office:** Joseph Bonneau, Anthony Civiello, Todd Gemeinhardt, Nate Gosch, Marcus Miller.

U.S. DEPARTMENT OF AGRICULTURE

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THE NATURE CONSERVANCY

Kim Elkins.

PEORIA TRIBE OF INDIANS OF OKLAHOMA

Justin Downs.

AMERICAN BIRD CONSERVANCY-OAKS AND PRAIRIES JOINT VENTURE

Kenneth Gee, James Giocomo.



Aquatic Resources

COMPLETED PROJECTS

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Effects of surface-groundwater interactions on stream fishes under altered base-flow conditions

Altered thermal regimes affect stream fishes both directly and indirectly, influencing their distribution, growth, reproduction, and survival. Increasing temperatures and the demand for freshwater highlight the need to predict stream fish responses to increasing stream temperatures under altered flow regimes. First, we determined CTMax for 10 stream fishes of the Ouachita Mountain ecoregion (20°C acclimation, 2°C per h heating rate). Critical thermal maxima ranged 34.0–38.3°C among species. Benthic fishes had the lowest CTMax, and the only surface-dwelling species tested had the highest CTMax. Next, whole-body cortisol concentrations of six stream fishes of the Ouachita Mountain ecoregion exhibited no significant differences in stress responses between treatment temperatures after prolonged exposure to elevated water temperatures. Results from our CTMax trials were used to predict thermal responses by stream fishes for 15 hypothetical flow-release scenarios using a calibrated and validated WASP model. Results indicated the current release operation was insufficient to provide a suitable downstream thermal regime for most of the fishes tested. Increasing release magnitude and/or releasing from hypolimnetic reservoir locations could improve the downstream thermal habitat for these fishes.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATORS

Shannon K. Brewer and Garey A. Fox

STUDENT INVESTIGATORS

Yan Zhou, Ph.D. Candidate; Justin Alexander, M.S. Candidate

COMPLETED

May 2018

A general status assessment of blue suckers in Oklahoma rivers

Like many big-river obligate fishes in North America, Blue Suckers *Cycorephus elongates* are a species of conservation concern. In Oklahoma, Blue Suckers are vulnerable to extirpation; however, knowledge of Blue Suckers within the state is limited. The goal of this project is to develop a working knowledge of the Blue Sucker population in Oklahoma, and inform the State's Wildlife Action Plan. Our objectives are: 1) determine the distribution and quantify potential spawning habitats, 2) estimate age and growth of several populations, and 3) estimate abundances using mark-recapture. Preliminary data suggest Blue Suckers move throughout the Red River between Denison Dam and the Arkansas border, and > 50 km upstream into major tributaries. Like Blue Suckers in other regions, we determined Blue Suckers often live > 20 years, and occupy habitats with swift current during the spring.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATORS

Shannon K. Brewer and Daniel E. Shoup

STUDENT INVESTIGATOR

Joseph Dyer, Ph.D. Candidate

COMPLETED

December 2018



KELSEY ANDERSON HOLDING A MATURE FEMALE BLUE SUCKER CAPTURED BELOW HUGO DAM IN THE KIAMICHI RIVER, OKLAHOMA. (J. DYER PHOTO)

Evaluating the effectiveness of stream restoration projects based in natural channel design concepts using process-based investigations

The central theme of the program was stream restoration, and specifically evaluating natural channel design approaches through process-based investigations. Many current stream rehabilitation projects use natural channel design concepts, which are often criticized. The alternative is a complex, process-based analysis of the dynamic system and impact of stream modifications on the hydraulics, sediment transport, and biological community. We are mentoring 21 undergraduate students from across the country over three summers (2015-2017) as part of this program. Students participate in research projects quantifying the role of vegetation on streambank erosion, documenting the influence of in-stream structures on retention in the stream, evaluating the effect of excess sediment on fish, using aquatic macroinvertebrates to assess streambank modifications, and examining interactions between groundwater and stream temperatures. Participants benefited from multi-disciplinary collaboration and experienced mentoring. Students received professional development training on ethics, responsible conduct of research, research writing, basic statistics and study design, state-of-the-art equipment used in various disciplines, and career and graduate school opportunities

FUNDING

National Science Foundation

FACULTY INVESTIGATORS

Shannon K. Brewer and Garey A. Fox

COMPLETED

August 2018



DR. SHANNON BREWER AND DR. GAREY FOX WITH REU STUDENTS FOLLOWING THEIR FINAL PRESENTATIONS.

Using environmental DNA (eDNA) to assess the presence of cavefish and crayfish populations in caves of the Ozark Highlands

Environmental DNA (eDNA) is a new tool that may help improve monitoring efforts for many organisms, especially those that occur in aquatic environments. Cavefish and cave crayfish are ecologically important organisms that occur in groundwater ecosystems and most are of conservation concern. Because of the habitat in which they reside, it is difficult to determine presence of populations with traditional visual surveys. The inability to adequately monitor cavefish and cave crayfish populations impedes conservation efforts. Our objective was to compare the use of eDNA to traditional visual surveys for monitoring cave fish and cave crayfish populations in the Ozark Highlands. Detection probability of both cavefishes and cave crayfishes varied by survey method and was significantly related to water volume, water velocity, and substrate. Our results indicated approximately 4 eDNA surveys versus 9 visual surveys would be needed to be confident cavefish were absent if undetected via sampling. Alternatively, it would take about 6 visual surveys versus 10 eDNA surveys to achieve a cumulative detection probability near one for cave crayfishes. After adjusting for detection, we identified several locations where cave crayfish or fish populations likely occur but have previously gone undetected. We also found disturbance was a major driver related to unoccupied sites by cave crayfishes.

FUNDING

U.S. Fish and Wildlife Service, Refuges

FACULTY INVESTIGATORS

Shannon K. Brewer and Ronald Van Den Bussche

STUDENT INVESTIGATOR

Josh Mouser, M.S. Candidate

COMPLETED

December 2018

Assessing the spawning movement and habitat needs of riverine Neosho smallmouth bass

The spawning and early development periods of stream fish strongly influence population dynamics. Appropriate management efforts rely on quantifying the environmental conditions and habitats needed during these periods. Unfortunately, this information is incomplete for the Neosho Smallmouth Bass (NSMB). We used radio telemetry and snorkel surveys to (1) quantify movements and microhabitat use of adult NSMB during the spawning period, (2) determine habitat factors at multiple spatial scales that relate to suitable spawning habitat, and (3) quantify the survival of age-0 NSMB relative to hierarchical stream-habitat conditions. Our tracking results indicate most larger movements occurred during the spawning season, fish did not use Grand Lake O' the Cherokee as habitat, and fish movement was generally related to increasing discharge conditions. We documented nest clustering behavior by Neosho Smallmouth Bass. Cluster presence was more prevalent in warmer stream reaches with wide, shallow channels, and less likely in groundwater-gaining reaches, whereas overall nest abundance was greater in warmer streams and reaches with deeper pools. We showed the importance of both warmer streams and deep pools of small streams for Smallmouth Bass rearing. We found negative relationships between floods and first-year juvenile survival and show the importance of stream network position for mitigating the negative effects of July floods. Our analyses of both nesting and young-of-year habitat use suggest small streams, typically not considered important to many fisheries, are responsible for a proportion of Neosho Smallmouth Bass production

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATOR

Shannon K. Brewer

STUDENT INVESTIGATOR

Andy Miller, Ph.D. Candidate

COMPLETED

December 2019

Incorporating an approach to aid river and reservoir fisheries in an altered landscape

6 The objective of our study was to determine the relationship between flow or water-level patterns on fish recruitment and growth of two pelagic fishes. We sampled fishes from two rivers and two reservoirs and related seasonal and annual hydrology variables to the recruitment and growth of each species. Freshwater Drum and Gizzard Shad reached maximum ages of 32 and 7 years in rivers, but 31 and 8 years in reservoirs. Both species grew larger in rivers. The annual number of river reversals and prespawn discharge explained 33% of the variation in riverine drum recruitment. Reservoir retention time was negatively related to recruitment of drum in reservoirs. Recruitment of riverine shad was positively related to high flow pulses. Growth of both species in reservoirs was positively related to the annual number of days that water levels were above conservation pool, and drum growth was also negatively related to summer minimum water levels. In general, pelagic reservoir fishes relied more on annual hydrology parameters, whereas riverine fishes benefited more from seasonal patterns. Results of this study provide important information on the influence of hydrology on pelagic fish production in both rivers and reservoirs.

FUNDING

U.S. Fish and Wildlife Service, Gulf Coast Prairie Landscape Conservation Cooperative

FACULTY INVESTIGATORS

Shannon K. Brewer and Daniel E. Shoup

STUDENT INVESTIGATOR

John Dattilo, M.S. Candidate

COMPLETED

December 2017



JOHN DATTILO HOLDING FRESHWATER DRUM SAMPLED FROM THE ELK RIVER (D. CARL PHOTO)

Developing a tool for adjusting catch of stream centrarchids

We developed a stream sampling protocol for ODWC that focused on a calibrated model for Ozark Highland streams. After evaluating sampling efficiency and bias to support the collection of scientifically defensible monitoring data, we provided the agency with a spreadsheet that would calculate adjusted abundance data. We provided training on how to update the model so it can be used by agency personnel.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATOR

Shannon K. Brewer

COMPLETED

October 2017



ANDY MILLER HOLDING A NEOSHO SMALLMOUTH BASS CAPTURED FOR RADIO TAGGING (S. BREWER PHOTO)



DR. SHANNON BREWER AND JOSH MOUSER FILTERING WATER FROM A CAVE IN THE OZARK HIGHLANDS (D. ASHLEY PHOTO)

Economics of the Oklahoma paddlefish fishery

This project measured Oklahoma recreational paddlefish anglers' preferences for catch-and-release fishing. We used stated preference data from a choice experiment to identify the effect of a hypothetical catch-and-release regulation on fishing preferences, and revealed preference data to measure the desirability of actual paddlefish fishing locations. We then modeled the effects of catch-and-release regulations on location choice and participation in the Oklahoma fishery. Our results showed that although anglers generally dislike catch-and-release, most anglers directly affected by catch-and-release will either continue fishing at their preferred site or switch to a site where harvesting is permitted. Our preferred model predicted two-thirds will continue to participate in the paddlefish fishery even if catch-and-release fishing is required statewide

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATOR

Richard Melstrom

STUDENT INVESTIGATOR

Wonkyu Cha, graduate research assistant, PhD Agricultural Economics

COMPLETED

June 2017



Genetic integrity and population status of shoal bass in the upper Chattahoochee River, Georgia

The shoal bass is an endemic species of black bass native to the Apalachicola-Chattahoochee-Flint river system of Georgia, Alabama, and Florida and is vulnerable to extinction because of competition and genetic hybridization with invasive species and habitat loss. Based on genetic analyses and population monitoring over three years, 76% of Shoal Bass in Big Creek were introgressed with non-native Smallmouth Bass alleles and low effective population sizes (<200) were documented in the Chattahoochee River and Chestatee River above Lake Lanier, but these two populations were less affected by hybridization with non-native species. Collectively, these populations in the northern portion of the range grew slower, lived longer, and experienced lower annual mortality than other studied populations. Conservation efforts focused on remediating the effects of non-native species coupled with preserving forested areas in the watershed could be effective for long-term sustainability of this species. Additionally, we found that some angling effort was directed at Shoal Bass in the recreation area, which could be an opportunity to engage the public to increase support for conservation of this species

FUNDING

U.S. National Park Service

FACULTY INVESTIGATOR

James M. Long

INVESTIGATOR

Andrew Taylor, Ph.D. Candidate

COMPLETED

December 2017

Determine the distribution of state-endangered longnose darter through niche model transferability

Longnose Darters are known from two river systems in Oklahoma, but believed to have been extirpated from the Poteau River system. Translocation efforts from Lee Creek into Blackfork Creek were made in 1991–92 with hopes of reestablishing a Poteau River system population, but whether this population currently persists is unknown. To investigate this, created environmental niche models of Longnose Darters and used that information to target areas for sampling. Our search for occurrence records found a recent collection in the upper Poteau River, demonstrating that the species has not been extirpated as previously thought, and that a potentially hidden population exists in the Kiamichi River. We failed to detect Longnose Darters in the translocated Blackfork Creek location, suggesting the reestablishment effort was unsuccessful. Other streams that exhibited suitable habitat for Longnose Darter included Sans Bois Creek, Sallisaw Creek, and the Illinois River. From backpack electrofishing sampling, we found that Longnose Darters were the least detectable of all the co-occurring darter species, from 5 to 10%, with the greatest detectability in spring compared to summer

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATORS

James M. Long and Monica Papeş

STUDENT INVESTIGATORS

Colt Holley, M.S. Candidate; Xiao Feng and Andrew Taylor, Ph.D. Candidates; Josh Hills, Matt Pallett, Field Technicians.

COMPLETED

December 2018

Assessing wild juvenile trout ecology in the lower Mountain Fork

Many tailwaters in the southeastern United States have been stocked with Rainbow Trout, but few have reported natural reproduction. Past research has found juvenile trout in the main stem and tributaries of the lower Mountain Fork in southeastern Oklahoma, suggesting the potential for recruitment of wild fish. We surveyed for juvenile trout at 12 sites along 19 km of the designated trout portion of the lower Mountain Fork to estimate age, spawning date, and growth rates using otolith microstructure analysis. Juvenile trout were the result of spawning that took place from late January through mid-April. Growth and body condition were variable between years, but similar to other systems. Weekly survival estimates using catch curves were low (<80%), suggesting limited potential for recruitment. Wild, juvenile Rainbow Trout ate a variety of food items, but selected for amphipoda and diplostraca and against trichoptera. Potential for a wild fishery may exist, but would probably be limited because of low recruitment

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATORS

James M. Long and Wyatt W. Hoback

STUDENT INVESTIGATORS

Tyler Farling, M.S. Candidate; Melissa Reed and Joel Bjornen, Field Technicians.

COMPLETED

June 2018



MULTIAGENCY SAMPLING TEAM AT BIG CREEK (A. TAYLOR PHOTO)



COLT WITH LONGNOSE DARTER (M. PALLETT PHOTO)



LOWER SPILLWAY CREEK AT THE LOWER MT. FORK TAILWATER TROUT FISHERY (T. FARLING PHOTO)

Assessment of invasion extent of Asian Swamp Eels in ponds and backwater marshes adjacent to the Chattahoochee River

Asian Swamp Eels in Georgia are known from 3 ponds within the Chattahoochee Nature Center and the adjacent backwater marsh area of the Chattahoochee River, but the extent of their invasion has been difficult to ascertain due to harsh sampling conditions. Using leaf litter traps for juveniles, we found that Asian Swamp Eels have expanded their range in the marshes of the river to over 1.5 km from the nature center ponds. Subsequent backpack electrofishing from canoe documented invasion in a marsh tributary. Next generation genetics tools estimated the adult breeding population in the marshes to be from 57 to 154 individuals. Depletion sampling in the nature center ponds failed to produce declining catch rates over a series of days, suggesting a very large population with limited susceptibility to electrofishing on any given day. The biology of the species and the difficult sampling conditions present significant challenges to eradicating this invasive species

FUNDING

U.S. National Park Service

FACULTY INVESTIGATOR

James M. Long

STUDENT INVESTIGATORS

Andrew T. Taylor, Postdoctoral Fellow; Jeff Johnson, M.S. Candidate; Colt Holley, Matt Pallett, Courtney Anderson, Joel Bjornen, Steven Nanez, Field Technicians.

COMPLETED

December 2018



JEFF JOHNSON WITH A JUVENILE ASIAN SWAMP EEL (C. HOLLEY PHOTO)

The influence of behavior, physiology, and genomics on the reproductive success of Alligator Snapping Turtles

The alligator snapping turtle is a species for which a captive propagation/head-start program has been implemented to restore this turtle to river systems from which it has been extirpated. The purpose of this study was to obtain a better understanding of the reproductive biology of the species for captive management. Follicle development in females began in late August and continued through early spring followed by ovulation in mid- to late-April. In males, large quantities of mature sperm were only likely available from October through March. Males were also more active than females from October to March, suggesting that mating may occur during this time. Oocyte membrane-bound sperm detection revealed that nearly all eggs that did not develop were infertile. We were unable to determine if paternity contributed to additional biases in reproductive success due to the extremely low genetic diversity of this species. The results of our study provide necessary information to breeding and reintroduction program managers about the reproductive biology of the alligator snapping turtle

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATOR

Ronald A. Van Den Bussche

STUDENT INVESTIGATOR

Denise Thompson, Ph.D. candidate

COMPLETED

December 2018



FEMALE ALLIGATOR SNAPPING TURTLE FROM BREEDING POPULATION AT TISHOMINGO NATIONAL FISH HATCHERY (D. THOMPSON PHOTO)

Accuracy of clupeid population data collected by hydroacoustics

Shad (*Dorosoma* spp.) are an important prey species that can effect growth and survival of sportfish. Therefore, it is important to accurately estimate shad densities to properly manage piscivore populations. Current methods for estimating shad abundance are time and labor intensive, imprecise, and may lack accuracy. Horizontal hydroacoustics may provide a more accurate and precise alternative to current shad sampling techniques. To test this, we created known densities of shad in a 15-m x 15-m x 4.5-m deep enclosure made from 6-mm square mesh and imaged them with a Simrad EK-60 120 kHz echosounder oriented horizontally. Shad density estimates scaled accurately with known density and were more precise (6.8% coefficient of variation of the mean) than other shad-sampling gear. Therefore, we recommend horizontal hydroacoustics for sampling shad. A side-aspect target-strength-to-total-length equation that considers fish orientation was developed in the laboratory to improve accuracy of side-aspect echo integration for shad

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATOR

Dan Shoup

STUDENT INVESTIGATOR

Garrett R. Johnson, M.S. Candidate

COMPLETED

June 2018



NET PEN SET IN LAKE CARL BLACKWELL TO ASSESS ACCURACY OF HYDROACOUSTICS (G. JOHNSON PHOTO)

Fisheries data analysis system

Fisheries data analysis is a critical part of the management process. This project produced an online data analysis system for the Oklahoma Department of Wildlife Conservation (ODWC). The application was built in program R and uses the Shiny package extension to provide an interactive web interface. All historic data for the ODWC are housed in the application. Biologists can select specific data sets based on filterable criteria for lake, year, month, and/or gear. They can then use check boxes to select the individual analyses they want performed (all are performed by default) and then view and download various tables and figures summarizing the analyzed metrics. This new application provides additional metrics that were not analyzed in the previous system and makes data and analyzed fishery metrics available to biologists anywhere they have an internet connection

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATOR

Dan Shoup

STUDENT INVESTIGATOR

Dray Carl, M.S. Candidate

COMPLETED

June 2018



SCREEN SHOT OF THE FISHERIES DATA ANALYSIS SYSTEM APPLICATION (D. SHOUP PHOTO)

Aquatic Resources

ONGOING PROJECTS



Evaluating changes in fish assemblages of the Red River via flow alteration

How alterations to natural flow regimes have affected biota drives a large portion of contemporary research in stream ecology. However, the underlying mechanisms responsible for changes in local warm water stream fish assemblages remain poorly understood. In addition, there is a high degree of uncertainty in long-term predictions of the distribution and abundance of warm water fishes over coarse spatial scales. We will (1) Determine how alterations to the flow regime have changed the functional diversity of Red River fish assemblages, (2) Examine how flow metrics and species traits explain local fish assemblages in the Red River basin, and (3) Develop flow-ecology groups using functional and ecological traits to provide a basis for comparison of ecosystem dynamics in the Red River to other river basins. We will use a hierarchical Bayesian approach to examine both species-environment and trait-environment relationships, where we will model flow-ecology relationships among stream fishes at both the hydrologic response unit and ecoregion scale using a tiered model-selection procedure.

FUNDING

U.S. Geological Survey (RWO 55)

FACULTY INVESTIGATOR

Shannon K. Brewer

STUDENT INVESTIGATOR

Robert Mollenhauer, Postdoctoral Fellow

EXPECTED COMPLETION

March 2020



JOEY DYER WITH A WHITE BASS FROM THE RED RIVER, OKLAHOMA (J. DYER PHOTO)

Determining instream flows needed to support the federally threatened Arkansas River Shiner *Notropis girardi* and associated assemblage

Understanding connectivity of habitat patches, relationships between occupancy and long-term flow patterns, and some understanding of movements during the non-breeding season would facilitate a broader understanding of the flows needed to support pelagophil fishes. Our preliminary results indicate Arkansas River Shiner and Plains Minnow are negatively related to seasonal predictability of flooding during cool periods. However, the Plains Minnow relationship reversed to positive during warmer seasons, whereas AR River Shiner relationship remained unchanged. Plains Minnow had a negative relationship with variability in the number of high flow pulses and a positive relationship with river fragment length whereas Arkansas River Shiner had a negative relationship with land-use disturbance. Arkansas River Shiner showed a bias for downstream movement during the winter. Movements were documented between 0 and 30,230 m (30.23 km). The first documentation of upstream movement was recorded on December 27, and the longest movement was recorded during the spring (May 21) by a fish in breeding condition. Connectivity is being quantified using drone flights and will be included in the final analyses.

FUNDING

U.S. Geological Survey (RWO 56)

FACULTY INVESTIGATOR

Shannon K. Brewer

STUDENT INVESTIGATORS

Daniel Logue and Desiree Moore, M.S. Candidates

EXPECTED COMPLETION

December 2020



ARKANSAS RIVER SHINER TAGGED TO EXAMINE WINTER MOVEMENT IN THE SOUTH CANADIAN RIVER (D. MOORE PHOTO)

Evaluation of sustainable water availability in drought prone watersheds in southeastern Oklahoma

A better understanding of how drought and fragmentation of watersheds interact to structure aquatic communities, alter the vulnerability of species to local extirpation, and determine the trajectory of recovery from disturbance is needed to inform proactive conservation and management actions. This project is a collaboration between the Chickasaw Nation, Aquastrategies, and the Oklahoma Cooperative Fish and Wildlife Research Unit. Our objective is to examine the effects of previous droughts on fish populations. We will compile fisheries data sets that have been temporally replicated within the Red River Basin. Hydrologic regime will be characterized to develop statistical relationships among fish traits, species, and indicators of drought. Our results will show which traits are most susceptible to drought, and which spatial locations have been most problematic for recovery following drought. The resulting model will be useful to developing water-management strategies in the basin that support both vulnerable fish populations and human needs.

FUNDING

U.S. Geological Survey (RWO 58)

FACULTY INVESTIGATOR

Shannon K. Brewer

STUDENT INVESTIGATOR

Robert Mollenhauer, Postdoctoral Fellow

EXPECTED COMPLETION

June 2020

Assessing the distribution and habitat needs of the Least Darter and sympatric species of the Ozark and Arbuckle Mountain ecoregions

Isolated populations may benefit from different conservation and management activities. The Least Darter is a species of conservation concern that has two isolated populations occupying portions of the Arbuckle Mountain and Ozark Highlands ecoregions. Our study found that the distribution of Least Darter was most strongly related to cool water temperatures, usually less than 22° C. However, relationships with microhabitat use indicate vegetation, lower water velocities, and fine substrates are strong indicators of habitat use. We additionally documented 5 new localities for Least Darter in the Ozark Highlands (2) and the Arbuckle Uplift (3), but we also documented historic collection sites where we believe Least Darter is no longer present. We are currently working on completing our analyses.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATOR

Shannon K. Brewer

STUDENT INVESTIGATOR

Dusty Swedberg, M.S. Candidate

EXPECTED COMPLETION

December 2020



LEAST DARTER SAMPLED FROM THE ARBUCKLE MOUNTAIN ECOREGION OF OKLAHOMA (D. SWEDBERG PHOTO)

Movement and flow recruitment relationships of Prairie Chub: An endemic Great Plains cyprinid

The Prairie Chub is classified as a pelagic broadcast-spawning cyprinid based on phylogenetic relationships and shared morphological characteristics with other *Macrhybopsis* spp. Great Plains pelagic-spawning cyprinid populations have undergone substantial population and range declines due to their sensitivity to anthropogenic changes to the natural flow regime. Currently, there is a paucity of information regarding Prairie Chub biology and life history; thus, little is known about specific factors (i.e., discharge magnitudes) that promote successful recruitment in the upper Red River basin. The purpose of this project is to improve the conservation and management of Prairie Chub and other pelagic broadcast minnows including members of the *Macrhybopsis* complex. We will assess movement at several locations to determine the relationship with recruitment. We will also evaluate the importance of flow regime metrics and relationships between hydrology and recruitment. This project is a collaborative effort by the Oklahoma Cooperative Fish and Wildlife Research Unit (Brewer) and Texas A&M University (co-PI, Perkin). This research will provide a useful ecological metric for informing future water management decisions that will help conserve populations of pelagic broadcast-spawning cyprinids in the upper Red River basin.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATORS

Shannon K. Brewer (OSU) and Joshua Perkin (Texas A&M)

STUDENT INVESTIGATORS

Meaghan Wedgeworth, M.S. Candidate; Zachary Steffensmeier, Ph.D. Candidate

EXPECTED COMPLETION

June 2021

Assessing the effects of stocked Rainbow Trout on native fishes in Spavinaw Creek, Oklahoma

Rainbow Trout are native only to the western United States but are stocked widely throughout the country to increase fishing opportunities for anglers. Competitive interactions have been shown to be condition specific (e.g., water temperature) and thus, may only occur seasonally or under certain environmental conditions. We PIT tagged trout in November 2018 (n = 495) and February 2019 (n = 605) prior to stocking and actively and passively located post stocking using both an active floating array and two passive fixed arrays. Directional movement by stocked Rainbow Trout was evident with upstream movements related to increases in daily discharge and downstream movements related to decreases in daily discharge. Apparent weekly survival rates for both autumn and spring stocked fish increased through winter and spring when water-temperatures were cool. Rainbow Trout persisted in Spavinaw Creek despite average warm water temperatures during summer; however, the weekly apparent survival rate during summer declined when maximum daily water temperatures exceeded 25 °C. Preliminary laboratory results indicate behavioral aggressions by Smallmouth Bass increases in the presence of trout. Ongoing efforts will determine how native fishes respond to the presence of trout via resource use and growth in a controlled laboratory setting.

FUNDING

Oklahoma Department of Wildlife Conservation and Arkansas Game and Fish Commission

FACULTY INVESTIGATOR

Shannon K. Brewer

STUDENT INVESTIGATORS

Skylar Wolf, Kimberly Brown and Peyton Shaw, M.S. Candidates

EXPECTED COMPLETION

December 2021

Assessing crayfish populations of the Ozark Highlands Ecoregion with an emphasis on invasion potential

Crayfish is a globally diverse group of invertebrates and one of the most important taxa in North American streams. Many crayfishes are identified as species of concern due to anthropogenic alteration, narrow distributions, and interactions with invasive crayfish. An estimated 48% of North American crayfish are at risk of extinction and widespread stream changes may result from loss of crayfish species despite their important role in stream structure and function, including a primary diet item of Smallmouth Bass *Micropterus dolomieu*. We will compile existing crayfish data, determine the hierarchical structure of habitats associated with crayfishes, determine crayfish demographics, and determine factors related to the spread of non-native crayfishes within the Ozark Highlands ecoregion. We compile all historical data and began monthly sampling on three Ozark Highland streams where we focus on fecundity, ageing, and habitat use by *Faxonius meeki brevis*, *F. nana*, and *F. macrus*. We are currently preparing for the first major field season to examine occupancy by crayfish in Ozark Highland and surrounding streams.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATOR

Shannon K. Brewer

STUDENT INVESTIGATOR

Brooke Grubb, Ph.D. Candidate

EXPECTED COMPLETION

May 2023



FAXONIUS MEEKI BREVIS EGG-BEARING FEMALES (B. GRUBB PHOTO)

Assessment of prey consumption and body condition of Missouri River age-0 *Scaphirhynchus* sturgeon

Loss of shallow-water habitat (SWH) in the Missouri River is a likely contributing factor in the decline of Pallid Sturgeon, and to a lesser extent, Shovelnose Sturgeon. A primary hypothesized benefit of SWH is increased prey availability and improved condition of young-of-year sturgeon. We are assessing prey use and lipid content of age-0 sturgeon from the lower Missouri River basin and comparing among sites and years. To date, we have found a strong longitudinal trend in prey use, with ephemeroptera more represented at sites farther upstream and diptera larvae dominating the stomach contents at lower sites. A positive linear trend between lipid content with gutted mass and a positive exponential trend for fish length exists for age-0 sturgeon but these trends vary in their explanatory ability depending on longitudinal position in the river. Whole body lipid content accumulated at faster rates at upstream sites than downstream sites.

FUNDING

U.S. Army Corp of Engineers

FACULTY INVESTIGATORS

James M Long, Andrew R. Dzialowski, and Jason Belden

STAFF INVESTIGATORS

Alin González-Barnes, Senior Research Specialist; Lauren Sequy, Joel Bjornen, Taylor Brooks, Rebecca Stokes, Mary Kate Higginbotham, and Cody Barnes, Lab Technicians.

EXPECTED COMPLETION

January 2021



GUT CONTENTS OF A JUVENILE SHOVELNOSE STURGEON FROM THE LOWER MISSOURI RIVER (A. GONZÁLEZ-BARNES PHOTO)

Determining factors associated with Paddlefish restoration success in reservoirs

To mitigate losses of Paddlefish populations in Oklahoma, the U.S. Fish and Wildlife Service and the Oklahoma Department of Wildlife Conservation have stocked reservoirs throughout the state, but with variable success. Two factors hypothesized to contribute to the success of these efforts are spawning substrate and food availability. We identified six reservoirs and nine reservoir tributaries to study for substrate and food availability related to Paddlefish stocking success. Over the course of 2019, five of nine reservoir tributaries had side-scan sonar imagery collections to evaluate spawning substrate availability. At Oologah Lake, where Paddlefish were successfully restored, we found that the Verdigris River had abundant hard substrate potentially suitable for Paddlefish spawning and hydrology had minimal effects on its availability. For prey availability, we established sampling transects for collection of zooplankton during spring and summer. Due to accessibility issues from high water, summer sampling was limited, but preliminary analyses of these data show that differences in type and size of zooplankton are apparent.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATORS

James M. Long and Andrew R. Dzialowski

STUDENT INVESTIGATORS

Ryan Gary and Bryan Eachus, M.S. Candidates; Luke Marshall, Cameron Sherbon, and Wyatt Wolfenkoehler, Field Technicians.

EXPECTED COMPLETION

June 2021



RYAN GARY WITH PADDLEFISH FROM KEYSTONE LAKE (J. SCHOOLEY PHOTO)

Assessing distribution of Yaqui Catfish in the Rio Yaqui drainage, US-Mexico

Yaqui Catfish *Ictalurus pricei* is a federally-threatened species, extirpated from its native range in the wild in the US, and threatened in the remainder of its range in the Yaqui, Mayo, and Fuerte river basins of Mexico. Using presence-only niche models, we are estimating the potential range of Yaqui Catfish in the Yaqui River basin and predicting suitable habitat in stream segments. To date, we have estimated that 93% of stream segments are suitable for Yaqui Catfish, suggesting that this species can tolerate a wide range of conditions. With these results, we are also using environmental DNA in a probabilistic sampling framework to determine the current distribution of Yaqui Catfish and its non-native congener Channel Catfish. Our preliminary data shows high detection probability of Yaqui Catfish (>90%) and that all sites with Yaqui Catfish also had a detection of Channel Catfish. Additional results are forthcoming and will be analyzed in an occupancy model framework to help guide conservation efforts for this species.

FUNDING

U.S. Fish and Wildlife Service

FACULTY INVESTIGATOR

James M. Long

STUDENT INVESTIGATORS

Thomas Hafen, M.S. Candidate; Alexandre Gutiérrez-Barragán, Field Technician.

EXPECTED COMPLETION

December 2021



EDNA SAMPLING FOR YAQUI CATFISH AND CHANNEL CATFISH AT CAJON BONITO, MEXICO (T. HAFEN PHOTO)

Economic value and regional impacts of Canton Lake fishery: impacts and implications of alternative water uses

Debates over water allocation for alternative uses followed water releases from Canton Lake during the 2010-2013 drought. While water rights at Canton Lake rest with Oklahoma City, the lake remains a popular recreation destination in the region suggesting significant social and economic values for its recreational use. Using data collected through visitor surveys from 2018 to 2019 we sought to provide a more holistic picture of the human dimensions at Canton Lake. Our satisfaction model suggests that perceived quality of the fishing experience, attachment to the lake, and management problems contribute the most to a visitor's satisfaction outcome while facilities and trip characteristics played a smaller, yet significant, role. Economic data further suggests that resident and nonresident visitors contribute significantly to the regional economy, particularly in the retail and accommodation & food services sectors. These results indicate that future withdrawals from Canton Lake under current policy are likely to have significant negative social and economic effects.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATOR

Omkar Joshi

STUDENT INVESTIGATORS

Adam K. Frakes and Zach Darby, M.S. Candidates; Kendall Scarlett, David Wall, and Katelyn Jeffries, Field Technicians.

EXPECTED COMPLETION

March 2020



ANGLERS TAKE ADVANTAGE OF SPRING WALLEYE SPAWNING AT CANTON LAKE DAM (A. FRAKES PHOTO)

Black bass angler harvest and opinions in relation to stream size, access, and fish diversity

Understanding the diversity of anglers' perception and valuation of fishing in Oklahoma streams is important by ODWC biologists for management. How anglers value the quality and experience of fishing at Illinois river and how they compare it with other tributaries of Lake Tenkiller (Baron Fork, and Caney Creek) may help in understanding and managing the expectations of anglers in these and similar-sized streams in the Ozark region of Oklahoma. Questions such as the value of river trips, total welfare loss if streams were inaccessible, and attitudes and preferences of anglers in maintaining high-quality fishing experience would provide invaluable information to fishery managers and help develop sound management strategy for ODWC. Survey-based valuations such as choice modelling coupled with creel surveys would allow researchers to fully evaluate the black bass fisheries in these systems.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATORS

Omkar Joshi, James M. Long, Andrew T. Taylor

STUDENT INVESTIGATORS

Binod Chapagain, Postdoctoral Fellow; Lauren Sequey, Chase Waldorf, Emily Rice, Kayleigh Locke, Field Technicians

EXPECTED COMPLETION

June 2020



EMILY RICE MEASURES A BASS AS PART OF A SURVEY OF BASS ANGLERS IN EASTERN OKLAHOMA (J. LONG PHOTO)

Distribution, habitat affiliation, and abundance of the Ringed Salamander in Oklahoma

The Ringed Salamander is endemic to the Ozark Highlands and Ouachita Mountains of Arkansas, Missouri, and Oklahoma. Very little is known of this species in Oklahoma. Adults emerge en masse from underground burrows to breed in upland ephemeral ponds during fall rains at night. We are conducting 1) nocturnal field surveys, 2) capture of adults via drift fences with funnel and pitfall traps, and 3) dipnet surveys for larvae at multiple ponds in eastern Oklahoma. We have observed migration of hundreds of adult salamanders to ponds, documented courtship, marked individuals with Visible Implant Elastomer (VIE) tags, and photographed them for mark-recapture studies. We are evaluating individual identification via natural pattern variation against the back-up method of VIE tags. We have marked and photographed >1000 adults and recorded hundreds of larvae. We are measuring multiple habitat variables and using them for niche modeling in GIS to predict occurrence at new localities.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATORS

Stanley Fox and Elisa Cabrera-Guzmán

STUDENT INVESTIGATOR

Taylor Carlson, M.S. Candidate

EXPECTED COMPLETION

June 2021



PHOTOGRAPHING DORSAL COLOR PATTERN OF AN ADULT RINGED SALAMANDER (T. CARLSON PHOTO)

Effects of sucker gigging on fish populations in Oklahoma scenic rivers

Sucker gigging is a cultural method of fish harvest throughout the Ozarks, including within Oklahoma scenic rivers. Harvest during sucker gigging tournaments can be substantial (e.g., > 1,000 fish harvested in a weekend). Little is known about the effect of this local, but intense, harvest on the fish communities of these systems, but life-history characteristics of suckers (long-lived, low natural mortality relative to shorter-lived species, and highly migratory) suggest these tournaments have potential to affect fish communities over a large distance from the locations of these tournaments. This study will evaluate the effects of sucker harvest on population dynamics in Spavinaw Creek and determine the harvest level at which overfishing would occur. This information is necessary to evaluate the need for harvest regulations on this cultural fishery to ensure sustainability of the fishery and ecosystem integrity.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATORS

Dan Shoup and Shannon K. Brewer

STUDENT INVESTIGATOR

Doug Zentner, Ph.D. Candidate

EXPECTED COMPLETION

June 2022



SAMPLING FOR SUCKERS WITH AN ELECTROFISHING TOTE BARGE IN THE WINTER. (D. ZENTNER PHOTO)

Striped Bass exploitation in tailwater habitats of east-central Oklahoma

Striped Bass (*Morone saxatilis*) is an important sportfish that often congregates in tailwater habitats, where they are potentially vulnerable to overharvest. This study will evaluate the current population demographics, exploitation rate, and movement patterns of Striped Bass from tailwater habitats of the Lower Illinois and Canadian Rivers and the mainstem Arkansas River to determine the potential for growth overfishing of tailwater fisheries. A delayed hooking mortality study will also be conducted to evaluate the mortality rate of fish that are captured but not harvested to allow better predictions of the effectiveness of restrictive bag limits. The above data will be evaluated with a population harvest model to determine the optimum harvest regulations for sustaining quality fishing in this fishery.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATORS

Dan Shoup and Shannon K. Brewer

STUDENT INVESTIGATOR

Alex Vaisvil, Ph.D. Candidate

EXPECTED COMPLETION

December 2022



ANDREW TAYLOR PREPARING A PIT TAG TO IMPLANT IN A SHOAL BASS (J. LONG PHOTO)



ODWC AND OSU FIELD CREW SAMPLING BLACK BASS IN THE ILLINOIS RIVER (J. LONG PHOTO)



A STRIPED BASS FROM THE ARKANSAS RIVER (M. WINSTEAD PHOTO)

Terrestrial Resources

COMPLETED PROJECTS



The economic impact of Lesser Prairie Chicken protection in Oklahoma

This project measured the effect of listing the lesser prairie chicken as a threatened species on several different economic measures. We conducted a before-after comparison of employment and oil and gas wells in counties with and without suitable prairie chicken habitat, which revealed that employment declined about 1.5% in affected counties. Drilling of oil and gas wells also fell in areas with habitat, as a small number of drills were enrolled in voluntary habitat conservation plans. These effects tended to be larger in areas with more habitat or where habitat is deemed essential to the species. We also examined parcel-level sales data before and after the listing. While standard regression models provided evidence that property values declined after listing, this finding did not hold up in models that controlled for latent county and year effects.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATOR

Richard Melstrom

STUDENT INVESTIGATORS

Kangil Lee, Ph.D. Candidate;
Derek Wietelman, Undergraduate
Research Assistant

COMPLETED

June 2017

Thermal ecology and impacts of fragmentation and prescribed fire of Rio Grande wild turkey in Oklahoma.

We investigated habitat selection and movement of 36 Rio Grande wild turkey (*Meleagris gallopavo intermedia*). Vegetation type strongly influenced landscape temperature, with taller vegetation types having mean temperatures up to 8.95 oC cooler than the remainder of the landscape, and wild turkey showed strong selection for these areas. However, these cooler vegetation types were uncommon, only making up 8.2% of the landscape. We found that on the hottest days ($\geq 35^{\circ}\text{C}$), wild turkeys decreased movement by three fold during peak heating, while movement on cooler days ($< 30^{\circ}\text{C}$) was consistent throughout the day until the final locations. At broader scales, Oil/gas wells were avoided in both the breeding and non-breeding seasons, while high traffic roads were avoided and low traffic roads were selected for in the breeding season. However, forest vegetation was by far the most influential factor in space use of wild turkey throughout the year.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATORS

Dwayne Elmore, Craig Davis,
and Sam Fuhlendorf

STUDENT INVESTIGATOR

Allison Rakowski, M.S. Candidate

COMPLETED

June 2018



ALLISON RAKOWSKI ATTACHING A GPS TRANSMITTER TO A FEMALE WILD TURKEY (D. ELMORE PHOTO)

Investigation of shinnery oak propagation and establishment as a framework for restoration.

Shinnery oak (*Quercus havardii*) is a poorly understood shrub that was historically more widely distributed in the southern Great Plains. Several high priority birds use shinnery oak communities, so understanding the plant's ecology and wildlife habitat associations is important for conservation. We evaluated shinnery oak seed germination, survival, and rhizome growth. We found that rhizome survival was poor, but larger rhizomes survived better. Seedling germination was improved with a 2-week cold stratification and seedling survival was better with near ambient light conditions. Additionally, we determined that soil type was the primary variable related to shinnery oak distribution. Finally, several avian species of high conservation value including Bell's Vireo, Cassin's Sparrow, and Painted Bunting were found in moderate to high numbers in shinnery oak communities. They tended to be most abundant in areas that had not been burned for 2 or more years although Cassin's Sparrow fluctuated in numbers between years.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATORS

Dwayne Elmore, Craig Davis, and Sam Fuhlendorf

STUDENT INVESTIGATOR

Matt Carroll, Postdoctoral Fellow

COMPLETED

December 2018



SHINNERY OAK SEEDLINGS BEING GROWN AT THE KIAMICHI FORESTRY RESEARCH STATION (C. MEEK PHOTO)

Effect of energy development on Greater Prairie Chicken in Osage County, Oklahoma

We examined the habitat and space use of grassland birds in the Southern Great Plains Grassland songbirds showed a highly variable tolerance for energy development. Henslow's sparrows (*Ammodramus henslowii*) was the most sensitive species, avoiding oil wells in all unburned patches. Most other species response was highly dependent on the type of infrastructure and time since fire patch, suggesting heterogeneity may moderate many species responses to energy development. Female greater prairie-chickens (*Tympanuchus cupido*) habitat use was primarily driven by use of the vegetation mosaic that results from fire and grazing, with individuals using unburned patches during the nesting and lekking seasons then shifting use to recently burned patches in the post-nesting and nonbreeding season. Greater prairie-chicken response to energy development was more complex with individuals showing a seasonally dependent avoidance of high densities of oil wells and power lines.

FUNDING

Oklahoma Department of Wildlife Conservation and an anonymous donor

FACULTY INVESTIGATORS

Dwayne Elmore, Sam Fuhlendorf, and Craig Davis

STUDENT INVESTIGATOR

David Londe, M.S. Candidate

COMPLETED

June 2017



HANDING A GREATER PRAIRIE CHICKEN.

Bobwhite quail population and habitat studies

Northern bobwhite populations have declined considerably throughout most of their distribution over the last 40-50 years. Within Oklahoma, the bobwhite is an economically important game bird that contributes to local economies. Loss and degradation of habitat has played a significant role in the decline of bobwhite populations not only in Oklahoma, but also throughout their distribution. In this 6-year study, we found that northern bobwhite respond to extreme temperature during the breeding season by seeking thermal refugia; landscape heterogeneity promotes thermally favorable thermal environments for nesting and brooding; and northern bobwhite space was minimally influenced in the near-term by time-since-fire, although long-term effects of fire help maintain habitat. Development of artificial water sources appeared to act primarily as an attractant for quail. Northern bobwhite response to anthropogenic features (e.g., oil well development, roads) was minimal in terms of influencing movement patterns and habitat selection as well as harvest rates.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATORS

Craig Davis, Dwayne Elmore, Sam Fuhlendorf, and David M. Leslie, Jr.

STUDENT INVESTIGATORS

Eric Thacker, Postdoctoral Fellow; Kent Andersson, Senior Research Specialist; Evan Tanner and Matt Carroll, Ph.D. Candidates; Jeremy Orange, Rachel Beytke, and Cameron Duquette, M.S. Candidates

COMPLETED

July 2017



BOBWHITE QUAIL ON A FENCE (R. CARROLL PHOTO CREDIT).

Assessment of the density and the spatial and temporal variation of the American Burying Beetle

We estimated the distribution, abundance and temporal variation of the American Burying Beetle (ABB, *Nicrophorus americanus*) in Oklahoma. Trapping was done at 7 WMAs, 3 State Parks, and 2 National Wildlife Refuges. ABB were caught fairly regularly at Osage WMA, McClellan-Kerr WMA, Hulah WMA, Hugo WMA, and Sequoyah NWR. They were caught at low rates at Keystone WMA. We did not detect ABB at Oologah WMA, Robbers Cave WMA or State Park, Osage State Park, Sequoia State Park, and Little River NWR. Using existing data provided by the USFWS and our own data we tested for trends in ABB caught per unit of trapping effort. From the historical data, for Osage County and for Pittsburg County the best models indicated that ABB caught per trap night has increased in the past few years. For Atoka County the best model was year having no effect on ABB caught per trap night.

FUNDING
Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATOR
Barney Luttbeg

STUDENT INVESTIGATOR
Jillian D. Wormington, Ph.D. Candidate

COMPLETED
June 2017

Surveys to determine impacts of grazing and pecan orchards on the American Burying Beetle

The American Burying Beetle, *Nicrophorus americanus* (ABB), is classified as a habitat generalist, which remains in areas that have not been developed. There is comparatively little data on how the species reacts to grazing or plantings of managed trees. ABB is present in eastern Oklahoma, where natural grasslands have been converted for agriculture primarily for cattle and pecan production. Between 2017 and 2018, sampling for carrion beetles was conducted on land used as cattle pastures within ABB range in Oklahoma. Trapping efforts resulted in 2,338 carrion beetles from 9 species, including 74 ABB. Of the ABB, 67 captures were from pastures two were from pecan orchards, and five came from areas containing both factors. Although managed lands may still impact ABB, grazing and pecan orchards in Oklahoma do not appear to exclude occurrence.

FUNDING
Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATOR
W. Wyatt Hoback

STUDENT INVESTIGATOR
Jacob Farriester, M.S. Candidate

COMPLETED
March 2018

Reassessing black bear status in southeastern Oklahoma

To investigate population-level impacts of the black bear hunting season in southeastern Oklahoma, we undertook a capture-based study of the population using the same trap lines used in a 2001-2002 study. After 5-7 years of harvest of the population, we projected a population growth rate of 4% annually, compared to 14% annual growth prior to initiating the hunting season. We also trapped areas outside of the Ouachita National Forest, resulting in projected growth of 6% annually. We estimated the population at ~1300 black bears in southeastern Oklahoma. Within the Ouachita National Forest, some evidence suggested that prescribed fire influenced habitat selection at the landscape level. This study was modified in 2016 to include the east-central Oklahoma black bear population. This population selected riparian and moist oak forest, higher elevations and terrain ruggedness, and lower human population density. Female black bears were sensitive to habitat fragmentation; males were not.

FUNDING
Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATORS
W. Sue Fairbanks and David M. Leslie, Jr.

STUDENT INVESTIGATORS
Sara Lyda, Senior Research Specialist; Dani Techentin, Ph.D. Candidate; Morgan Pfander, Erica Perez, and Elliot Lustig, M.S. Candidates

COMPLETED
June 2018



AMERICAN BURYING BEETLE (M. DUMONT FWS.GOV PHOTO)



AMERICAN BURYING BEETLE TRAP IN PECAN ORCHARD THAT IS ALSO GRAZED (J. FARRIESTER PHOTO)



A YAWNING BLACK BEAR CUB (M. CLEARY PHOTO)

Human dimensions and social carrying capacity for black bears in eastern Oklahoma

As black bears (*Ursus americanus*) re-insert themselves into a now human-dominated landscape, understanding factors that play a role in human acceptance of black bears will help ensure human-black bear coexistence. We used a mail-back questionnaire to collect data from adult residents of eastern Oklahoma. Responses were compared among three study regions that differed in bear density, human density, land use, and existence of a black bear hunting season. We hypothesized that acceptance, perceived risk, values, attitudes, and behaviors of residents would differ among the three study regions. There was no significant difference in acceptance of black bears or risk perception among the three regions. Attitudes, valuing Oklahoma wildlife, behavioral intentions to reduce potential conflict, and education all positively influenced acceptance of black bears. Risk averse respondents and women were less accepting. Outreach to women and stakeholders who perceive high levels of risk from black bears may help raise acceptance capacity.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATORS

W. Sue Fairbanks and Omkar Joshi

STUDENT INVESTIGATOR

Matteo Cleary, M.S. Candidate

COMPLETED

December 2019



SURVEY OF BLACK BEARS IN OKLAHOMA (M. CLEARY PHOTO)



THE OSU BLACK BEAR RESEARCH TEAM, FROM LEFT: WILL CHILDRESS, COURTNEY DOTTERWEICH, AND SARA LYDA, WITH BLACK BEAR CUBS BEING EXAMINED DURING THE DENNING SEASON (S. LYDA PHOTO)

Terrestrial Resources

ONGOING PROJECTS



In support of ongoing Greater Prairie Chicken research in Osage County, Oklahoma

We are evaluating habitat selection and space use of Greater Prairie-Chickens during the brood rearing season. We are interested in evaluating food availability, vegetation structure, and thermal characteristics at sites used by broods. Preliminary results for brood habitat use indicate brooding hens showed strong selection for patches that had been burned and grazed in the previous 12 months and these sites had more insects than unburned patches. Within recently burned patches, selection for vegetation structure did not differ from what was available on the landscape at locations where broods were located in the mornings; however, afternoon locations had greater grass cover and visual obstruction, and less bare ground than random landscape locations and morning locations. Insect abundance is similar within recently burned patches. Additionally, afternoon brood locations appear to be thermally buffered compared to morning and random landscape locations, with afternoon sites experiencing fewer temperature extremes.

FUNDING

Oklahoma Department of Wildlife Conservation and anonymous private donor

FACULTY INVESTIGATORS

Dwayne Elmore, Craig Davis, and Sam Fuhlendorf

STUDENT INVESTIGATOR

Dave Londe, Ph.D. Candidate

EXPECTED COMPLETION

December 2021



A GREATER PRAIRIE CHICKEN ON THE LEK (D. LONDE PHOTO)

Quail ecology and management II

This current research project builds on what we learned from our past northern bobwhite research. In particular, this new project is a more management-focused with the following objectives: Determining the role harvest may play in pre-breeding bobwhite populations, Examining the relationship between bobwhite abundance and shrub cover, Evaluating the response of bobwhite food resources (invertebrates and seeds) to habitat management practices (e.g., shrub removal, prescribed fire, and grazing), and Assessing long-distance movements by bobwhite and the relationship of these movements with habitat and environmental conditions. Results from this study will assist ODWC with development of an effective and impactful conservation plan for bobwhites throughout the state (on both public and private lands). This study is being conducted across 4 wildlife management areas (WMAs). To date, we have deployed 221 GPS transmitters and accumulated 46,000 bobwhite locations, conducted >800 bird point counts and associated vegetation sampling, surveyed and assessed nutritional quality of invertebrates relative to management, set up burn plots at each WMA, and collected bobwhite harvest data from all 4 WMAs.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATORS

Craig Davis, Dwayne Elmore, Sam Fuhlendorf, Laura Goodman, Shawn Wilder

STUDENT INVESTIGATORS

Matt Carroll, Postdoctoral Fellow; Kent Andersson, Senior Research Specialist; Samantha Cady PhD candidate; Landon Neumann, John McQuaig, Jennifer Knutson, Anna Butler, Jacob Reeves, MS candidates

EXPECTED COMPLETION

June 2022

Status and trends in bobcat populations in Oklahoma

Bobcats (*Lynx rufus*) are one of the most-harvested furbearer species in Oklahoma, and can represent additional income for trappers. Bobcats are also important predators of small mammals, assisting in control of rodent and rabbit populations. The secretive nature of bobcats and their widespread distribution across the state make it difficult to monitor populations. Our study will assess trends in bobcat populations on a state-wide scale and estimate bobcat abundance on three Wildlife Management Areas in different ecoregions. Occupancy modeling will be used at the large scale, based on data collected December-January with hair snares deployed by undergraduate volunteers, from several Oklahoma universities, in their home counties. Hairs will be identified to species, microscopically. With hair collected from hair snare grids, we will estimate bobcat populations on the WMAs using genetic capture-recapture methods. We will evaluate non-invasive hair-snare methods to assess trends and population sizes of bobcats, independent of harvest data.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATOR

W. Sue Fairbanks

STUDENT INVESTIGATOR

Nathan J. Proudman, Ph.D. Candidate

EXPECTED COMPLETION

June 2022



BOBCAT (EN.WIKIPEDIA.ORG PHOTO)

Spatial ecology and expansion of recolonizing black bear populations in eastern Oklahoma

Black bears are recolonizing two areas of eastern Oklahoma that differ in human density, black bear density, land use, and habitat fragmentation. Proximity to humans poses both risks (increased mortality) and benefits (predictable food subsidies) for black bears. Knowledge of the spatial ecology of black bears in eastern Oklahoma will provide a more detailed picture of how bears are distributed across the landscape and why, help predict range expansion by the populations, and anticipate potential for bear-human conflict. In the east-central population, previous research indicated female black bears are sensitive to habitat fragmentation. We will deploy satellite collars with a 2-hour fix rate on yearling bears to investigate their movement patterns and factors that influence them during dispersal. In the southeastern population, we will use spatially-explicit data from satellite-collared bears to produce a more accurate population estimate and identify natural and anthropogenic features associated with high- and low-density areas.

FUNDING

Oklahoma Department of Wildlife Conservation and Herman Meinders

FACULTY INVESTIGATOR

W. Sue Fairbanks

STUDENT INVESTIGATOR

Sara Lyda, Senior Research Associate; Will Childress and Courtney Dotterweich, Ph.D. Candidates

EXPECTED COMPLETION

June 2023



BLACK BEAR CUB SLEEPING IN THE SUN WHILE BEING MEASURED. (S. LYDA PHOTO)

Monarch-Pollinator monitoring, tracking, and evaluation of grassland habitat and management practices in the southern plains

The southern Great Plains has been identified as critical for conservation efforts for monarchs and other pollinators, and much of the habitat identified in this region for pollinator conservation consists of grasslands. With the extensive loss and fragmentation of native grasslands, managed grasslands are becoming increasingly important for supporting conservation efforts. However, few baseline data exist for this region, making it challenging to assess the value of these efforts for monarchs and other pollinators. This project will provide baseline data for assessing the contribution of grassland management practices for supporting monarch/pollinator habitat, including variation in the availability of milkweed plants and flowering forbs across years.

FUNDING

Wildlife Management Institute

FACULTY INVESTIGATOR

Kristen Baum

EXPECTED COMPLETION

July 2020



EXAMPLE OF MANAGED GRASSLAND HABITAT WITH *ASCLEPIAS VIRIDIS*. (K. BAUM PHOTO)

Status of the Regal Fritillary (*Speyria idalia*) in Oklahoma

The regal fritillary historically occurred from Oklahoma to North Dakota and east to the Atlantic Coast, but is now being considered for listing under the Endangered Species Act. Little is known about the population trend of regal fritillaries in Oklahoma. This project will assess the current status, geographic range, and habitat needs for regal fritillaries in the tallgrass prairie region of Oklahoma, with a focus on locations where regal fritillaries have been previously documented.

FUNDING

Oklahoma Department of Wildlife Conservation

FACULTY INVESTIGATOR

Kristen Baum

STUDENT INVESTIGATOR

Emily Geest, Ph.D. Candidate

EXPECTED COMPLETION

June 2021



PAULINA HARRON HOLDING A MALE GREATER PRAIRIE-CHICKEN CAPTURED IN OSAGE COUNTY (D. LONDE PHOTO)



ADAM FRAKES SURVEYS CANTON LAKE VISITORS OVER MEMORIAL DAY HOLIDAY (K. SCARLETT PHOTO)



RIO YAQUI NEAR CIUDAD OBREGON, MEXICO (T. HAFEN PHOTO)



FEMALE REGAL FRITILLARY NECTARING ON ASCLEPIAS SULLIVANTII IN JUNE 2019. (E. GEEST PHOTO)



SCISSORTAIL ON FENCE (D. LONDE PHOTO)

Scholarly
Output01 JAN 2017
31 DEC 2019

22



Publications

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Beyke, R.L., C.A. Davis, S.D. Fuhlendorf, R.D. Elmore, and S. DuRant. 2017. Behavioral responses of ground-nesting birds to thermal variation during a critical life stage. Oklahoma Natural Resources Conference, Tulsa, OK.

Bowe, M., A. Miller, S.K. Brewer. 2018. Effect of suspended bentonite sediment on four stream fish. Annual Meeting of the Society of Freshwater Science, Detroit, MI.

Branham, K.D., W.S. Fairbanks, V. Jackson, and S. Alvarez-Briglie. 2018. Establishing a reliable population survey for bobcats in the state of Oklahoma. National Council on Undergraduate Research, Edmond, OK.

Branham, K. and W.S. Fairbanks. 2017. Establishing a reliable population survey for bobcats in the state of Oklahoma. The Wildlife Society Annual Conference, Albuquerque, NM.

Brewer, S.K. 2019. Forging a future for stream fishes under multiple environmental stressors. Invited Seminar, Auburn, AL.

Brewer, S.K. 2018. Scale matters: Relationships between stream organisms and thermal and flow patterns. Invited Seminar, Clemson, SC.

Brewer, S.K., J. Dattilo, and D. Shoup. 2018. Water levels and flow patterns that benefit growth and recruitment of lotic and lentic fishes. Annual meeting of the Southern Division American Fisheries Society, San Juan, PR.

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Brewer, S.K., T.A. Worthington, J. Burroughs, B. Brown, R. Mollenhauer, A. Rodger, and M. Skoog. 2017. First year survival, dispersal, and habitat use by Neosho Smallmouth Bass. Annual meeting of the Southern Division American Fisheries Society, Oklahoma City, OK.

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Burroughs, J., D. Swedberg, J. Tucker, M. Skoog, A. Rodger, S.K. Brewer. 2018. Efforts to conserve spring-fed obligates: Least Darter as an SGCN species. Annual Meeting of the American Fisheries Society, Atlantic City, NJ.

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Cady, S. and T. O'Connell. 2017. Areas of high primary productivity as potential climate refugia for birds during drought conditions. Central Ecology and Evolution Conference, Stillwater, OK.

Cady, S. and T. O'Connell. 2018. Habitat characterizations of songbirds in riparian forests of the Oklahoma Ozarks. Coordinating Committee Meeting of the Oklahoma Cooperative Fish and Wildlife Research Unit, Stillwater, OK.

Cady, S. and T. O'Connell. 2018. Songbird responses to drought conditions with temporal scale considerations. Midwest Fish and Wildlife Conference, Milwaukee, WI.

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Cady, S., T. O'Connell, S. Loss, N. Jaffe, and C. Davis. 2019. Species-specific and temporal scale-dependent responses of birds to drought. Annual meeting of the US-International Association for Landscape Ecology, Fort Collins, CO.

Carlson, T. N., E. Cabrera-Guzmán, and S. Fox. 2019. First documentation of breeding aggregations of the Ringed Salamander, *Ambystoma annulatum*, in Oklahoma, USA - Future monitoring and implications for the species' management. Annual Meeting of the Southwestern Association of Naturalists, Chihuahua, Chihuahua, Mexico.

Carlson, T. N., E. Cabrera-Guzmán, and S. Fox. 2019. First documentation of breeding aggregations of the Ringed Salamander, *Ambystoma annulatum*, in Oklahoma, USA. Joint Meeting of Ichthyologists and Herpetologists. Snowbird Ski Resort, UT.

Carroll, J.M., C.A. Davis, R.D. Elmore, and S.D. Fuhlendorf. 2017. Influence of management-driven disturbance on northern bobwhite space use and nesting ecology. Society for Range Management Annual Meeting, St. George, UT.

Carroll, J.M., C.A. Davis, R.D. Elmore, and S.D. Fuhlendorf. 2018. Northern bobwhite nest site use and survival on a landscape managed with prescribed fire in Oklahoma. Annual Meeting of Southeastern Association of Fish and Wildlife Agencies, Mobile, AL.

Carroll, J.M., R.D. Elmore, S.D. Fuhlendorf, and C.A. Davis. 2017. Shinnery oak propagation as a framework for restoration. Oklahoma Natural Resources Conference. Tulsa, OK.

Chapagain, B.P., O. Joshi, J.M. Long, and A.T. Taylor. 2019. Influence of place attachment and motivation on bass fishing demand in Oklahoma streams. Society of American Foresters, Louisville, KY.

Chapagain, B.P., O. Joshi, J.M. Long, and A.T. Taylor. 2020. Examining social-psychological factors within a black bass fishing demand model: a travel cost approach. Annual meeting of the Southern Division American Fisheries Society, Little Rock, AR.

Chapagain, B.P., O. Joshi, J.M. Long, and A.T. Taylor. 2020. The effects of social-psychological factors on black bass fishing demand in Oklahoma Ozark streams. Oklahoma Natural Resources Conference, Norman, OK.

Childress, W. and W.S. Fairbanks. 2018. Mapping the distribution of the sarcoptic mange mite (*Sarcoptes scabiei*) in black bear (*Ursus americanus*) populations across the United States. Central Plains Society of Mammalogists Annual Meeting, Stillwater, OK.

Childress, W., W.S. Fairbanks, S. Lyda, and K. Niedringhaus. 2019. Poster: Mapping the distribution of the sarcoptic mange mite (*Sarcoptes scabiei*) in black bear (*Ursus americanus*) populations across the United States. Oklahoma Natural Resources Conference, Tulsa, OK.

- Civiello, A.P., J.M. Long, N.J. Gosch, T.R. Gemeinhardt, K. Chojnacki, and A.J. DeLonay. 2017. The influence of shallow-water habitat on age-0 shovelnose sturgeon diet and condition. Missouri River Natural Resources Conference, Nebraska City, NE.
- Cleary, M., O. Joshi, and W.S. Fairbanks. 2018. Poster: Human dimensions of black bear (*Ursus americanus*) management in eastern Oklahoma: an assessment of cognitive hierarchy components, risk perceptions, and population tolerances. Central Plains Society of Mammalogists Annual Meeting, Stillwater, OK.
- Cleary, M. and W.S. Fairbanks. 2019. Human dimensions of black bear management in eastern Oklahoma: an assessment of cognitive hierarchy components, risk perceptions, and population tolerances. Annual Conference of The Wildlife Society, Reno, NV.
- Cleary, M. and W.S. Fairbanks. 2019. The human dimensions of black bear (*Ursus americanus*) management in eastern Oklahoma. Coordinating Committee Meeting of the Oklahoma Cooperative Fish and Wildlife Research Unit, Stillwater, OK.
- Cleary, M., O. Joshi, and W.S. Fairbanks. 2018. Human dimensions of black bear (*Ursus americanus*) management in eastern Oklahoma: an assessment of cognitive hierarchy components, risk perceptions, and population tolerances. International Symposium on Society and Resource Management. Salt Lake City, UT.
- Cleary, M., O. Joshi, and W.S. Fairbanks. 2019. Human dimensions of black bear (*Ursus americanus*) management in eastern Oklahoma: an assessment of human values, attitudes, behaviors and population tolerances. Oklahoma Natural Resources Conference, Tulsa, OK.
- Darby, Z., N. Poudyal, A. Frakes, and O. Joshi. 2019. The role of sense of place and perceived risk in acceptability of alternative water allocation strategies among recreational users of Canton Lake, Oklahoma. International Symposium on Society and Natural Resource Management, Oshkosh, WI.
- Dattilo, J.C., S.K. Brewer, and D.E. Shoup. 2017. Influence of hydrology on the age-specific abundance and growth of freshwater drum and gizzard shad from lotic and lentic habitats in Oklahoma. Annual meeting of the Southern Division American Fisheries Society, Oklahoma City, OK.
- Dattilo, J.C., S.K. Brewer, and D.E. Shoup. 2017. Influence of hydrology on the age-specific abundance and growth of freshwater drum and gizzard shad from lotic and lentic habitats. Annual Meeting of the American Fisheries Society, Tampa, FL.
- Dattilo, J.C., S.K. Brewer, and D. Shoup. 2018. Relationships between hydrology and year class strength and growth of Freshwater Drum from lotic and lentic ecosystems. Oklahoma Natural Resources Conference, Tulsa, OK.
- Davis, C.A. 2018. Woodstock on the Southern High Plains: Reproductive strategies of bobwhite and scaled quail. 3rd Annual Quail Forever Oklahoma State Habitat Convention, Oklahoma City, OK.
- DiStefano, R., D.C. Ashley, S.K. Brewer, and J. Mouser. 2018. Hunting Missouri's rarest crayfish using eDNA and visual surveys: a first look at the natural history of the caney mountain cave crayfish. International symposium on freshwater crayfish, Pittsburg, PA.
- Duquette, C., C. Davis, S. Fuhlendorf, and D. Elmore. 2017. Northern bobwhite (*Colinus virginianus*) habitat selection in a landscape affected by energy development. Oklahoma Natural Resources Conference, Tulsa, OK.
- Duquette, C.A., C.A. Davis, S.D. Fuhlendorf, and R.D. Elmore. 2017. Habitat Selection of northern bobwhite (*Colinus virginianus*) in an energy-producing landscape. Annual Society for Range Management Meeting, St. George, UT.
- Dyer, J. and S.K. Brewer. 2018. Population Dynamics of Blue Suckers in Red River, Oklahoma. Oklahoma Natural Resources Conference, Tulsa, OK.
- Dyer, J. and S.K. Brewer. 2018. Effects of hydrology on the population trajectory of Blue Suckers *Cycleptus elongatus*. Annual meeting of the Southern Division American Fisheries Society, San Juan, PR.
- Elmore, R.D., R.L. Beyke, C.A. Davis, S.D. Fuhlendorf, J.P. Orange, and E.P. Tanner. 2017. Scaled quail research summary. Western Association of Fish and Wildlife Agencies Western Quail Working Group Meeting. Roswell, NM.
- Elmore, R.D., E.P. Tanner, C.A. Davis, D.K. Dahlgren, S.D. Fuhlendorf, and J.P. Orange. 2017. Extreme weather events create pinch points for northern bobwhite. Perdix Symposium – International Union of Game Biologists. Montpellier, France.
- Elmore, R.D., E.P. Tanner, S.D. Fuhlendorf, C.A. Davis, D.K. Dahlgren, and J.P. Orange. 2018. Extreme weather events create pinch points for a galliform. Ecological Society of America Annual Meeting. New Orleans, LA.
- Fairbanks, W.S., J. Davis, V. Jackson, and N. Proudman. 2019. Connecting wildlife students with trapper stakeholder groups and collecting citizen science data. 2019 Southeast/Midwest Joint Furbearer Meeting, Enid, OK.
- Farriester, J. W.W. Hoback, B. Couger, J. Gustafson, and D. Hagen. 2019. Comparative Gene Expression and Upregulation of Possible Antimicrobial Peptide-Producing Genes of *Nicrophorus orbicollis* and *Nicrophorus pustulatus*. Southwestern Branch Entomological Society of America meeting, Tulsa, OK.
- Farriester, J., W.W. Hoback, P. Mulder. 2018. Burgers, not pies: Association of American burying beetles with grazed lands in Oklahoma. Southwestern Branch Entomological Society of America meeting, Albuquerque, NM.
- Farriester, J., W.W. Hoback, and D.G. Sneath. 2017. Arbor Day and the effect of hand-planted Nebraska forests on the American burying beetle. Southwestern Branch Entomological Society of America, Austin, TX.
- Farling, T., W.W. Hoback, and J.M. Long. 2017. Wild juvenile trout nursery habitat in an intermittent tributary and second order stream of a southeastern US tailwater. Oklahoma Clean Lakes and Watersheds Association Conference, Stillwater, OK.
- Frakes, A. and O. Joshi. 2019. Visitor dynamics & economic implications of future water allocation at Canton Lake, Oklahoma. International Symposium on Society and Natural Resource Management, Oshkosh, WI.
- Frakes, A. and O. Joshi. 2019. Potential economic impacts of management alternatives & factors associated with visitor satisfaction at Canton Lake, Oklahoma. Oklahoma Natural Resource Conference, Tulsa, OK.
- Frakes, A., O. Joshi, N. Poudyal, and Z. Darby. 2019. Potential economic impacts of future water policy at Canton Lake, Oklahoma. Meeting of the International Society of Forest Resource Economics, Columbus, OH.
- Goldkamp, A.K., J. Farriester, M. Couger, J. Matts, I.A. Hansen, W.W. Hoback, J.E. Gustafson, and D.E. Hagen. 2018. *De Novo* transcriptomes of the burying beetles *Nicrophorus pustulatus* and *Nicrophorus orbicollis*. Annual Arthropod Genomics Symposium, University of Illinois, Urbana-Champaign, IL.
- Gonzalez, A. and J.M. Long. 2018. Longitudinal trends in prey use and condition of age-0 Shovelnose Sturgeon in the lower Missouri River. Missouri River Natural Resources Conference, Nebraska City, NE.
- Gonzalez, A. and J.M. Long. 2018. Longitudinal trends in prey use and condition of age-0 Shovelnose Sturgeon in an altered river system. Oklahoma Natural Resources Conference, Tulsa, OK.
- Gonzalez, A. and J.M. Long. 2018. Longitudinal trends in prey use and condition of juvenile Shovelnose Sturgeon in the lower Missouri River. MRRP 2018 Fall Science Meeting – Pallid Webinar.
- Gonzalez, A. and J.M. Long. 2019. Longitudinal trends in prey use and condition of age-0 sturgeon in the Lower Missouri River. Annual meeting of the Southern Division of the American Fisheries Society, Galveston Island, TX.
- Grate, A., D. M. Thompson, and D. B. Ligon. 2020. Assessing fertility rates in a captive population of alligator snapping turtles. Emerging Researchers National Conference in STEM, Washington D.C.
- Griffin, M., H. Davis, J. Giocomo, K. Gee, S. Riley, and T. O'Connell. 2018. Monitoring grassland bird decline for strategic conservation: The Oaks and Prairies Joint Venture. Oklahoma Natural Resources Conference, Tulsa, OK.
- Guertault, L., G.A. Fox, S.K. Brewer. 2018. Geomorphic identification of physical habitat structures in a large, altered river system. River Flow conference, France.
- Holley, C.T. and J.M. Long. 2018. Evaluating the success of translocation efforts for a rare darter species in Oklahoma. Annual meeting for the Southern Division American Fisheries Society, Puerto Rico, PR.
- Holley, C.T., Feng, X., Papes, M., Taylor, A.T., and J.M. Long. 2017. Range-wide ecological niche model for the state-endangered Longnose Darter. Oklahoma Natural Resources Conference, Tulsa, OK.
- Holley, C.T., J.M. Long, and M. Papes. 2017. Evaluation of the translocation success of a rare darter species in Oklahoma. Southeastern Fishes Council Annual Meeting, Chattanooga, TN.
- Holley, C.T., J.M. Long, and M. Papes. 2018. A multi-scale evaluation of darter community habitat associations to aid conservation of species of conservation concern. Oklahoma Natural Resources Conference, Tulsa, OK.
- Holley, C.T., A.T. Taylor, and J.M. Long. 2017. Resample, recapture, and re-analyze: Using the 3 R's to resurrect the scale method of estimating fish age. Annual meeting of the Southern Division American Fisheries Society, Oklahoma City, OK.
- Jaffe, N., T. O'Connell, and J. Giocomo. 2017. Utility of fine resolution land cover data for modeling Northern Bobwhite abundance in the Oaks and Prairies of Oklahoma. National Quail Symposium, University of Tennessee, Knoxville, TN.
- Jaffe, N., T. O'Connell, and M. Papes. 2017. Evidence for avian population responses to temperature extremes. Oklahoma Natural Resources Conference, Tulsa, OK.
- Johnson, G.R. and D.E. Shoup. 2017. Horizontal target strength of Gizzard Shad *Dorosoma cepedianum*. Annual Meeting of the American Fisheries Society, Tampa, FL.

Johnson, G.R. and D.E. Shoup. 2017. Precision of Gizzard Shad abundance and size structure estimates from split-beam sonar. Annual meeting of the Southern Division American Fisheries Society, Oklahoma City, OK.

Johnson, G.R. and D.E. Shoup. 2018. Accuracy and precision of horizontally-oriented hydroacoustics when estimating abundance of Gizzard Shad. Oklahoma Natural Resource Conference, Tulsa, OK.

Johnson, J.R. and J.M. Long. 2017. Hydrologic factors associated with detection and occupancy of riparian areas by Asian Swamp Eel in the Chattahoochee River system, Georgia. Annual meeting of the Southern Division American Fisheries Society, Oklahoma City, OK.

Johnston, J., T.A. Worthington, and S.K. Brewer. 2017. Population responses of Shovelnose Sturgeon *Scaphirhynchus platyrhynchus* in the Arkansas and Red River basins to landscape characteristics. Annual meeting of the Southern Division American Fisheries Society, Annual Meeting, Oklahoma City, OK.

Londe, D.W., R.D. Elmore, S.D. Fuhlendorf, and C.A. Davis. 2018. Habitat selection and thermal ecology of greater prairie-chicken broods. Oklahoma Natural Resources Conference, Tulsa, OK.

Londe, D.W., R.D. Elmore, S.D. Fuhlendorf, and C.A. Davis. 2018. Greater prairie-chicken habitat use in a rangeland managed with prescribed fire and developed for energy development. 14th International Grouse Symposium, Logan, UT.

Londe, D.W., R.D. Elmore, S.D. Fuhlendorf, and C.A. Davis. 2018. Greater prairie-chicken habitat use in a rangeland managed with prescribed fire and developed for energy development. The Wildlife Society Annual Conference, Cleveland, OH.

Londe, D.W., R.D. Elmore, S.D. Fuhlendorf, and C.A. Davis. 2019. Habitat selection and thermal ecology of greater prairie-chicken broods. Oklahoma Natural Resources Conference. Oklahoma City, OK.

Londe, D.W., R.D. Elmore, S.D. Fuhlendorf, and C.A. Davis. 2019. Habitat selection and thermal ecology of greater prairie-chicken broods. Prairie Grouse Technical Conference. Bartlesville, OK.

Londe, D., S.D. Fuhlendorf, and R.D. Elmore. 2017. Effects of energy development and rangeland management on space use of greater prairie-chickens in southern Great Plains. Oklahoma Natural Resources Conference, Tulsa, OK.

Londe, D., S.D. Fuhlendorf, and R.D. Elmore. 2017. Effects of energy development and rangeland management on space use of greater prairie-chickens in southern Great Plains. Society for Range Management Annual Meeting, St. George, UT.

Londe, D.W., S.D. Fuhlendorf, R.D. Elmore, and C.A. Davis. 2017. Effects of rangeland management and energy development on Greater Prairie-Chicken nonbreeding habitat use. 32nd Prairie Grouse Technical Council Meeting, Dickinson, ND.

Long, J.M. 2017. The role of taxonomy in black bass diversity and implications for management and conservation. American Fisheries Society Annual Meeting, Tampa, FL.

Long, J.M., B.P. Chapagain, A.T. Taylor, and O. Joshi. 2019. Angler catch and attitudes toward black bass in Ozark Streams. ODWC meeting. Oklahoma Department of Wildlife Conservation annual meeting, Oklahoma City, OK.

Long, J.M., B.P. Chapagain, A.T. Taylor, and O. Joshi. 2019. Angler catch and attitudes toward black bass in Ozark Streams. Northeastern State University Fish and Wildlife club, Tahlequah, OK.

Long, J.M., A.T. Taylor, B.P. Chapagain, and O. Joshi. 2020. Stream size affects angler catch and attitudes toward black bass in Ozark streams. Annual meeting of Southern Division American Fisheries Society, Little Rock, AR.

Long, J.M., A.T. Taylor, B.P. Chapagain, and O. Joshi. 2020. Angler catch and attitudes toward black bass in Oklahoma Ozark streams. Oklahoma Natural Resources Conference, Norman, OK.

Lustig, E., W.S. Fairbanks, and S. Lyda. 2017. Resource selection and home range analysis of the American black bear (*Ursus americanus*) in the Ozark Mountains of east-central Oklahoma. Central Plains Society of Mammalogists Annual Meeting, Dubuque, IA.

Lustig, E., W.S. Fairbanks, and S. Lyda. 2017. Resource selection and home range analysis of the American black bear in the Ozark Mountains of east-central Oklahoma. The Wildlife Society Annual Conference, Albuquerque, NM.

Lustig, E., W.S. Fairbanks, and S. Lyda. 2017. Resource selection and home range analysis of the American black bear (*Ursus americanus*) in the Ozark Mountains of east-central Oklahoma. Oklahoma Natural Resources Conference, Tulsa, OK.

Melstrom, R.T. 2017. The petroleum industry's response to an endangered species listing. Agricultural and Applied Economics Association Annual Meeting, Chicago, IL.

Melstrom, R.T., K. Lee., and J.P. Byl. 2016. The effect of endangered species regulations on local employment: Evidence from the listing of the lesser prairie chicken. Agricultural and Applied Economics Association Annual Meeting, Boston, MA.

Miller, A. and S.K. Brewer. 2017. Diel movement and habitat use of juvenile Smallmouth Bass in an Ozark stream. Annual Meeting of the American Fisheries Society, Tampa, FL.

Miller, A. and S.K. Brewer. 2018. Multi-scale influences of habitat on age-0 Smallmouth Bass abundance in the Ozark Highlands. Oklahoma Natural Resources Conference, Tulsa, OK.

Miller, A. and S.K. Brewer. 2018. Relationship between densities of age-0 Neosho Smallmouth Bass and multi-scale habitat features of Ozark Highland streams. Annual Meeting of the American Fisheries Society, Atlantic City, NJ.

Mollenhauer, R. and S.K. Brewer. 2017. Sampling the stream landscape: an ecoregion-level capture probability model for stream fishes. Annual Meeting of the American Fisheries Society, Tampa, FL.

Mollenhauer, R., S.K. Brewer, D. Ryter, D. Moore, and R. Hart. 2018. Local colonization and extinction of Red River stream fishes in relation to flow contributions. Annual Meeting of the American Fisheries Society, Atlantic City, NJ.

Mollenhauer, R., D. Logue, and S.K. Brewer. 2018. Seining detection probability of small-bodied fishes in Great Plains sand-bed rivers. Oklahoma Natural Resources Conference, Tulsa, OK.

Mollenhauer, R., D. Ryter, D. Moore, and S.K. Brewer. 2018. Local colonization and extinction of Red River stream fishes in relation to groundwater contribution. Annual meeting of the Southern Division American Fisheries Society, San Juan, PR.

Moore, D. and S.K. Brewer. 2019. Presence of diminutive Great Plains fishes related to seasonal flow patterns. Joint Annual Meeting of the American Fisheries Society and the Wildlife Society, Reno, NV.

Moore, D. and S.K. Brewer. 2019. Autumn and winter movement of diminutive prairie fishes. Oklahoma Natural Resources Conference, Tulsa, OK.

Moore, D. and S.K. Brewer. 2019. Winter movement of diminutive prairie fishes. Annual Meeting of the Oklahoma Clean Lakes and Watersheds, Stillwater, OK.

Mouser, J., J. Glover, and S.K. Brewer. 2018. A new technique for determining crayfish population demographics. International symposium on freshwater crayfish, Pittsburg, PA.

Mouser, J., J. Glover, and S.K. Brewer. 2018. A new technique for determining crayfish population demographics. Oklahoma Natural Resources Conference, Tulsa, OK.

Mouser, J., R. Van Den Bussche, M. Niemiller, C. Wood, D. Ashley, and S.K. Brewer. 2017. New techniques for determining occurrence and demographics of cave crayfish. International Cave and Karst Symposium, Eureka Springs, AR.

O'Connell, T. and S. Cady. 2018. Temporal scales of Great Plains bird response to drought. Joint Annual Meeting of the American Ornithological Society, Tucson, AZ.

O'Connell, T., A. Matthews, B. Simons, and J. Giocomo. 2019. Temporal variability in abundance estimates for breeding birds in the Oaks and Prairies. Joint Annual Meeting of the Associated of Field Ornithologists and the Wilson Ornithological Society, Cape May, NJ.

O'Connell, T., B. Simons, S. Cady, N. Jaffe, and J. Giocomo. 2018. Interannual variability in abundance of breeding birds in central Oklahoma. Annual Technical Meeting of the Oklahoma Ornithological Society, Edmond, OK.

O'Connell, T., B. Simons, S. Cady, N. Jaffe, and J. Giocomo. 2019. Interannual variability in abundance of breeding birds in central Oklahoma. Oklahoma Natural Resources Conference, Tulsa, OK.

O'Connell, T., E. Sinnott, S. Cady, and M. Papes. 2019. Riparian zones as refugia and dispersal corridors for forest songbirds in the US Southern Plains. Annual meeting of the US-International Association for Landscape Ecology, Fort Collins, CO.

Perez, E., W.S. Fairbanks, and M. Pfander. 2017. Population status of the American black bear (*Ursus americanus*) in southeast Oklahoma. Oklahoma Natural Resources Conference, Tulsa, OK.

Perez, E., W.S. Fairbanks, and M. Pfander. 2017. Population dynamics of a recolonizing American black bear population under hunting pressures in southeastern Oklahoma. The Wildlife Society Annual Conference, Albuquerque, NM.

Pfander, M. and W.S. Fairbanks. 2017. Trap success and sample heterogeneity using bucket snares to capture American black bears in southeast Oklahoma. Oklahoma Natural Resources Conference, Tulsa, OK.

Porak, W., J.M. Long, H. Schramm, and T. Birdsong. 2017. Black bass diversity: a paradigm shift for fisheries managers. American Fisheries Society Annual Meeting, Tampa, FL.

Prentiss, N.L. and W.S. Fairbanks. 2018. Giving up density as an indicator of black bear (*Ursus americanus*) food preference in the Ouachita National Forest, Oklahoma. Central Plains Society of Mammalogists Annual Meeting, Stillwater, OK.

Prentiss, N.L. and W.S. Fairbanks. 2019. Giving up density as an indicator of black bear (*Ursus americanus*) food preference in the Ouachita National Forest, Oklahoma. Oklahoma Natural Resources Conference, Tulsa, OK.

Proudman, N.J., J.L. Davis, M.L. Haynie, V. Jackson, and W.S. Fairbanks. 2019. Assessing the distribution, trends, and abundances of bobcats (*Lynx rufus*) in Oklahoma. Central Plains Society of Mammalogists Annual Meeting. Cape Girardeau, MO.

- Proudman, N.J., J.L. Davis, V. Jackson, M. Haynie, and W.S. Fairbanks. 2019. Assessing the distribution, trends and abundance of bobcats in Oklahoma. The Wildlife Society Annual Conference, Reno, NV.
- Proudman, N., and W.S. Fairbanks. 2019. Poster: Assessing the distribution, trends and abundance of bobcats (*Lynx rufus*) in Oklahoma. Oklahoma Natural Resources Conference, Tulsa, OK.
- Proudman, N., W.S. Fairbanks, V. Jackson, M. Haynie, and J. Davis. 2019. Assessing distribution, trends, and abundance of bobcats (*Lynx rufus*) in Oklahoma. Southeast/Midwest Joint Furbearer Meeting, Enid, OK.
- Rakowski, A.E., R.D. Elmore, C.A. Davis, and S.D. Fuhlendorf. 2017. Thermal impacts on wild turkey movement and space use. The Wildlife Society Annual Conference, Albuquerque, NM.
- Rakowski, A.E., R.D. Elmore, C.A. Davis, and S.D. Fuhlendorf. 2017. Thermal impacts on wild turkey movement and space use. Oklahoma Natural Resources Conference. Tulsa, OK.
- Rakowski, A.E., R.D. Elmore, C.A. Davis, and S.D. Fuhlendorf. 2017. Effects of temperature on wild turkey movement and space use. 70th Annual Society for Range Management Meeting, St. George, UT.
- Rakowski, A.E., R.D. Elmore, C.A. Davis, and S.D. Fuhlendorf. 2018. Effects of management and human activity on space use and movement of wild turkey. Society for Range Management Annual Meeting. Reno, NV.
- Rakowski, A.E., R.D. Elmore, C.A. Davis, and S.D. Fuhlendorf. 2018. Thermal impacts on wild turkey movement and space use. Oklahoma Natural Resources Conference. Tulsa, OK.
- Rakowski, A.E., R.D. Elmore, C.A. Davis, and S.D. Fuhlendorf. 2018. Thermal impacts on wild turkey movement and space use. The Wildlife Society Annual Conference, Cleveland, OH.
- Reed, M.L., W.W. Hoback, and J.M. Long. 2018. Aquatic macroinvertebrates differ in time and space downstream of a southeast Oklahoma reservoir. Entomological Society of America, Southwestern Branch Annual Meeting, Albuquerque, NM.
- Reed, M.L., W.W. Hoback, J.M. Long, and A. Dzialowski. 2017. A darter's diet: macroinvertebrate diet of the Orangebelly Darter. Entomological Society of America, Southwestern Branch Annual Meeting, Austin, TX.
- Reed, M.L., W.W. Hoback, J.M. Long, and T. Farling. 2017. Diet of *Etheostoma radiosum* among tributaries of the lower Mountain Fork. Oklahoma Governor's Water Conference and Research Symposium. Norman, OK.
- Scimeca, R.C., E.L. Perez, W.S. Fairbanks, S. Ammar, C. Su, R.W. Gerhold, and M.V. Reichard. 2018. Seroprevalence, DNA isolation, and genetic characterization of *Toxoplasma gondii* from black bear (*Ursus americanus*) sera collected in eastern Oklahoma. Annual Meeting of the American Association of Veterinary Parasitologists, Denver, CO.
- Schwartz, K., A. Jackson, S. Fairbanks, and M. Reichard. 2018. Internal parasite loads of wild black bears (*Ursus americanus*) via fecal testing. National Veterinary Scholars Symposium, College Station, TX.
- Sequy, L. and J.M. Long. 2019. Evaluating the divergent qualities of non-native black bass: economic advantages versus ecological repercussions. Annual meeting of the Southern Division American Fisheries Society, Galveston Island, TX.
- Swedberg, D., R. Mollenhauer, and S.K. Brewer. 2018. Estimating detection probability using multiple gears for Least Darter and sympatric spring-associated species. Annual meeting of the Southern Division American Fisheries Society, Galveston, TX.
- Swedberg, D., R. Mollenhauer, and S.K. Brewer. 2019. Estimating detection probability using multiple gears to sample Least Darter. Oklahoma Natural Resources Conference, Tulsa, OK.
- Swedberg, D., R. Mollenhauer, and S.K. Brewer. 2019. Estimating detection probability using multiple gears to sample Least Darter. Annual Meeting of the Oklahoma Clean Lakes and Watersheds, Stillwater, OK.
- Tanner, E., D. Elmore, C. Davis, and S. Fuhlendorf. 2017. Wintering bird response to the presence of artificial water. Oklahoma Natural Resources Conference, Tulsa, OK.
- Tanner, E.P., R.D. Elmore, D.K. Dahlgren, C.A. Davis, and S.D. Fuhlendorf. 2017. Comparison of dog surveys and fall covey surveys in estimating fall population trends of Northern bobwhite. Quail 8 Symposium, Knoxville, TN.
- Taylor, A.T., M.R. Bangs, B.J. Freeman, and J.M. Long. 2019. A cryptic invader: SNPs inform Asian Swamp Eel management. Annual meeting of the Southern Division American Fisheries Society, Galveston Island, TX.
- Taylor, A.T. and J.M. Long. 2018. Genetic integrity and population status of Shoal Bass in the upper Chattahoochee River basin, Georgia. The Biennial CESU Network National Meeting, Shepherdstown, WV.
- Taylor, A.T., J.M. Long, B.P. Chapagain, and O. Joshi. 2019. Angler catch and attitudes toward black bass in Ozark streams. Oklahoma Academy of Science, University of Central Oklahoma, Edmond, OK.
- Taylor, A.T., J.M. Long, M.R. Schwemm, and S.K. Brewer. 2018. A genetic status assessment of the Neosho Smallmouth Bass: hybridization, diversity, and population structure. Oklahoma Natural Resources Conference, Tulsa, OK.
- Taylor, A.T., M. Papes, and J.M. Long. 2017. Informing conservation of fluvial black bass species with range-wide species distribution models. Annual Meeting of the American Fisheries Society, Tampa, FL.
- Taylor, A.T., M.D. Tringali, and J.M. Long. 2017. Shoal Bass Hybridization in the Chattahoochee River below Morgan Falls Dam, Georgia. Annual Meeting of the Southeastern Association of Fish and Wildlife Agencies, Louisville, KY.
- Taylor, A.T., M.D. Tringali, and J.M. Long. 2017. A collaborative, range-wide genetic structure survey to inform management and conservation of the Shoal Bass. Annual Meeting of the American Fisheries Society, Tampa, FL.
- Thompson, D.M., S.J. Spangler, B.M. Fillmore, K.G. Graves, and D.B. Ligon. 2019. Seasonal activity patterns and reproductive cycles in a captive population of alligator snapping turtles (*Macrochelys temminckii*). Turtle Survival Alliance Annual Symposium, Tucson, AZ.
- Tringali, M.D., S.M. Sammons, J.M. Long, N. Van Bibber, K. Panzner, and A.T. Taylor. 2017. A range-wide threat assessment for Shoal Bass from introgressive hybridization. American Fisheries Society Annual Meeting, Tampa, FL.
- Whitledge, G., W. Doyle, J. Long, B.C. Neely, and J.D. Schooley. 2017. Applications of emerging fisheries techniques for paddlefish. Annual meeting of the Southern Division American Fisheries Society, Oklahoma City, OK.
- Wedgeworth, M., R. Mollenhauer, and S.K. Brewer. 2019. Local colonization and extinction of Prairie Chub *Machrybopsis australis* across wet-dry cycles in the upper Red River Basin. Oklahoma Natural Resources Conference, Tulsa, OK.
- Wolf, S., R. Mollenhauer, and S.K. Brewer. 2019. Movement and survival of Rainbow Trout *Oncorhynchus mykiss* in an Ozark stream. Annual Meeting of the Southeastern Association of Fish and Wildlife Agencies, Hilton Head, SC.
- Wolf, S., R. Mollenhauer, E. Tanner, and S.K. Brewer. 2018. Seasonal Habitat Selection by Fishes in Ozark Streams. Annual Meeting of the American Fisheries Society, Atlantic City, NJ.
- Wolf, S., E. Tanner, R. Mollenhauer, S. Fuhlendorf, and S.K. Brewer. 2018. Determining the temperature selection patterns of native stream fishes in an Ozark stream. Oklahoma Natural Resources Conference, Tulsa, OK.
- Wolf, S., R. Mollenhauer, E. Tanner, S. Fuhlendorf, and S.K. Brewer. 2019. Seasonal microhabitat selection by native fishes in Ozark streams. Oklahoma Natural Resources Conference, Tulsa, OK.
- Wolf, S., E. Tanner, S. Fuhlendorf, R. Mollenhauer, and S.K. Brewer. 2019. Practical tool or shiny penny? Using fiber-optic distributed temperature sensing to improve evaluations of temperature selection by stream fishes. Annual meeting of the Southern Division American Fisheries Society, Galveston, TX.
- Valentine, G. and S.K. Brewer. 2018. Groundwater influence on water temperature in an Ozark Stream. Annual Meeting of the Ecological Society of American, New Orleans, LA.
- Yaklin, D. and W.S. Fairbanks. 2017. Black bear (*Ursus americanus*) use of prescribed burn units in the Ouachita National Forest in Oklahoma. Oklahoma Natural Resources Conference, Tulsa, OK.
- Zentner, D.L., Shoup, D.E., and Brewer, S.K. 2019. Age and growth of catostomids in the Ozark Highlands. Oklahoma Natural Resource Conference, Tulsa, OK.

Theses/Dissertations

- Justin Alexander. 2017. Determining the effects of altered thermal regimes on stream fishes of the Ouachita Mountain Ecoregion. M.S., Oklahoma State University, Stillwater. (Advisor, Brewer)
- Fidelis A Atuo. 2017. Spatial distribution of aerial predators: Influences on usable space for quail; Ph.D., Oklahoma State University, Stillwater. (Advisor, O'Connell)
- Rachel L. Beytke. 2017. Thermal ecology of two ground-nesting galliforms during a critical reproductive stage. M.S., Oklahoma State University, Stillwater. (Advisors, Davis and Fuhlendorf)
- Samantha Cady. 2018. Ecological assessment of Ozark watersheds using breeding birds: a blueprint for riparian restoration. M.S., Oklahoma State University, Stillwater. (Advisor, O'Connell)
- Matteo Cleary. 2019. Analyses of the psychological and demographic factors affecting acceptance capacity for American black bears in eastern Oklahoma. M.S., Oklahoma State University, Stillwater. (Advisor, Fairbanks)
- John Dattilo. 2017. Incorporating an approach to aid river and reservoir fisheries in an altered landscape. M.S., Oklahoma State University, Stillwater. (Advisors, Brewer, Shoup)

Cameron A. Duquette. 2017. Indirect effects of energy development in grasslands. M.S., Oklahoma State University, Stillwater. (Advisors, Davis and Fuhlendorf)

Joseph Dyer. 2018. Migration strategies and habitat use by Blue Sucker in the Red River Basin. Ph.D., Oklahoma State University, Stillwater. (Advisor, Brewer)

Jacob Farriester. 2018. Carrion beetles in orchards and ranches in Oklahoma and investigation of genes associated with antimicrobial production. M.S., Oklahoma State University, Stillwater. (Advisor, Hoback)

Adam K. Frakes. 2019. An assessment of economic impact & visitor satisfaction: a case study from Canton Lake, Oklahoma. M.S., Oklahoma State University, Stillwater. (Advisor, Joshi)

Colt Holly. 2018. Habitat suitability and detection probability of Longnose Darter (*Percina nasuta*) in Oklahoma. M.S., Oklahoma State University, Stillwater. (Advisor, Long)

Nicolas Jaffe. 2017. Predictive mapping of priority birds in the Oaks and Prairies. M.S., Oklahoma State University, Stillwater. (Advisor, O'Connell)

Garrett R. Johnson. 2017. Assessing horizontally-oriented acoustic methods for gizzard shad abundance assessments: accuracy, precision and target orientation. M.S., Oklahoma State University, Stillwater. (Advisor, Shoup)

Jeffery Johnson. 2017. Detection, occupancy and distribution of Asian Swamp Eel (*Monopterus albus*) in Georgia. M.S. Oklahoma State University, Stillwater. (Advisor, Long)

Dave Londe. 2017. The effects of rangeland management and energy development on the habitat use of grassland birds in the Southern Great Plains. M.S., Oklahoma State University, Stillwater. (Advisor, Fuhlendorf)

Elliot J. Lustig. 2018. American black bear ecology in the Oklahoma Ozarks: home range estimation, fragmentation analysis, and resource selection. M.S., Oklahoma State University, Stillwater. (Advisor, Fairbanks)

Andy Miller. 2019. Assessing the spawning movement and habitat needs of riverine Neosho Smallmouth Bass. Ph.D., Oklahoma State University, Stillwater. (Advisor, Brewer)

Josh Mouser. 2019. Determining the presence and demographics of cave fish and cave crayfish populations using novel techniques. M.S., Oklahoma State University, Stillwater. (Advisors, Brewer, Van Den Busche)

Erica L. Perez. 2018. Population dynamics and infectious disease seroprevalence in American black bears of southeastern Oklahoma. M.S., Oklahoma State University, Stillwater. (Advisor, Fairbanks)

Allison Rakowski. 2018. Thermal ecology and effects of anthropogenic development on wild turkey. M.S., Oklahoma State University, Stillwater. (Advisor, Elmore)

Lauren Sequy. 2019. Non-native black bass: potential conflicts in fisheries management. M.S., Oklahoma State University, Stillwater. (Advisor, Long)

Andrew Taylor. 2017. Influences of fragmentation on fluvial-specialist black bass species. Ph.D., Oklahoma State University, Stillwater. (Advisor, Long)

Skylar Wolf. 2019. Assessing the effects of stocked Rainbow Trout on the distribution and abundance of native fishes of Spavinaw Creek, M.S., Oklahoma State University, Stillwater. (Advisor, Brewer)

Jillian D. Wormington. 2017. Facial marking form and function in subsocial *Nicrophorus* beetles. Ph.D., Oklahoma State University, Stillwater. (Advisor, Luttbeg)

Danielle M. Yaklin. 2017. The effects of prescribed fire for forest management on black bear forage availability, resource selection, and distribution in the U.S. Interior Highlands. Ph.D., Oklahoma State University, Stillwater. (Advisor, Fairbanks)

Yan Zhou. 2017. Quantifying groundwater interactions and implications on thermal regimes of streams. Ph.D. Oklahoma State University, Stillwater. (Advisor, Brewer, Fox)

Awards/Honors

Shannon Brewer, Outstanding Fisheries Worker of the Year Award, Oklahoma Chapter American Fisheries Society (February 2017).

Shannon Brewer, Performance Award, U.S. Geological Survey (October 2017).

Shannon Brewer, Performance Award, U.S. Geological Survey (October 2018).

Shannon Brewer, Performance Award, U.S. Geological Survey (October 2019).

Kimberly Brown, James K. Schooley Best Student Presentation Award, Oklahoma Chapter American Fisheries Society (February 2019).

Samantha Cady, Phoenix Award for Outstanding Master's Student, Graduate and Professional Student Government Association, Oklahoma State University (April 2018).

Taylor Carlson, Bruce Stewart Student Travel Award, Southwestern Association of Naturalists (April 2019).

Taylor Carlson, Howard McCarley Student Research Award, Southwestern Association of Naturalists (April 2019).

Taylor Carlson, Bryan P. Glass Scholarship, Integrative Biology Department, Oklahoma State University (April 2019).

John Dattilo, Jimmie Pigg Travel Scholarship, Oklahoma Chapter American Fisheries Society. (February 2017).

Joey Dyer, Outstanding Graduate Student in Fisheries, Oklahoma State University (April 2018).

Tyler Farling, Lower Mountain Fork River Scholarship, Lower Mountain Fork River Foundation (March 2017).

Jacob Farriester, First Place MS Oral Presentation, Southwestern Branch of the Entomological Society of America (March 2017).

Jacob Farriester, First Place MS Poster Presentation, Southwestern Branch of the Entomological Society of America (March 2018).

James Long, Performance Award, U.S. Geological Survey (October 2017).

James Long, Performance Award, U.S. Geological Survey (October 2018).

James Long, Performance Award, U.S. Geological Survey (October 2019).

Andy Miller, James K. Schooley Best Student Presentation Award, Oklahoma Chapter American Fisheries Society (February 2018).

Robert Mollenhauer, W.F. Thompson Best Paper Award, American Institute of Fishery Research Biologists (December 2019).

Josh Mouser, 3rd Place Abstract Writing Contest, Oklahoma State University (May 2017).

Joshua Mouser, Outstanding Graduate Student in Fisheries, Oklahoma State University (April 2018).

Joshua Mouser, Student Travel Award, International Association of Astacology (May 2018).

Dan Shoup, Outstanding Fisheries Worker of the Year Award, Oklahoma Chapter American Fisheries Society (February 2018).

Rakowski, A.E., R.D. Elmore, C.A. Davis, and S.D. Fuhlendorf, Best student paper, Oklahoma Natural Resources Conference (February 2018).

Evan Tanner, Dwayne Elmore, Sam Fuhlendorf, Craig Davis, David Dahlgren, and Jeremy Orange, Outstanding Peer-Reviewed Publication Award, Oklahoma Chapter of The Wildlife Society (February 2017).

Andrew Taylor, Great Plains CESU Graduate Student Award, Great Plains Cooperative Ecosystems Studies Unit (December 2017).

Andrew Taylor, Robert L. Lochmiller, II Endowed Scholarship in Wildlife Ecology, NREM Department, Oklahoma State University (April 2017).

Andrew Taylor, Sally Jo Bible Outstanding Graduate Student Award, NREM Department, Oklahoma State University (April 2017).

Skylar Wolf, 1st Place Video Competition, Oklahoma State University (May 2018).

Skylar Wolf, Jimmie Pigg Travel Scholarship, Oklahoma Chapter American Fisheries Society (February 2019).

Skylar Wolf, Outstanding Graduate Student in Fisheries Scholarship, Oklahoma State University (April 2019).



71 YEARS OF SERVICE

Oklahoma Cooperative Wildlife Research Unit (est. 1948)

UNIT LEADERS

Walter P. Taylor, 1948-51
Adolph M. Stebler, 1951-67
John A. Morrison, 1967-75
Paul A. Vohs, Jr., 1976-79
Frank Schitoskey, Jr., 1980-83
O. Eugene Maughan, 1983-84 (acting)

ASSISTANT UNIT LEADERS

Fred Baumgartner, 1948-65
George A. Moore, 1953-65
Robert I. Smith, 1965-67
James C. Lewis, 1967-77
John A. Bissonette, 1977-81

Oklahoma Cooperative Fishery Research Unit (est. 1965)

UNIT LEADERS

Bradford E. Brown, 1965-66 (acting)
Robert C. Summerfelt, 1966-76
O. Eugene Maughan, 1977-84

ASSISTANT UNIT LEADERS

Bradford E. Brown, 1966-70
Austin K. Andrews, 1970-75
Michael D. Clady, 1976-81

Oklahoma Cooperative Fish and Wildlife Research Unit (combined 1984)

UNIT LEADERS

O. Eugene Maughan, 1984-87
Phillip J. Zwank, 1987-89
David M. Leslie, Jr., 1989-2016
Shannon K. Brewer, 2017 (acting)
James M. Long, 2017-19 (acting)
James M. Long, 2019-present

ASSISTANT UNIT LEADERS

David M. Leslie, Jr., 1985-89
Alexander V. Zale, 1985-93
William L. Fisher, 1991-2008
Dana L. Winkelman, 1998-2003
James M. Long, 2009-19
Shannon K. Brewer, 2010-20

