



OKLAHOMA  
COOPERATIVE  
FISH AND WILDLIFE  
RESEARCH UNIT

# TRIENNIAL REPORT 2014|16

*Celebrating Our 9th 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 cardinal shiner (*Luxilus cardinalis*) is a small minnow, commonly found in small to medium, clear-water streams of the Ozarks region. These fish often school together in large numbers and are best observed while snorkeling. The males become bright red during the spawning season, as depicted in this underwater photograph. Photograph by B. Brown.

Triennial Report designed by  
Oklahoma State University  
Marketing Services.

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 2014–2016.

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 complete our 7th 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 [www.coopunits.org](http://www.coopunits.org), [www.okstate.edu](http://www.okstate.edu), [www.wildlifedepartment.com](http://www.wildlifedepartment.com), [www.wildlifemanagementinstitute.org](http://www.wildlifemanagementinstitute.org), and [www.fws.gov](http://www.fws.gov).

---

(vacant)  
Unit Leader/Wildlife

**Shannon K. Brewer**  
Assistant Unit Leader/Fisheries

**James M. Long**  
Assistant Unit Leader/Fisheries

### **Coordinating Committee** (current voting members)

**Thomas G. Coon**  
Vice President of the Division of Agricultural Sciences and Natural Resources, Oklahoma State University

**J.D. Strong**  
Director, Oklahoma Department of Wildlife Conservation

**John F. Organ**  
Chief, Cooperative Research Units, U.S. Geological Survey

**Steve A. Williams**  
President, Wildlife Management Institute

# CONTENTS

2



4



14



21



## 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 2014–2016 is clear: 35 student/faculty awards, 22 theses/dissertations, 73 peer-reviewed and technical publications, and 184 presentations at professional state, regional, national, and international meetings.

**2014  
2016**

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.

## Oklahoma Cooperative Fish and Wildlife Research Unit

007 Agriculture Hall  
Oklahoma State University  
Stillwater, OK 74078-3051  
P 405-744-6342  
F 405-744-5006



# Biennial Report

2014  
2016

2



## Unit Staff

**Dr. David M. Leslie, Jr.** (retired 2016)  
Unit Leader and Adjunct Professor.  
Ph.D., Oregon State University,  
1982. Terrestrial vertebrate ecology;  
endangered species. cleslie@usgs.gov

**Dr. Shannon K. Brewer**  
Assistant Unit Leader and Adjunct  
Associate Professor. Ph.D., University  
of Missouri, 2008. Stream ecology.  
shannon.brewer@okstate.edu

**Dr. James M. Long**  
Assistant Unit Leader and Adjunct  
Associate Professor. Ph.D.,  
Oklahoma State University, 2000.  
Conservation ecology and fisheries  
science. longjm@okstate.edu

**Cheryl McKnight**  
Senior Administrative  
Support Specialist. cheryl.  
mcknight@okstate.edu

**Marcie Lemons**  
Administrative Support Specialist  
marcie.lemons@okstate.edu

**Renee Flasch**  
Administrative Support Specialist  
renee.flasch@okstate.edu

## Cooperators

**OKLAHOMA STATE UNIVERSITY**  
**Agricultural Economics:** Tracy  
Boyer, Max Melstrom, David Shideler;  
**Biosystems and Ag Engineering:**  
Garey Fox, Dan Storm, Jason Vogel;  
**Entomology and Plant Pathology:**  
Carmen Greenwood, Wyatt Hoback,  
Michael Reiskind; **Natural Resource  
Ecology and Management:** Jim Ansley  
(Head), Craig Davis, Dwayne Elmore,  
Sue Fairbanks, Sam Fuhlendorf,  
Mark Gregory, Steve Hallgren, Karen  
Hickman, Omkar Joshi, Scott Loss,  
Tim O'Connell, Dan Shoup, Larry  
Talent, Rod Will; **Integrative Biology:**  
Jason Belden, Andy Dzialowski,  
Tony Echelle, Stanley Fox, Meredith  
Hamilton, Scott McMurry, Monica  
Papes, Loren Smith (Head), Michi  
Tobler, Ron Van Den Bussche.

**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), Don Groom, Kurt  
Kuklinski, Jason Schooley, Richard  
Snow, Curtis Tackett; **Wildlife:** Curt  
Allen, Bruce Burton, Steve Conrady,  
Brett Cooper, Scott Cox, Jerrod  
Davis, Bill Dinkines (Assistant Chief),  
Craig Endicott, Colby Farquhar, Matt

Fullerton, Joe Hemphill, Melinda  
Hickman, Russ Horton, Mark Howery,  
Allan Janus, Ron Justice, Mike O'Meilia,  
Scott Parry, Alan Peoples (Chief), JD  
Ridge, Mike Sams, Doug Schoeling,  
Rod Smith, Rex Umber, Derek Wiley.

### U.S. GEOLOGICAL SURVEY

**Cooperative Research Units:** Shana  
Coulby, Barry Grand, Amanda  
Maslowski, Missy Thode, Kevin  
Whalen, Tim Grabowski (Assistant  
Unit Leader, Texas); **Northern Prairie  
Science Center:** Ned Euliss; **South  
Central Climate Science Center:**  
Kim Winton, Mike Langston.

### U.S. FISH AND WILDLIFE SERVICE

**Region 2:** James Broska; **Tulsa  
Ecological Services:** Ken Collins,  
Daniel Fenner, Ken Frasier, Jonna  
Polk (Project Leader), Kevin Stubbs;  
**Oklahoma Fisheries Resource Office:**  
Brent Bristow; **Lower Rio Grande  
National Wildlife Refuge:** Bryan  
Winton and staff; **Ozark Plateau  
National Wildlife Refuge:** Richard  
Stark and staff; **Salt Plains National  
Wildlife Refuge:** Glen Hensley,  
Barry Smart; **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:** Todd Gemeinhardt,  
Nate Gosch, Marcus Miller.

### U.S. DEPARTMENT OF AGRICULTURE

**Natural Resource Conservation  
Service:** Diane Eckles, Bill  
Effland; **US Forest Service:** John  
Baldwin, Robert Bastarache

### 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

## Research Personnel

**POST-DOCTORAL ASSOCIATES**

Matt Carroll  
Robert Mollenhauer  
Valerie O'Brien  
Eric Thacker  
Thomas Worthington

**RESEARCH ASSOCIATES**

Kent Andersson  
Cara Caricato-Michalke  
Brian Cunningham  
Alin Gonzalez-Barnes  
Sara B. Lyda

**PH.D. CANDIDATES**

Fidelis Atuo  
Angela Begosh  
Anissa Delecki  
Richard Dolman  
Joey Dyer  
Xioa Feng  
Bart Kensinger  
William Mausbach  
Andrew Miller  
Reid Morehouse  
Ashley Tanner  
Evan Tanner  
Andrew Taylor  
Danielle Techentin  
Yan Zhou

**M.S. CANDIDATES**

Justin Alexander  
Emily Artz  
Rachel Beyke  
Samantha Cady  
Evan Cartabiano  
Anthony Civiello  
Leah Dale  
John Dattilo  
Cameron Duquette  
Nicole Farless  
Tyler Farling  
Shane Foye  
Alli Giguere  
Jonathan Harris  
Colt Holley  
Nicholas Jaffe  
Garrett Johnson  
Jeffery Johnson  
Josh Johnston  
Daniel Logue  
Elliot Lustig

**M.S. CANDIDATES** CONTINUED

Kenneth Masloski  
Joshua Mouser  
Jeremy Orange  
Erica Perez  
Morgan Pfander  
Jarrod Powers  
Allison Rakowski  
Trevor Starks  
Christopher Tanner  
Maureen Thompson

**RESEARCH TECHNICIANS**

Courtney Anderson  
John Baggerly  
Taylor Baurichter  
Joel Bjornen  
Kelly Boyer  
Bryce Burkehead  
Thomas Campbell  
Zoe Cooper  
Jodie Crose  
Kasey Goins  
Colby Gregg  
Cassie Hamilton  
Tanner Hart  
Nathan Hillis  
Joshua Hills  
Jake Holliday  
Garrett Hopper  
Blayne Houshe  
Alex James  
Mark Jensen  
Kortney Kowal  
Alicia Maple  
Dakota McNeil  
Dawson McNeil  
Drew Miller  
Julia Mueller  
Steven Nanez  
Matthew Pallett  
Elizabeth Pope  
Abbey Ramirez  
Melissa Reed  
Ariel Richter  
Justin Rolan  
Katherine Schwartz  
Scott Talent  
Connie Teschner  
Anthony Thorton  
Desiree Williams  
Case Wyatt

**VOLUNTEERS**

Kyle Andreska	Darien Lozon
Michaela Bailey	Joshua Luft
Sarah Ball	Ashley Lyon
Alexander Barnes	Laura Mackey
Kristen Bayley	Steven Maichak
Jessica Beach	Joshua Malinowski
Zachary Blunk	Brittany Manley
Ernest J. Borchert	Frances Marshall
Talia Branham	Lindsay Martindale
Caitlin Brown	Trevor Mattera
Taylor Brunsteter	Kelsey McClearn
Kara Burger	Sarah McIntire
Michael Caballero	Kyle Meadows
Adrian Cain	Nicholas Melone
Allison Causey	Vincent Meyer
Justin Clarke	Ashley Minnich
Lacey Clarke	Jessica Mitcham
Joseph Connor	Marian Morris
Matthew Critean	Corin Olivas
Roy Cruz	Alex Oppenborn
Spencer Davis	Bryce Owen
Zackary Delisle	Eric Pasay
Benjamin Determan	William Pence
Ehren Epperson	Sydney Pracht
Sydney Everett	Thornton Raskevitz
Dailee Fagnant	Tyler Reed
William Funk	Taylor Root
Ana Gabriel	Rainey Rowell
Emily Garder	Tyler Saltmer
Michelle Gardner	Amanda Scofield
Daniel Giesen	Madeline Scott
Katelynn Gifford	Robert Sheffer
Jason Glover	Cooper Sherrill
Ryan Greenway	Brittany Simons
Kori Groenveld	Abbey Smith
Tyler Hadley	Ashley Stanberry
Derrian Hall	Aubrey Stearns
Daniel Harrington	Kaili Stevens
Josh Hendricks	Nate Stott
Chelsea Hinton	Jessica Swift
Brittany Hoback	Kaitlin Taylor
Lindsay Howard	Brittney Tayrien
Kelly Hoyer	Katherine Teets
Ashley Huinker	Amy Thompson
Alex James	Micah Walker
Bailey Joe Johnson	Alexis Whiles
Jarrett Kachel	Derek Wietelman
Joseph King	Morgan Womack
Carolyn Kyle	Alexis Wood
Rebecca Long	Spencer Wood

# Aquatic Resources

## COMPLETED PROJECTS

4



### Processing samples to monitor at-risk fish species in large prairie rivers of Oklahoma

The Oklahoma Ecological Services Field Office of the U.S. Fish and Wildlife Service conducts annual monitoring of species of conservation concern. The primary interest is documenting the status of the Arkansas River Shiner, a federally-threatened species, and the Prairie Speckled Chub, an endemic species of the Red River. A backlog of samples has prevented a rigorous analysis of those samples. We identified and processed samples from 2014-2016 to develop a reference collection of fishes inhabiting the rivers of the southern Great Plains.

**FUNDING**  
Oklahoma Department of Wildlife Conservation

**FACULTY INVESTIGATORS**  
Shannon K. Brewer

**STUDENT INVESTIGATORS**  
Jake Holliday, Dakota McNeill, Dawson McNeill, Desiree Williams, and Joshua Mouser, Lab Technicians

**COMPLETED**  
April 2016

### Impacts of flow alterations on crayfishes in southeast Oklahoma rivers

Narrow-range endemics are considered particularly vulnerable to extirpation because they often use specific habitats that are highly susceptible to human disturbance. We investigated several crayfish species endemic to the Ouachita Mountains of Oklahoma and Arkansas. We established spatial distributions (i.e., range) using Maximum Entropy modeling. We then investigated crayfish habitat use with quantitative sampling and a paired movement study. Finally, we evaluated the ability of crayfish to burrow under different environmental conditions in a controlled laboratory setting. Our results suggest climate change and sedimentation resulting from land-use practices, combined with increased water withdrawals have the potential to alter crayfish distributions and affect persistence of some crayfish populations.

**FUNDING**  
Oklahoma Department of Wildlife Conservation

**FACULTY INVESTIGATORS**  
Shannon K. Brewer and Michael Tobler

**STUDENT INVESTIGATORS**  
Joey Dyer, M.S Candidate; Blayne Housh, Kortney Kowal, Julia Mueller, Jarrod Powers, and Justin Rolan, Field Technicians

**COMPLETED**  
May 2014



THE UPPER CIMARRON RIVER CAN BE MORE SALINE THAN OCEAN WATER (PHOTO: S. BREWER)



ORCONECTES MENA, AN ENDEMIC CRAYFISH OF THE OUACHITA MOUNTAIN ECOREGION (PHOTO: S. BREWER)

## Flow-ecology relationships of fishes in the Arbuckle Mountains and Ozark Highlands

Stream flow and thermal regimes are often coupled and can be altered by anthropogenic activities. We examined the influence of altered flows on assemblages of the Arbuckle Mountains and Ozark Highlands, and characterized the thermal tolerances of 15 stream fish species. Our flow-ecology relationships showed that many abiotic and biotic characteristics were positively related to dynamic flow conditions including increased magnitude and number of flow reversals. Many species belonging to reproductive guilds with some taxonomic resolution (e.g., *Moxostoma*) showed similar patterns to both flow and temperature. We ranked species in order of their environmental tolerances and showed that species with higher tolerances were generally able to increase their tolerances under slower heating conditions. Our data suggest fine guild designations may be useful to predicting both thermal and flow responses.

### FUNDING

The Nature Conservancy

### FACULTY INVESTIGATOR

Shannon K. Brewer

### STUDENT INVESTIGATORS

Nicole Farless, M.S. Candidate;  
Jake Holliday, Field Technician

### COMPLETED

December 2015



NICOLE FARLESS WITH A LONGNOSE GAR  
(PHOTO: S. BREWER)

## Predicting the distribution of freshwater mussel assemblages in small rivers of southeastern Oklahoma

The goal of this project was to determine the environmental factors related to the distribution and abundance of mussels in the Muddy and Clear Boggy rivers in southern Oklahoma. We determined that side-scan sonar was an effective tool for preliminary assessments of mussel presence when they are located at the substrate surface and in relatively fine substrate. Models predicting freshwater mussel densities performed much better than presence models with drainage area, width-depth ratios, and percent of shale geology selected most often as explanatory variables. Unlike many species, Wabash pigtoe was tolerant of agriculture land use. Mussel species known to have a limited number of host fishes showed significant positive relationships between mussel density and fish-host density. The results of our study provide information about the environmental factors influencing specific-species densities, which can guide conservation initiatives.

### FUNDING

Oklahoma Department of  
Wildlife Conservation

### FACULTY INVESTIGATORS

Shannon K. Brewer and  
Timothy J. O'Connell

### STUDENT INVESTIGATORS

Jarrold Powers, M.S. Candidate; Bryce  
Burkhead, Thomas Campbell, and  
Mark Jensen, Field Technicians

### COMPLETED

May 2016



FRESHWATER MUSSEL FROM THE MUDDY BOGGY RIVER  
(PHOTO: J. POWERS)

## Ecosystem stress response function of climate change in the Arkansas-Red River basin

Maintaining appropriate flows to support the biological integrity of larger riverine ecosystems is difficult. Understanding interactions among climate, streamflow, water quality, and stream ecology for watersheds in the Canadian River Basin can be achieved using existing data and technology. A physics-based hydrologic model that simulates streamflow using high-resolution radar data was used to more accurately capture spatial and temporal patterns in precipitation variability. Existing fish-community data were collected and compiled into a database and biotic responses were assessed to evaluate the influence of modeled streamflow. The relationship between water quality and the fish community only revealed an expected downstream addition of fishes. Our calculated flow metrics showed inconsistencies in metrics related to variance, while those related to central tendency match predicted flows. Examination of these abrupt changes revealed over-prediction during a storm when hail was present. There were several other cases in the lower Canadian River where the model exhibited similar behavior of isolated over-prediction. As a result, flow-ecology relationships were limited to describing patterns with average flow values. The outcome of this work suggest modeling extreme high and low flows of the Great Plains is difficult and historic gage data would be most useful to establishing patterns between relevant extreme flows and fishes.

### FUNDING

U.S. Department of the Interior, South-Central Climate Science Center

### FACULTY INVESTIGATOR

Shannon K. Brewer

### STUDENT INVESTIGATOR

Thomas Worthington,  
Postdoctoral Fellow

### COMPLETED

December 2016

## Standardized fish-sampling methods for Oklahoma streams

6 Fundamental challenges of establishing stream fish-environment relationships are variable detection and the multiscale structure of stream systems. We modeled tow-barge electrofishing detection among Ozark Highland stream fishes across environmental conditions. Seven reach-scale variables and segment-scale lithology were associated with variable electrofishing detection. We also improved the applicability of electrofishing for monitoring stream-dwelling Smallmouth Bass using a multinomial N-mixture model, where water clarity, depth, and wetted channel width explained variable detection. We compared snorkeling to tow-barge electrofishing to both examine differences in species detection and evaluate the efficacy of snorkeling for estimating warmwater stream-fish abundance. Electrofishing tended to detect rarer species more often than snorkeling. Snorkeling also typically underestimated abundance, particularly for cryptic species. Lastly, we examined Ozark Highland stream fish-environment relationships at multiple spatial scales. Variable stream-fish densities were associated with reach-scale temperature variation and segment-level geology. Variable stream-fish occurrence was associated with riffle-run-pool sequence area and reach-scale substrate size, temperature variation, and residual pool depth. Our project demonstrated the complexity of stream-fish detection across environmental conditions and highlighted the importance of multiscale approaches to advance stream-fish ecology and management.

### FUNDING

Oklahoma Department of Wildlife Conservation

### FACULTY INVESTIGATOR

Shannon K. Brewer

### STUDENT INVESTIGATOR

Robert Mollenhauer, Ph.D. Candidate

### COMPLETED

December 2016

## Effects of USDA conservation programs on High Plains playa wetlands

This research assessed the influence of USDA conservation practices on playa wetland ecosystems in the High Plains. We evaluated ecosystem services for playa wetlands in three land treatment groups: cropland, lands enrolled in USDA conservation programs (e.g., CRP and WRP), and grassland. Results include the development of predictive functional condition indicator models that include multiple-scale factors that contribute to differences in ecosystem service estimates. The work helped develop models for a USGS Integrated Landscape Modeling effort.

### FUNDING

U.S. Department of Agriculture, Natural Resources Conservation Service

### FACULTY INVESTIGATORS

Loren Smith and Scott McMurry

### STUDENT INVESTIGATOR

Bart Kensinger, Ph.D. Candidate

### COMPLETED

December 2015



PLAYA FULL OF *COREOPSIS TINCTORIA* IN SILVERTON, TX (PHOTO: A. BEGOSH)

## Improving sampling and monitoring of shovelnose sturgeon in the Great Plains

Isolated populations of Shovelnose Sturgeon in the Arkansas River and Red River basins of the southern Great Plains represent the southwest extent of the species current range. The distribution of Shovelnose Sturgeon in the Arkansas River basin was primarily related to mean annual discharge, but the Red River populations were related to the extent of available habitat and discharge. As expected by big river fishes, both populations were negatively correlated with elevation. We had very limited success capturing Shovelnose Sturgeon in the Arkansas River using gears and methods reported in reviewed studies. Thus, we developed a hybrid method using trammel nets, while flows were manipulated by water-management agencies. We captured 26 Shovelnose Sturgeon in five days using our hybrid method, the most successful method used. Results from this study will be used to provide insight into future study designs, and advise future study objectives.

### FUNDING

Oklahoma Department of Wildlife Conservation

### FACULTY INVESTIGATOR

Shannon K. Brewer

### STUDENT INVESTIGATOR

Josh Johnston, M.S. Candidate

### COMPLETED

December 2016



SHOVELNOSE STURGEON COLLECTED FROM THE ARKANSAS RIVER, OKLAHOMA (PHOTO: J. JOHNSON)

**Synthesizing models useful for ecohydrology and ecohydraulic approaches: an emphasis on integrating models to address complex research questions**

Ecohydrology combines empiricism, data analytics, and the integration of models to characterize linkages between ecological and hydrological processes. A challenge for practitioners is determining which models best generalizes heterogeneity in hydrological behavior, including water fluxes across spatial and temporal scales, integrating environmental and socio-economic activities to determine best watershed management practices, and data requirements. We conducted a literature review and synthesis of hydrologic, hydraulic, water quality, and ecological models designed for solving interdisciplinary questions. We reviewed 1,275 papers and identified 178 models that have the capacity to answer an array of research questions. Of these models, 43 were commonly applied. Forty-one of 43 reviewed models were linked to at least one other model: WASP (linked to 21 other models), SWAT (19), and HEC-RAS (15). However, model integration was still relatively infrequent. Simply increasing the interoperability of model platforms, transformation of models to user-friendly forms, increasing user-support, defining the reliability and risk associated with model results, and increasing awareness of model applicability may promote increased use of models across sub-disciplines.

**FUNDING**

U.S. Geological Survey, South-Central Climate Science Center

**FACULTY INVESTIGATOR**

Shannon K. Brewer

**STUDENT INVESTIGATOR**

Tom Worthington, Post-Doctoral Fellow

**COMPLETED**

December 2016

**Zooplankton composition and prey-use of juvenile fishes in constructed shallow-water habitats**

The Missouri River has experienced significant anthropogenic alterations over the past 100 years, particularly loss of shallow-water habitat (SWH). In response, the U.S. Army Corps of Engineers created ~1,390 ha of SWH on the lower Missouri River from Sioux City, Iowa downstream to the confluence with the Mississippi River. The hypothesized benefits of created-SWH for native juvenile fish were apparent for alpha and gamma diversity, but not beta diversity, which was affected by longitudinal position in the riverscape. For the two most commonly captured species, *Hiodon* spp. and Freshwater Drum, prey use was not affected by habitat type. Juvenile *Macrhybopsis* spp. minnows, which are declining in abundance in the lower Missouri River, consumed mostly midge pupae, but variations in prey use were evident among the species.

**FUNDING**

U.S. Army Corps of Engineers

**FACULTY INVESTIGATORS**

James M. Long and Andrew R. Dzialowski

**STUDENT INVESTIGATORS**

William Mausbach, Ph.D. Candidate; Trevor Starks, M.S. Candidate

**COMPLETED**

December 2014

**Evaluating the effects of shallow water habitat implementation on age-0 *Scaphirhynchus* sp. prey use and body condition**

The Missouri River has been heavily modified for navigation. Of particular interest is the loss of shallow-water habitat (SWH) that is hypothesized to have negatively affected certain riverine species. In response, the U.S. Army Corps of Engineers created ~1,390 ha of SWH on the lower Missouri River. In conjunction with U.S. Army Corps of Engineers, we sampled age-0 sturgeon at 5 sites that varied in amounts of SWH to determine if prey use and lipid content varied accordingly. We also worked with U.S. Geological Survey biologists to determine the effects of starvation and satiation on lipid content. From 2 years of study, we found that interannual variation was a larger influence on prey use and body condition than amount of SWH. Flow variability was likely the main driving force, with higher lipid contents found during the year with higher mean discharge.

**FUNDING**

U.S. Army Corps of Engineers

**FACULTY INVESTIGATORS**

James M. Long and Andrew R. Dzialowski

**STUDENT INVESTIGATORS**

Anthony Civiello, M.S. Candidate; Alin González-Barnes, Temporary Technician

**COMPLETED**

December 2016



TREVOR WITH A BUFFALO CAPTURED FROM THE MISSOURI RIVER (PHOTO: A. CIVIELLO)



ANTHONY WITH SEVERAL JUVENILE PADDLEFISH FROM THE MISSOURI RIVER (PHOTO: A. CIVIELLO)

## Effects of water quality and drought on fish community composition in an aging Great Plains reservoir

Sedimentation at Great Salt Plains Lake (GSPL) in northwestern Oklahoma has reduced water storage capacity to the point where the lake is not supporting aquatic recreation. Additionally, long-term drought and high turbidity have negatively affected the resident ichthyofauna. We sampled multiple habitats in the reservoir to document the current composition of the fish assemblage and compare to previous assessments when the reservoir was first impounded. The current composition of fishes at GSPL is dominated by two small-bodied fishes that are tolerant of salinity: Inland Silverside and Plains Killifish. Large-bodied fishes are largely absent, with the exception of Common Carp, which is in contrast to the community immediately after impoundment when Gizzard Shad, River Carpsucker, and Channel Catfish were very common.

### FUNDING

Oklahoma Cooperative Fish and Wildlife Research Unit

### FACULTY INVESTIGATOR

James M. Long

### STUDENT INVESTIGATORS

Evan Cartabiano, M.S. Candidate;  
Tanner Hart, Field Technician

### COMPLETED

December 2014



CARP SKELETON ON THE BANKS OF SALT PLAINS LAKE  
(PHOTO: E. CARTABIANO)

## Effects of water quantity on fish community composition in the upper Cimarron River, Oklahoma

The Cimarron River in Oklahoma is largely undammed except for a 23-km long irrigation canal (Old Settler's Irrigation Canal) built between 1893 and 1905. Water from the Cimarron River is diverted into the canal by a sand dam, which is destroyed periodically by high flows and then re-built. In 2012, we sampled for fish above, below and within the altered reach and within the canal. A persistent drought kept many stretches of river devoid of water, but in general, water quantity and fish diversity were positively correlated. Above the canal, where water quantity was greatest, species diversity followed suit. Of 10 total species captured, 9 were found above the diversion. Species diversity decreased downstream, with no more than 6 species documented at a site.

### FUNDING

U.S. Fish and Wildlife Service,  
Oklahoma Cooperative Fish and Wildlife Research Unit

### FACULTY INVESTIGATOR

James M. Long

### STUDENT INVESTIGATOR

Christopher Tanner, M.S. Candidate

### COMPLETED

December 2014



BLOCK NET OVER THE CIMARRON RIVER  
(PHOTO: C. TANNER)

## Identification of Neosho smallmouth bass (*Micropterus dolomieu velox*) stocks for reintroduction into Grand Lake, Oklahoma

There has long been interest in stocking non-native forms of Smallmouth Bass in eastern Oklahoma that tolerate reservoir conditions and grow larger than native forms. However, potential native stocks could be cultivated to increase abundance in reservoirs while avoiding issues with non-natives. As a result, we surveyed several tributaries in the Grand Lake and Lake Tenkiller regions of Oklahoma within the native range of Neosho Smallmouth Bass to assess genetic variation and potential brood stock sources for aquaculture. Genetic surveys identified three main stocks: one in the Illinois River basin and two in the Grand Lake watersheds. The Grand Lake stocks corresponded to large and small rivers and that large rivers (e.g., Elk River) supported a greater amount of genetic diversity.

### FUNDING

Peoria Tribe of Indians of Oklahoma

### FACULTY INVESTIGATORS

Shannon K. Brewer, James  
M. Long, Michael D. Tringali,  
Michael R. Schwemm

### STUDENT INVESTIGATORS

Andrew Taylor, Ph.D. Candidate;  
Joel Bjornen and Colt Holley,  
Field Technicians

### COMPLETED

August 2016



A NEOSHO SMALLMOUTH BASS FROM THE OZARKS  
(PHOTO: A. TAYLOR)

**Assessing the potential for rainbow trout reproduction in tributaries of the lower Mountain Fork River below Broken Bow Dam, southeastern Oklahoma**

The tailwater trout fishery in the Mountain Fork of the Little River below Broken Bow Dam is one of only two year-round trout streams in Oklahoma; spawning migrations from stocked trout, particularly Rainbow Trout, could be adding to the diversity of tributary streams, at least seasonally. We sampled for fishes in 10 tributary streams of the designated trout area of the lower Mountain Fork below Broken Bow Lake, Oklahoma. Trout were found in four streams, but only those found in Bee Branch and an unnamed tributary near the spillway were small enough to indicate reproduction. These results document that stocked Rainbow Trout sometimes do migrate into these small tributaries, at least seasonally, and that reproduction can occur.

**FUNDING**

U.S. Forest Service

**FACULTY INVESTIGATOR**

James M. Long

**STUDENT INVESTIGATORS**

Trevor A. Starks and Tyler Farling, M.S. Candidates; Anthony Thornton, Taylor Baurichter, Jeff Johnson, Garrett Johnson, and Colt Holley, Field Technicians.

**COMPLETED**

September 2016



TREVOR WITH RAINBOW TROUT FROM A LOWER MT. FORK TRIBUTARY (PHOTO: J. LONG)

**Factors affecting distribution of endangered fish and crayfish species in northeastern Oklahoma**

The Oklahoma Comprehensive Wildlife Conservation Strategy indicates that small rivers (Spring and Illinois Rivers), gravel bottom streams (Spavinaw Creek), and large rivers (Grand-Neosho River) in the Ozark Region represent priority conservation landscapes. These habitats support a number of fish and crayfish species of concern. We are evaluating population biology and conservation status of state-listed fish and crayfish in the northeastern portion of Oklahoma through field surveys to assess distribution and habitat requirements. We are also evaluating current and historical distributions of the listed species using ecological niche modeling to identify landscape-level environmental factors shaping species distributions.

**FUNDING**

Oklahoma Department of Wildlife Conservation

**FACULTY INVESTIGATOR**

Michael Tobler

**STUDENT INVESTIGATORS**

Reid Morehouse, Ph.D. Candidate; Garrett Hopper, and Drew Miller, Field Technicians

**COMPLETED**

May 2014



CRAYFISH WITH PIT TAG (PHOTO: J. DYER)



BOB MOLLENHAUER USING THE TOW BARGE IN AN OZARK STREAM (PHOTO: S. BREWER)



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



ORANGETHROAT DARTER FROM NORTHEAST OKLAHOMA (PHOTO: B. BROWN)

# Aquatic Resources

## ONGOING PROJECTS



10

### 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 growing 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 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 layers 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

#### EXPECTED COMPLETION

May 2018

### A general status assessment of blue suckers in Oklahoma rivers

Like many big-river obligate fishes in North America, Blue Suckers *Cycoreptus 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

#### EXPECTED COMPLETION

December 2018



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

**Evaluating the effectiveness of stream restoration projects based in natural channel design concepts using 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, research training, insight to graduate programs, and experienced mentoring.

**FUNDING**

National Science Foundation

**FACULTY INVESTIGATORS**

Shannon K. Brewer and Garey A. Fox

**EXPECTED COMPLETION**

August 2018



DR. SHANNON BREWER AND DR. GAREY FOX WITH REU STUDENTS FOLLOWING THEIR FINAL PRESENTATIONS (PHOTO: XXXXX)

**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. Inability to adequately monitor cavefish and cave crayfish populations impedes conservation efforts. Our objective is to compare the use of eDNA to traditional visual surveys for monitoring cave fish and cave crayfish populations in the Ozark Highlands. We have completed visual surveys and eDNA collection at 1-5 survey locations at 42 caves, wells, and springs. We are currently extracting and amplifying DNA from the water samples to determine presence of cavefish and cave crayfish DNA.

**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

**EXPECTED COMPLETION**

December 2018



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

**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), which occupies the southwest edge of the species' native range. We are using 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. We have completed two years of tracking and snorkel surveys for both young of year and nesting fish. We have one more year of tracking to complete prior to analyses.

**FUNDING**

Oklahoma Department of Wildlife Conservation

**FACULTY INVESTIGATOR**

Shannon K. Brewer

**STUDENT INVESTIGATOR**

Andy Miller, Ph.D. Candidate

**EXPECTED COMPLETION**

December 2019



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

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

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

### **EXPECTED COMPLETION**

December 2017

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

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

### **FUNDING**

U.S. Geological Survey

### **FACULTY INVESTIGATOR**

Shannon K. Brewer

### **STUDENT INVESTIGATOR**

Robert Mollenhauer, Postdoctoral Fellow

### **EXPECTED COMPLETION**

May 2019



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

## **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. It is considered vulnerable to extinction because of competition and genetic hybridization with invasive species and habitat loss. Within the upper Chattahoochee River basin, shoal bass are isolated in Big Creek below Lake Lanier and in the Chestatee and Chattahoochee rivers above Lake Lanier. Quantifying local-scale population dynamics of Shoal Bass inhabiting three isolated tributaries of the upper Chattahoochee River basin revealed that these populations grew slower, lived longer, and experienced lower annual mortality than other studied populations, which may be adaptations to variable recruitment or lower over-winter survival of age-0 fish. The Big Creek population appears at risk of extirpation because of its isolated nature, low numbers of adults, and greater variation in recruitment.

### **FUNDING**

U.S. National Park Service

### **FACULTY INVESTIGATOR**

James M. Long

### **INVESTIGATOR**

Andrew Taylor, Ph.D. Candidate

### **EXPECTED COMPLETION**

December 2017



ANDREW WITH A SHOAL BASS BEING TAGGED FOR TELEMETRY (PHOTO: A. TAYLOR)

**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, we set out to create environmental niche models of Longnose Darters at two scales: 1) river segment scale throughout the known range and 2) channel-unit scale within Lee Creek and project these models onto streams of the Poteau River basin. After mapping the habitat of the Poteau River system, the niche models will allow us to target future sampling events in areas of varying habitat suitability.

**FUNDING**

Oklahoma Department of Wildlife Conservation

**FACULTY INVESTIGATORS**

James M. Long and Monica Papes

**STUDENT INVESTIGATORS**

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

**EXPECTED COMPLETION**

December 2018



COLT WITH LONGNOSE DARTER (PHOTO: M. PALLETT)

**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 are surveying 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. Results to date indicate few places where reproduction is successful and variable age and growth among successful sites. At two sites, wild juvenile Rainbow Trout were hatched between February 17 and April 11, growing between 0.25 mm/day and 0.44 mm/day. Future work will focus on prey use and availability to provide insight into mechanisms affecting among-site variation in trout growth.

**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.

**EXPECTED COMPLETION**

June 2018



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

**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 and a backwater marsh of the Chattahoochee River, but it is unknown how widespread the eels have invaded. We are conducting intensive sampling with leaf litter traps for juveniles in an occupancy modeling framework to document the presence of the species. Our methods have documented that Asian Swamp Eels have expanded their range in the marshes of the river. Detection probability ranged from 0.20 to 0.37 depending on year and was influenced by trap depth and water temperature. Occupancy of a site was depending on proportion of vegetation and silt substrate, which we portrayed on a map to illustrate where this species could likely occur. Future work is investigating methods to control this invasive species.

**FUNDING**

U.S. National Park Service

**FACULTY INVESTIGATOR**

James M. Long

**STUDENT INVESTIGATORS**

Jeff Johnson, M.S. Candidate; Colt Holley, Matt Pallett, Courtney Anderson, Steven Nanez, Field Technicians.

**EXPECTED COMPLETION**

December 2018



JUVENILE ASIAN SWAMP EEL (PHOTO: J. JOHNSON)

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

Loss of shallow-water habitat (SWH) in the Missouri River has been identified as one of the likely contributing factors in the decline of Pallid Sturgeon, and to a lesser extent, Shovelnose Sturgeon. A primary hypothesized benefit of SWH is that increased prey items are present and result in 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, Jason Belden

#### STAFF INVESTIGATOR

Alin González-Barnes, Senior Research Specialist

#### EXPECTED COMPLETION

December 2020



AN ASSORTMENT OF PREY ITEMS AVAILABLE TO STURGEON IN THE LOWER MISSOURI RIVER (PHOTO: A. GONZÁLEZ)

### 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 22 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 from hydroacoustic samples scaled accurately with known density and were more precise (6.8% coefficient of variation of the mean) than has been reported for other shad-sampling gear. Therefore, we recommend horizontal hydroacoustics for sampling shad.

#### FUNDING

Oklahoma Department of Wildlife Conservation

#### FACULTY INVESTIGATOR

Dan Shoup

#### STUDENT INVESTIGATOR

Garrett R. Johnson, M.S. Candidate

#### EXPECTED COMPLETION

June 2018



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

### Quantifying seining detection probability for small-bodied fishes of Great Plains sand-bed rivers

Shifting sand-bed streams of the Great Plains represent a challenge to address stream fish detection error. We quantified seining detection probability for diminutive fishes across a range of sampling conditions in Great Plains rivers of Oklahoma. We observed a quadratic relationship between water depth and detection probability, which varied among species and was dependent on water clarity. Similarly, the direction of the relationship between water clarity and detection probability was species specific and dependent on water depth. The relationship between water temperature and detection probability was also species dependent. Our results support that differentiating between a true and false species absence can be obtained with 2-6 spatially-replicated seine hauls under average sampling conditions. However, detection probability was extremely low for the federally-threatened Arkansas River Shiner and >10 seine hauls per 200-m of stream would be needed to assess its presence.

#### FUNDING

U.S. Geological Survey, South-Central Climate Science Center

#### FACULTY INVESTIGATOR

Shannon K. Brewer

#### STUDENT INVESTIGATOR

Daniel Logue, M.S. Candidate

#### COMPLETED

December 2016

# Terrestrial Resources

## COMPLETED PROJECTS



### Influence of land use and the Conservation Reserve Program on native pollinator communities

This study determined how land use affects native invertebrate pollinator diversity in the Southern High Plains of Texas. The targeted land uses were playas and their associated uplands in cropland, Conservation Reserve Program, and native grasslands/rangeland. We collected pollinators using blue vane traps set out for ~ 24h in playas and uplands immediately surrounding wetlands. Pollinator diversity was measured and compared among land uses, and then between playas and uplands to determine playa contribution to pollination service. We also collected vegetation data every six weeks including vegetation species present, ground cover composition, plant height, and canopy gap. An additional component of the project determined the plant species on which pollinators were feeding. Through targeted hunting techniques, we captured pollinators feeding on flowers and documented these visits over the six-month field period.

**FUNDING**

U.S. Department of Agriculture, Farm Service Agency

**FACULTY INVESTIGATORS**

Loren Smith and Scott McMurry

**STUDENT INVESTIGATOR**

Angela Begosh, Ph.D. Candidate

**COMPLETED**

December 2016

### Impact of fragmentation and habitat heterogeneity on lesser prairie-chickens

We assessed lesser prairie-chicken (LPC) movement and habitat selection in relation to anthropogenic features. We found that LPC selected CRP land cover and avoided cropland. CRP also facilitated LPC road crossings. We found no evidence that LPCs avoided power lines, residential areas, or oil or gas wells. However, movements that crossed powerlines or roads were longer than expected, indicating that LPCs minimized time spent under/crossing these features. The anthropogenic landscape, including human-created vegetation types (CRP and cropland) and anthropogenic features, was a primary driver of LPC habitat selection and movement patterns. Human policy and management decisions can greatly impact the anthropogenic landscape for this sensitive species, therefore conservation planning should account for the arrangement of vegetation and anthropogenic features on the landscape.

**FUNDING**

Oklahoma Department of Wildlife Conservation

**FACULTY INVESTIGATORS**

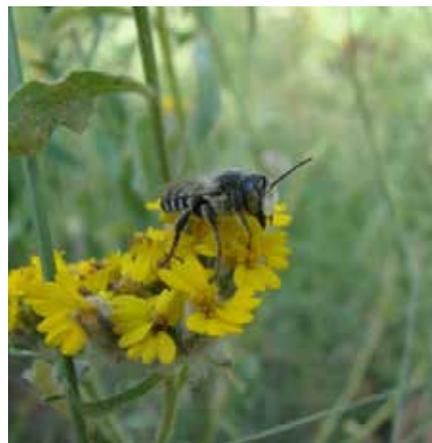
Dwayne Elmore, Sam Fuhlendorf, Craig Davis, and Mark Gregory

**STUDENT INVESTIGATOR**

Ashley Tanner, Ph.D. Candidate

**COMPLETED**

December 2015



BEE HELPING POLLINATE A FLOWER (PHOTO: L. SMITH)



ASHLEY TANNER HOLDING A CAPTURED LESSER PRAIRIE-CHICKEN (PHOTO: D. ELMORE)

### Range expansion of black bears in eastern Oklahoma

16

Populations of black bears are expanding in eastern Oklahoma. To better understand this process, we captured and marked 47 black bears (14 females, 33 males) in Sequoyah, Cherokee, and Adair counties in east-central Oklahoma. We also conducted hair snare surveys to develop a genetics based population estimate. The population estimate was  $69.7 \pm 13.2$  based on capture-recapture and  $100.9 \text{ bears} \pm 23.5$  (95% CI) based on genetics. Fecundity in this population was 0.36 female cubs/adult female/year. From population parameters measured in this study and data from neighboring Arkansas, projection matrices indicated growth rate ( $\lambda$ ) of 0.98. The heavily male-biased sex ratio and young age structure indicates east-central Oklahoma is the expansion front of this black bear population. Based on reproduction alone, this population is not yet self-sustaining..

**FUNDING**

Oklahoma Department of Wildlife Conservation

**FACULTY INVESTIGATORS**

Sue Fairbanks and David M. Leslie, Jr.

**STUDENT INVESTIGATORS**

Sara Lyda, Senior Research Specialist; Emily Artz, M.S.Candidate; Connie Teschner, Field Technician

**COMPLETED**

June 2016



A FIVE-WEEK-OLD MALE CUB OBSERVES HIS SURROUNDINGS FOR THE FIRST TIME WHILE RESEARCHERS ADJUST HIS MOTHER'S COLLAR. (PHOTO: S. LYDA)

### Arthropod availability and bobwhite quail nesting success

Bobwhite quail feed on arthropods in early spring, and chicks rely almost exclusively on insects and other invertebrates until at least 4 weeks of age. Hens may use available arthropod prey in assessing potential nesting sites because it is critical to survival of chicks in their first weeks of life. Vegetation and landscape structure may also relate to preferred arthropod abundance as a determinate of brood habitat quality. Spring and summer arthropod sampling was coordinated with habitat manipulation and radio telemetry studies. Up to 14 species of ants and 43 species of grasshoppers have been documented and their abundances were associated with differences in vegetation gradients in study areas.

**FUNDING**

Oklahoma Department of Wildlife Conservation

**FACULTY INVESTIGATORS**

Carmen Greenwood and David M. Leslie, Jr.

**STUDENT INVESTIGATORS**

Valerie O'Brien, Postdoctoral Fellow; Alli Giguere, Kenneth Masloski, and Shane Foye, M.S. Candidates; John Baggerly, Colby Gregg, Cassie Hamilton, and Ariel Richter, Field Technicians

**COMPLETED**

July 2015



KENNETH COMPARING SAMPLING TECHNIQUES FOR GRASSHOPPERS (C. GREENWOOD PHOTO)

### Effects of Fragmentation on small mammal communities in the Lower Rio Grande Valley, Texas

The Lower Rio Grande Valley National Wildlife Refuge includes >147 tracts, many in the Rio Grande's threatened riparian corridor. We determined responses of small mammals to habitat fragmentation, measured connectivity among small mammal use of the native-agricultural matrix surrounding refuge tracts, and used landscape genetics to determine the potential for long-term persistence of small mammal species in tracts of varying size and quality. Small mammals were sampled over 4 seasons on 15 tracts of varying size and extant riparian vegetation for 8,250 trap-nights with an overall 62% trapping success. The small mammal community was dominated by white-footed mice, but also included Coues' rice rat, a species considered threatened in Texas. Urbanization affected gene flow of white-footed mice, whereas no gene-flow effect was found in agricultural areas.

**FUNDING**

U.S. Fish and Wildlife Service, Oklahoma Cooperative Fish and Wildlife Research Unit

**FACULTY INVESTIGATORS**

David M. Leslie, Jr., Monica Papeş, Timothy J. O'Connell, and Ron A. Van Den Bussche

**STUDENT INVESTIGATOR**

Richard Dolman, Ph.D. Candidate

**COMPLETED**

July 2015



ALLISON QUANTIFYING ANT COMMUNITIES (C. GREENWOOD PHOTO)

## Range-wide lesser prairie-chicken spatial targeting tool

This project assisted with finalizing the cooperative 5-state Lesser Prairie Chicken (LPC) Spatial Model and Western Governors' Association Crucial Habitat Assessment Tools (CHAT) Project. We helped to expand the first version of the Southern Great Plains (SGP) CHAT and create a more robust spatial planning tool (SPT) for directing conservation for the lesser prairie-chicken. This tool was a critical component for agency planning, because it was important that agencies providing conservation for lesser prairie-chicken worked from the same source data for maximum benefit to the species and its habitat. The 5-state wildlife conservation agencies in the lesser prairie-chicken's distribution (Colorado, New Mexico, Kansas, Oklahoma, and Texas), the Natural Resources Conservation Service, and the U.S. Fish and Wildlife Service adopted the first version of the SGP-CHAT as their primary planning tool for LPC conservation.

### FUNDING

Oklahoma Department of Wildlife Conservation

### FACULTY INVESTIGATOR

David M. Leslie, Jr.

### STUDENT INVESTIGATORS

Brian Cunningham and Cara Caricato-Michalke, Senior Research Specialists

### COMPLETED

May 2014

## Conservation status of the Lower Rio Grande Valley, Texas

Twenty-six years ago, Jahrsdoerfer and Leslie synthesized existing data and literature for the Lower Rio Grande Valley (LRGV) of extreme southern Texas, providing natural-history descriptions of plant and animal communities with a focus on human impacts and management options. The U.S. Fish and Wildlife Service maintains 3 national wildlife refuges in the LRGV, and conservation of critical habitats and species has been an ongoing challenge in the past 26 years relative to the greatly expanded human population and resulting urbanization, homeland security, escalating land prices, etc. Nearly 500 peer-reviewed publications, published since 1988, with specific focus on some aspect of the ecology, management, and conservation of the LRGV were synthesized in an updated report with scientific and managerial insights gained in the past 26 years to enhance understanding and highlight conservation needs of the LRGV.

### FUNDING

U.S. Fish and Wildlife Service

### FACULTY INVESTIGATOR

David M. Leslie, Jr.

### COMPLETED

December 2016

## Biases of collision mortality data from wind energy development on U.S. wildlife

Hundreds of thousands of bats die annually by colliding with U.S. wind turbines, yet little is known about factors causing variation in mortality. We conducted a quantitative synthesis of 218 studies at 100 wind facilities. This data set, the largest compiled for bats to date, indicates that collision mortality is greatest for migratory tree-roosting species (Hoary Bat, Eastern Red Bat, Silver-haired Bat) and from July to October. Based on studies meeting inclusion criteria and analyzed under a common statistical framework, we found an inverse relationship between bat mortality and grassland cover surrounding wind facilities. Grassland cover is associated with reduced activity and abundance of tree-roosting bats, which may also reduce turbine collisions. Further representative sampling of wind energy facilities is required to validate this pattern. Ecologically informed placement of wind facilities involves not only consideration regarding bat mortality, but also factors associated with bird mortality and indirect ecosystem impacts.

### FUNDING

U.S. Geological Survey

### FACULTY INVESTIGATOR

Scott Loss

### STUDENT INVESTIGATOR

Maureen Thompson, M.S. Candidate

### COMPLETED

December 2015



A WINDMILL ON THE PRAIRIE (PHOTO: D. ELMORE)

## Influence of spatial distribution of predators on northern bobwhite quail

18 Northern bobwhite quail are susceptible to predation from multiple avian and mammalian predators. In addition to direct losses, the recurring presence of predators in certain areas might cause quail to avoid those areas, rendering otherwise suitable habitat to be unsuitable. We modeled the annual spatial distribution of carnivores and raptors to create overlays that can be compared with the spatial distribution of quail from companion research. Results suggested that high-use areas of mammalian predators might be avoided by nesting quail, but raptors overlap more broadly with quail occurrence, especially in winter. Numerous conference presentations were delivered, one student investigator successfully defended a thesis, and all field work was completed during the reporting period.

### FUNDING

Oklahoma Department of Wildlife Conservation

### FACULTY INVESTIGATORS

Timothy J. O'Connell and David M. Leslie, Jr.

### STUDENT INVESTIGATORS

Fidelis Atuo, Ph.D. Candidate; Jonathan Harris, M.S. Candidate; Case Wyatt, Nathan Hillis, Alicia Maple, and Jodie Crose, Field Technicians

### COMPLETED

July 2017



FIDEL ATUO WALKING TO A RAPTOR SURVEY POINT (PHOTO: J. CROSE)

## Wildlife exposure to aflatoxins in supplemental feed

Wildlife can be exposed to aflatoxins in contaminated grain during supplemental feeding. Greenhouse trials were conducted in 2013 to compare the environmental factors that contribute to aflatoxin formation. Results suggested that aflatoxins in wildlife feed can be reduced by selecting milo instead of corn, broadcasting grain instead of distributing in piles, and limiting the length of time that grain persists before ingestion. Feeding should be avoided during wet conditions when daily temperatures exceed 18°C. Those involved in wildlife feeding/baiting are urged to weigh the possible benefits with the known risks that supplemental feeding may pose to wildlife species. An Extension Fact Sheet was developed, providing guidelines to landowners for supplemental wildlife feeding.

### FUNDING

Oklahoma Department of Wildlife Conservation

### FACULTY INVESTIGATORS

Timothy J. O'Connell, Dwayne Elmore, and Jason Belden

### STUDENT INVESTIGATOR

Leah Dale, M.S. Candidate

### COMPLETED

June 2014



A MISSISSIPPI KITE NESTLING AT PACKSADDLE WMA (PHOTO: F. ATUO)

## Western fence lizards as a reptile model to assess ingestion of depleted uranium

We conducted a collaborative research project with the U.S. Army Engineering Research and Development Center. Many wildlife species, including reptiles, may be exposed to compounds found on military bases, including depleted uranium (DU). Reptiles have been largely neglected in ecological risk assessment analyses primarily due to the lack of a laboratory reptile model. The western fence lizard was evaluated as a possible reptile model for estimating the potential for trophic transfer of DU from terrestrial invertebrates to terrestrial vertebrates. Understanding how DU travels through the food web and where burdens are likely to be found within the subject's body is ultimately critical for assessing environmental risks. Mealworms were exposed to DU contaminated food, allowed to bioaccumulate, and fed to the fence lizard via forced ingestion.

### FUNDING

U.S. Army Corps of Engineers

### FACULTY INVESTIGATOR

Larry Talent

### STUDENT INVESTIGATORS

Anissa Delecki, Ph.D. Candidate; Scott Talent, Lab Technician

### COMPLETED

September 2014



WESTERN FENCE LIZARDS (PHOTO: L. TALENT)

# Terrestrial Resources

## ONGOING PROJECTS



### 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

#### EXPECTED COMPLETION

July 2017

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

We assessed movement and space use of 25 female Rio Grande wild turkeys during June-August, 2016 using GPS transmitters on which recorded locations every 2 hours from 0800-2000 daily. We also measured temperatures for turkey locations and random locations. We found that during peak heating (1200-1600 hours), locations where turkeys loaf (1400 hour turkey locations) were up to 6°C cooler than the locations at which turkeys feed (0800 hour turkey locations). Additionally, turkeys moved an average of 90m less between successive locations during the hours of peak heating (1200-1600 hours) on days >30°C than on days where temperature remained <30°C. These findings suggest that turkeys may be using the thermal variation across the landscape to help mitigate thermal extremes during the hours of peak heating and are modifying behavior to minimize exposure to high heat.

#### FUNDING

Oklahoma Department of Wildlife Conservation

#### FACULTY INVESTIGATORS

Dwayne Elmore, Craig Davis, and Sam Fuhlendorf

#### STUDENT INVESTIGATOR

Allison Rakowski, M.S. Candidate

#### EXPECTED COMPLETION

June 2018



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

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

Shinnery oak contributes to an ecologically unique biotic community in the Southern Great Plains, yet little research exists related to its management and restoration. We are 1) examining environmental constraints on germination and transplanting, 2) assessing environmental parameters that influence seedling survival, 3) identifying target areas for restoration, and 4) conducting surveys to examine the influence of vegetation structure on density of Bell's vireo and Cassin's sparrow in a shinnery oak community. Ultimately, we will address key factors that may currently be limiting the ability of land managers to restore and maintain shinnery oak on the landscape in order to benefit wildlife species of conservation concern. Preliminary results indicate that acorns have higher germination rates than rhizome sprouting rates, cold stratification increases acorn germination, and shading decreases seedling survival.

#### FUNDING

Oklahoma Department of Wildlife Conservation

#### FACULTY INVESTIGATORS

Dwayne Elmore, Craig Davis, and Sam Fuhlendorf

#### STUDENT INVESTIGATOR

Matt Carroll, Postdoctoral Fellow

#### EXPECTED COMPLETION

December 2018



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

### Reassessing black bear status in southeastern Oklahoma

Black bears have been hunted in southeastern Oklahoma since 2009, following extensive research demonstrating an expanding, harvestable population. To investigate impacts of the hunting season, we captured and marked 122 individual bears (65 females, 57 males) and estimated population level parameters. From winter dens surveys, fecundity was estimated at  $0.58 \pm 0.11$  female cubs/adult female/year. The population estimate for the core area was  $175.0 \pm 79.2$  bears (95% CI). Expanded efforts to include all 4 counties in which black bear hunting occurs will ultimately provide a population estimate for this expanding population. Using population parameters from this study, the estimated asymptotic growth rate ( $\lambda$ ) was 1.06. Some evidence suggested prescribed fire affected habitat selection at the landscape level, but was more equivocal at the home range level.

#### FUNDING

Oklahoma Department of Wildlife Conservation

#### FACULTY INVESTIGATORS

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

#### EXPECTED COMPLETION

June 2018



A 3-YEAR-OLD FEMALE BLACK BEAR DENS IN A GROUND NEST WITH HER FIRST LITTER OF 3 CUBS (PHOTO: S. LYDA)



RESEARCHERS COLLECT MORPHOLOGICAL MEASUREMENTS FROM A SEDATED BLACK BEAR DURING SUMMER TRAPPING; COURTNEY DOTTERWEICH, WILL CHILDRESS, ERICA PEREZ, KATHERINE WILLIAMS (PHOTO: S. LYDA)



A COLLARED FEMALE BLACK BEAR DENS IN A GROUND EXCAVATION IN THE OUACHITA MOUNTAINS WITH TWO CUBS (PHOTO: S. LYDA)



ERICA PEREZ, M. S. CANDIDATE, REPLACES THE COLLAR OF A DENNING FEMALE BLACK BEAR IN THE OUACHITA MOUNTAINS (PHOTO: S. LYDA)

## Ecological Assessment of Ozark watersheds using breeding birds

This project aims to increase our understanding of riparian forest and watershed condition that supports a suite of priority, riparian-associated songbirds in the Oklahoma portion of the Ozark Mountains ecoregion. Focusing on first- and second-order streams, we aim to refine information on the distribution and abundance of songbirds in Ozark forests, using a combination of broad land cover and fine-scale vegetation cover and composition in small watersheds. During the reporting period, we established the field sampling protocol and completed year 1 surveys. We surveyed 150 points along 30 stream reaches Adair, Delaware, and Cherokee counties. We documented at least 60 species of breeding birds in rich forests where we found at least 48 species of canopy trees. Preliminary analysis suggested that distribution of riparian-associated songbirds was determined largely by fine scale horizontal cover.

### FUNDING

Oklahoma Department of Wildlife Conservation

### FACULTY INVESTIGATOR

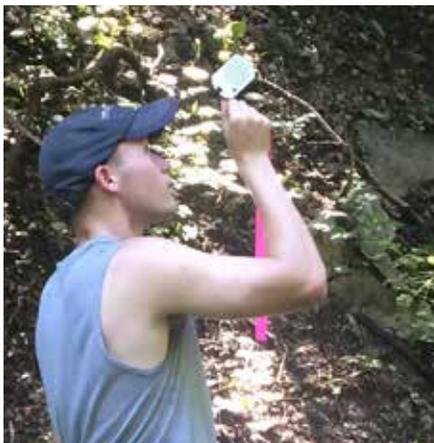
Tim O'Connell

### STUDENT INVESTIGATORS

Samantha Cady, M.S. Candidate; Katie Schwartz, Kasey Goins, and Alex James, Field Technicians

### EXPECTED COMPLETION

June 2018



FIELD TECHNICIAN ALEX JAMES ESTIMATING TREE CANOPY HEIGHT WITH A CLINOMETER (PHOTO: S.CADY)

## Monitoring for priority grassland birds in the Oklahoma Oaks and Prairies

With partners from the Oaks and Prairies Joint Venture, we began in 2014 a monitoring program for priority grassland birds across 10 Oklahoma counties supporting cross timbers and tallgrass prairie land cover. As part of an intended 10-year effort, we conducted roadside point counts for breeding birds using an established method to account for differences in detectability among species and observers. We paired survey locations, modeled after the North American Breeding Bird Survey, with land cover data to analyze habitat use and selection for multiple species, including northern bobwhite quail. The objective is to provide data at fine and regional scales to reveal benefits from and suggest modifications to habitat protection incentive programs on private lands.

### FUNDING

American Bird Conservancy, Oaks and Prairies Joint Venture

### FACULTY INVESTIGATOR

Timothy J. O'Connell

### STUDENT INVESTIGATORS

Nicolas Jaffe, M.S. Candidate; Kelly Boyer, Abbey Ramirez, Callan Pope, Zoe Cooper, Jonathan Harris, and Katie Schwartz, Field Technicians

### EXPECTED COMPLETION

December 2024



BOBWHITE QUAIL ON THE PRAIRIE (PHOTO: R. BEYKE)



AN IMMATURE RED-TAILED HAWK SCANS FOR PREY (PHOTO: F. ATUO)



A STREAM RUNS THROUGH A VERDANT OZARK FOREST (PHOTO: S.CADY)

# Scholarly Output

01 JAN 2014  
31 DEC 2016



## Awards And Honors

**Fidelis Atuo** (Ph.D. student; advisor, O'Connell) received the Robert L. Lochmiller II Endowed Scholarship in Wildlife Ecology, Oklahoma State University (2014), travel award to attend the joint annual meeting of the Wilson Ornithological Society and Association of Field Ornithologists (2014), Williams Distinguished Graduate Student Fellowship, Oklahoma State University (2016), Best Poster Presentation Award, Fall 2016 Technical Meeting of the Oklahoma Ornithological Society (2016), and a travel award to attend the 6th North American Ornithological Conference (2016).

**Shannon Brewer** (Unit Scientist) received a performance award from U.S. Geological Survey (2014, 2015, 2016).

**Matt Carroll** (Ph.D. student; advisor, Davis), **Craig Davis**, **Sam Fuhrendort**, and **Dwayne Elmore** (Unit Cooperating Faculty) received the Outstanding Peer-Reviewed Publication Award from the Oklahoma Chapter of The Wildlife Society (2016).

**Anthony Civiello** (M.S. student; advisor, Long) received the Robert A. Klumb Student Travel Grant from the Missouri River Natural Resources Committee (2015).

**Leah Dale** (M.S. student; advisor, O'Connell) was a semifinalist at the 3-minute thesis competition, College of Agricultural Science and Natural Resources, Oklahoma State University (2014).

**Craig Davis** (Unit Cooperating Faculty) received the Texas Tech University, Department of Natural Resource Management, Outstanding Alumnus Award (2016).

**Joseph Dyer** (Ph.D. student; advisor, Brewer) received Bridge to Doctorate Fellowship, National Science Foundation (2014), Jimmie Pigg Travel Scholarship, Oklahoma Chapter of the American Fisheries Society (2014), Best Student Presentation, Oklahoma Chapter of the American Fisheries Society (2014), and the Murray-Gray Unit Service Award, Oklahoma Cooperative Fish and Wildlife Research Unit (2015).

**Jonathan Harris** (M.S. student; advisor, O'Connell) received a travel award to attend the Joint Annual Meeting of the American Ornithologists' Union, Cooper Ornithological Society, and Society of Canadian Ornithologists (2014).

**Richard Hatcher** (ODWC Director [retired]) received the Murray-Gray Unit Service Award, Oklahoma Cooperative Fish and Wildlife Research Unit (2016).

**Chip Leslie** (Unit Scientist [retired]) received a performance award from U.S. Geological Survey (2014, 2015).

**James Long** (Unit Scientist) received a performance award from U.S. Geological Survey (2014, 2015, 2016).

**Kenneth Maslowski** (Ph.D. student; advisor, Greenwood) received a 3rd place oral presentation award from the Entomological Society of America, Southwest Branch meeting (2014).

**Cheryl McKnight** (Unit Senior Administrative Support Specialist) received the Murray-Gray Unit Service Award, Oklahoma Cooperative Fish and Wildlife Research Unit (2016).

**Bob Mollenhauer** (Ph.D. student; advisor, Brewer) received Outstanding Oral Presentation, Awarded by the Oklahoma Water Science Center (2015), Williams Distinguished Graduate Student Fellowship, Oklahoma State University (2015), Skinner Memorial Travel Award, American Fisheries Society (2016), Best Student Presentation, Oklahoma Chapter of the American Fisheries Society (2016), and Outstanding Graduate Student in Fisheries Scholarship, Oklahoma State University (2016).

**Trevor Starks** (M.S. student; advisor, Long) received the Jimmie Pigg Travel Scholarship, Oklahoma Chapter of the American Fisheries Society (2015).

**Andrew Taylor** (Ph.D. student; advisor, Long) received the Jimmie Pigg Memorial Outstanding Student Achievement Award from the Southern Division American Fisheries Society Warmwater Streams Committee (2016), the Outstanding Graduate Student in Fisheries, Oklahoma State University, NREM Department (2015), the Otto S. Cox Graduate Fellowship for Genetics Research, Oklahoma State University (2014), the Jimmie Pigg Travel Scholarship, Oklahoma Chapter of the American Fisheries Society (2014), and the Don L. Brumbaugh Scholarship, Sonotronics Inc. (2014).

## Theses and Dissertations

**Emily Artz**. 2016. Genetic mark-recapture abundance estimate and dietary preferences in a recently re-established American black bear population. Master's Thesis. Oklahoma State University, Stillwater. (Advisor, Fairbanks)

**Matt Carroll**. 2015. Connecting environmental factors with northern bobwhite quail (*Colinus virginianus*) movement and habitat use patterns under a fire and grazing management regime in a semiarid region. Doctoral Dissertation. Oklahoma State University, Stillwater. (Advisor, Davis)

**Evan Cartabiano**. 2014. Resilience of fish communities to extreme drought at Salt Plains National Wildlife Refuge: implications for endangered migratory birds and consequences of climate change. Master's Thesis. Oklahoma State University, Stillwater. (Advisor, Long)

**Leah Dale**. 2014. Supplemental feeding of Northern Bobwhites: potential for aflatoxicosis. Master's Thesis. Oklahoma State University, Stillwater. (Advisor, O'Connell)

**Richard W. Dolman**. 2015. Small mammal communities and functional connectivity in the Lower Rio Grande Valley: a landscape perspective. Doctoral Dissertation. Oklahoma State University, Stillwater. (Advisor, Leslie)

**Joseph J. Dyer**. 2014. The impact of flow alterations to crayfishes in southeastern Oklahoma, with an emphasis on the mena crayfish (*Orconectes mena*). Master's Thesis, Oklahoma State University, Stillwater. (Advisor, Brewer)

**Nicole Farless**. 2015. The influence of flow alteration on instream habitat and fish assemblages. Master's Thesis. Oklahoma State University, Stillwater. (Advisor, Brewer)

**Shane Foye**. 2015. Ground-dwelling arthropod forage of Northern bobwhite quail chicks. Doctoral Dissertation. Oklahoma State University, Stillwater. (Advisor, Greenwood)

**Allison Guigere**. 2014. Resource partitioning in ant communities of arid grasslands in western Oklahoma. Master's Thesis. Oklahoma State University, Stillwater. (Advisor, Greenwood)

**Jonathan Harris.** 2015. Estimating mesopredator predation risk for northern bobwhite. Master's Thesis. Oklahoma State University, Stillwater. (Advisor, O'Connell)

**Kenneth Masloski.** 2014. Comparative analysis of novel and traditional sampling methodology for Acrididae in arid grasslands. Effects of a vegetative gradient on arthropod forage of Northern bobwhite quail chicks. Doctoral Dissertation. Oklahoma State University, Stillwater. (Advisor, Greenwood)

**Robert Mollenhauer.** 2016. Sampling the stream landscape: Factors influencing detection and distribution of stream fishes. Doctoral Dissertation. Oklahoma State University, Stillwater. (Advisor, Brewer)

**Reid Morehouse.** 2014. Species distributions and trait-environment correlations: Implications for the evolutionary ecology of crayfish (Decapoda: Cambaridae). Doctoral Dissertation. Oklahoma State University, Stillwater. (Advisor, Tobler)

**W. Chris Musselman.** 2014. The importance of maintaining shallow-water habitats for the movement and survival of stream fishes. Master's Thesis. Oklahoma State University, Stillwater. (Advisor, Brewer)

**Jeremy Orange.** 2015. Northern bobwhite (*Colinus virginianus*) and scaled quail (*Callipepla squamata*) chick survival and alternative reproductive strategies in western Oklahoma. Master's Thesis. Oklahoma State University, Stillwater. (Advisor, Davis)

**Morgan Pfander.** 2016. American black bear ecology in southeastern Oklahoma: population status and capture methodology. Master's Thesis. Oklahoma State University, Stillwater. (Advisor, Fairbanks)

**Jarrod Powers.** 2016. Factors related to the distribution of freshwater mussels on Muddy and Clear Boggy rivers. Master's Thesis. Oklahoma State University, Stillwater. (Advisor, Brewer)

**Richard A. Snow.** 2014. Validation of daily ring formation in otoliths of Alligator Gar. Master's Thesis. Oklahoma State University, Stillwater. (Advisor, Long)

**Trevor Starks.** 2015. Larval fish ecology in restored habitats in the lower Missouri River. Master's Thesis. Oklahoma State University, Stillwater. (Advisor, Long)

**Christopher D. Tanner.** 2014. The effects of water quantity on water quality and fish community composition in the upper Cimarron River, Oklahoma. Master's Thesis. Oklahoma State University, Stillwater. (Advisor, Long)

**Evan Tanner.** 2015. The climate of *Colinus* and *Callipepla*: Current patterns with future implications. Doctoral Dissertation. Oklahoma State University, Stillwater. (Advisor, Elmore)

**Maureen Thompson.** 2015. Predictors of bat mortality rates at North American wind facilities and an evaluation of biases influencing mortality estimates. Master's Thesis. Oklahoma State University, Stillwater. (Advisor, Loss)

## Publications

**Atuo, F.A., N. Hillis, and T. O'Connell.** 2014. Photographic confirmation of Scaled Quail in Ellis County. Bulletin of the Oklahoma Ornithological Society 47:1-4.

**Birdsong, T.W. M.S. Allen, J.E. Claussen, G.P. Garrett, T.B. Grabowski, J. Graham, F. Harris, A. Hartzog, D. Hendrickson, R.A. Krause, J.K. Leitner, J.M. Long, C.K. Metcalfe, D.P. Philipp, W.F. Porak, S. Robinson, S.M. Sammons, S. Shaw, J.E. Slaughter, and M.D. Tringali.** 2015. Native black bass initiative: implementing watershed-scale approaches to conservation of endemic black bass and other native fishes in the southern United States. Pages 363-378 in Tringali, M.D., J.M. Long, T.W. Birdsong, and M.S. Allen, editors. Black bass diversity: multidisciplinary science for conservation. American Fisheries Society, Symposium 82, Bethesda, Maryland.

**Brewer, S.K.** 2014. Smallmouth Bass. Pages 380-382 in Kansas Fishes Committee, editors. Kansas Fishes, University of Kansas Press.

**Brewer S.K. and M. Davis.** 2014. Gulf Coast Prairie Landscape Conservation Cooperative regional hypotheses of ecological responses to flow alteration. U.S. Department of Interior, Fish and Wildlife Service, Cooperator Science Series FWS/CSS-108-2014, Washington, D.C.

**Brewer, S.K. and J.J. Dyer.** 2014. The impacts of flow alterations to crayfishes in southeastern Oklahoma, with an emphasis on the Mena crayfish (*Orconectes menae*). U.S. Department of Interior, Fish and Wildlife Service, Cooperator Science Series FWS/CSS-105-2014, Washington, D.C.

**Brewer, S.K. and J.M. Long.** 2015. Biology and ecology of genetically distinct Neosho and Ouachita Smallmouth Bass. Pages 281-295 in Tringali, M.D., J.M. Long, T.W. Birdsong, and M.S. Allen, editors. Black Bass Diversity: Multidisciplinary Science for Conservation. American Fisheries Society Symposium 82, Bethesda.

**Brewer, S.K., R.A. McManamay, A.D. Miller, R. Mollenhauer, T. Worthington, and T. Arsuoff.** 2016. Advancing environmental flow science: Developing frameworks for altered landscapes and integrating efforts across disciplines. Environmental Management 58:175-192. DOI: 10.1007/s00267-016-0703-5.

**Brewer, S.K. and W.C. Musselman.** 2014. Habitat use and movement by fishes using shallow-water habitats in three scenic rivers in Oklahoma. U.S. Department of Interior, Fish and Wildlife Service, Cooperator Science Series FWS/CSS-110-2014, Washington, D.C.

**Brewer, S.K. and D.J. Orth.** 2015. Species conservation profile of the Smallmouth Bass *Micropterus dolomieu*. Pages 9-26 in Tringali, M.D., J.M. Long, T.W. Birdsong, and M.S. Allen, editors. Black Bass Diversity: Multidisciplinary Science for Conservation. American Fisheries Society Symposium 82, Bethesda.

**Brewer, S.K. and J. Powers.** 2014. Developing a multiple spatial scale model to predict the distribution of Oklahoma's freshwater mussel assemblages with an emphasis on the small rivers of southeastern Oklahoma. U.S. Department of Interior, Fish and Wildlife Service, Cooperator Science Series FWS/CSS-113-2015, Washington, D.C.

**Carroll, M.J., C.A. Davis, R.D. Elmore, S.D. Fuhlendorf.** 2015. A ground nesting Galliform's response to thermal heterogeneity: implications for ground-dwelling birds. PLoS ONE DOI: 10.1371/journal.pone.0143676.

**Carroll, M.J., C.A. Davis, R.D. Elmore, S.D. Fuhlendorf, and E.T. Thacker.** 2015. Thermal patterns constrain diurnal behavior of ground-dwelling bird. Ecosphere 6(11): art222.

**Carroll, J.M., C.A. Davis, R.D. Elmore, and S.D. Fuhlendorf.** 2016. Response of northern bobwhite movements to management-driven disturbance in a shrub dominated ecosystem. Rangeland Ecology & Management 70:175-182.

**Carroll, M.J., C.A. Davis, S.D. Fuhlendorf, and R.D. Elmore.** 2016. Landscape pattern is critical for the moderation of thermal extremes. Ecosphere 7(7):art e01403.

**Cartabiano, E.C., D.R. Stewart, and J.M. Long.** 2015. Effect of bait and gear type on turtle bycatch and Channel Catfish population parameter estimates in a reservoir. Journal of Freshwater Ecology 30:407-415.

**Carter, T.S., M. Superina, and D.M. Leslie, Jr.** 2016. *Priodontes maximus* (Cingulata: Dasypodidae). Mammalian Species 48(932):21-34.

**Crosby, A.D., R.D. Elmore, D.M. Leslie, Jr. and R.E. Will.** 2015. Looking beyond rare species as umbrella species: Northern bobwhite and conservation of grassland and shrubland birds. Biological Conservation 186:233-240.

**Dakin, E.E., B.A. Porter, B.J. Freeman, and J.M. Long.** 2015. Hybridization threatens Shoal Bass populations in the upper Chattahoochee River basin. Pages 491-502 in Tringali, M.D., J.M. Long, T.W. Birdsong, and M.S. Allen, editors. Black bass diversity: multidisciplinary science for conservation. American Fisheries Society, Symposium 82, Bethesda, Maryland.

**Dale, L., T. O'Connell, and R. D. Elmore.** 2015. Aflatoxins in wildlife feed: Know how to protect wildlife. Oklahoma Cooperative Extension Service, fact sheet NREM 9021.

**Dale, J. C.B. Zou, W.J. Andrews, J.M. Long, Y. Liang, and L. Qiao.** 2015. Climate, water use, and land surface transformation in an irrigation intensive watershed - streamflow responses from 1950 through 2010. Agricultural Water Management 160:144-152.

**Davis M. and S.K. Brewer.** 2014. Gulf Coast Prairie Landscape Conservation Cooperative regional hypotheses of ecological responses to flow alteration. U.S. Department of Interior, Fish and Wildlife Service, Cooperator Science Series FWS/CSS-107-2014, Washington, D.C.

**Diffendorfer, J.E., Erickson, R., Heist, K., Johnson, D.H., Loss, S.R., Thogmartin, W., Merrill, M., Corum, M.** 2015. Draft methodology to assess the impact of wind energy development on birds and bats. U.S. Geological Survey, Scientific Investigations Report 2015-5066, 40 p. <http://dx.doi.org/10.3133/sir20155066>.

**Dyer, J.J., J. Mouser, and S.K. Brewer.** 2016. Habitat use and growth of the Western Painted Crayfish *Orconectes palmeri longimanus*. Journal of Crustacean Biology 36:172-179. DOI: 10.1163/1937240X-00002417.

**Dyer, J.J., T.A. Worthington, and S.K. Brewer.** 2015. Response of narrow-range crayfish to hyporheic water availability and excess sedimentation. Hydrobiologia 747:147-157. DOI: 10.1007/s10750-014-2126-8.

**Earl, J.E., S.D. Fuhlendorf, D. Haukos, A.M. Tanner, R.D. Elmore, and S.A. Carleton.** 2016. Characteristics of lesser prairie-chicken (*Tympanuchus pallidicinctus*) long-distance movements across their distribution. Ecosphere 7(8): art e01441.

**Foye, S., C. Greenwood, M. Payton and K. Masloski.** 2015. Ground-dwelling arthropod communities related to nesting success of Northern Bobwhite at two western Oklahoma Wildlife Management Areas. Southwestern Entomologist 40:463-478.

**Gatlin, M.R., J.M. Long, and D.J. Turton.** 2015. Observational changes to the natural flow regime in Lee Creek in relation to altered precipitation patterns and its implications for fishes. *Proceedings of the Oklahoma Academy of Science* 95:135-146.

**Gosch, N.J.C., M.L. Miller, T.R. Gemeinhardt, T.A. Starks, A.P. Civiello, J.M. Long, and J.L. Bonneau.** 2016. Prey consumption and preference of age-0 sturgeon in the lower Missouri River. *River Research and Applications* 32:1819-1823.

**Lee, D.N., R.C. Stark, W.L. Puckette, M.J. Hamilton, D.M. Leslie, Jr., and R.A. Van Den Bussche.** 2015. Population connectivity of endangered Ozark big-eared bats (*Corynorhinus townsendii ingens*). *Journal of Mammalogy* 96:522-530.

**Leslie, D.M., Jr.** 2014. Letters to a young scientist by E. O. Wilson (book review). *Journal of Mammalogy* 95:431.

**Leslie, D.M., Jr.** 2016. An international borderland of concern: conservation of biodiversity in the Lower Rio Grande Valley. U.S. Geological Survey Scientific Investigations Report 2016-5078:i-xii, 1-120.

**Leslie, D.M., Jr.** 2016. Enhancing the future of BioScience. *BioScience* 66:435.

**Leslie, D.M., Jr.** 2016. Bovids of the world: antelopes, gazelles, cattle, goats, sheep, and relatives (book review). *Journal of Wildlife Management* 81:554.

**Leslie, D.M., Jr., and B.A. Huffman.** 2015. *Potamochoerus porcus* (Artiodactyla: Suidae). *Mammalian Species* 47(919):15-31.

**Long, J.M.** 2014. Spotted bass. Pages 383-384 in Kansas Fishes Committee, editor. *Kansas Fishes*, University Press of Kansas, Lawrence.

**Long, J.M., M.S. Allen, W.F. Porak, and C.D. Suski.** 2015. An historical perspective of black bass management in the United States. Pages 99-122 in Tringali, M.D., J.M. Long, T.W. Birdsong, and M.S. Allen, editors. *Black bass diversity: multidisciplinary science for conservation*. American Fisheries Society, Symposium 82, Bethesda, Maryland.

**Long, J.M., B.L. Barthel, W.F. Porak, M.S. Allen, T.W. Birdsong, J.E. Slaughter, and M.D. Tringali.** 2015. Black bass diversity: bringing rare species into conservation focus. Pages xi-xiv in Tringali, M.D., J.M. Long, T.W. Birdsong, and M.S. Allen, editors. *Black bass diversity: multidisciplinary science for conservation*. American Fisheries Society, Symposium 82, Bethesda, Maryland.

**Long, J.M., Y. Liang, D.E. Shoup, A.R. Dzialowski, and J.R. Bidwell.** 2014. GIS-based rapid-assessment of bighead carp *Hypophthalmichthys nobilis* (Richardson, 1845) suitability in reservoirs. *Management of Biological Invasions* 5:363-370.

**Long, J.M. and R.T. Melstrom.** 2016. Measuring the relationship between sportfishing trip expenditures and anglers' species preferences. *North American Journal of Fisheries Management* 36:731-737.

**Long, J.M. and R.A. Snow.** 2016. Ontogenetic development of otoliths in a living fossil fish species, the Alligator Gar (*Atractosteus spatula*). *Transactions of the American Fisheries Society* 145: 537-544.

**Long, J.M., T.A. Starks, T. Farling, and R. Bastarache.** 2016. Assessing the potential for Rainbow Trout reproduction in tributaries of the Mountain Fork River below Broken Bow Dam, southeastern Oklahoma. e-Research Paper SRS-58, U.S. Department of Agriculture Forest Service, Southern Research Station. 15 p.

**Masloski, K., M. Payton, M. Reiskind, C. Greenwood.** 2014. Evidence for diet-driven habitat partitioning of Melanoplineae and Gomphocerinae grasshoppers (Orthoptera: Acrididae) along a vegetation gradient in a Western Oklahoma grassland. *Environmental Entomology* 43:1209-1214.

**McManamay, R.A., S.K. Brewer, H.I. Jager, and M.J. Troia.** 2016. Organizing environmental flow frameworks to meet hydropower mitigation needs. *Environmental Management* 58:365-385. DOI: 10.1007/s00267-016-0726-y.

**Monteith, K.B., K.L. Monteith, R.T. Bowyer, D.M. Leslie, Jr., and J.A. Jenks.** 2014. Reproductive effects on fecal nitrogen as an index of diet quality: an experimental assessment. *Journal of Mammalogy* 95:301-310.

**Orange, J.P., C.A. Davis, R.D. Elmore, and S.D. Fuhlendorf.** 2016. Temporary communal brooding in northern bobwhite and scaled quail broods. *Western North American Naturalist* 76:122-127.

**Orange, J.P., C.A. Davis, R.A. VanDenBussche, S.D. Fuhlendorf, R.D. Elmore, and E.T. Thacker.** 2014. Development and characterization of 23 microsatellite loci for scaled quail. *Conservation Genetic Resources* DOI:10.1007/s12686-014-0243-3.

**Orange, J.P., C.A. Davis, R.D. Elmore, E.P. Tanner, S.D. Fuhlendorf, and E.T. Thacker.** 2016. Evaluating the efficacy of brood flush counts: A case study in two quail species. *Western North American Naturalist* 76:485-492.

**Porta, M.J. and J.M. Long.** 2015. Evaluation of a five-year shoal bass conservation-stocking program in the upper Chattahoochee River, Georgia. Pages 169-180 in Tringali, M.D., J.M. Long, T.W. Birdsong, and M.S. Allen, editors. *Black bass diversity: multidisciplinary science for conservation*. American Fisheries Society, Symposium 82, Bethesda, Maryland.

**Powers, J., S.K. Brewer, J.M. Long, and T. Campbell.** 2015. Evaluating the use of side-scan sonar for detecting freshwater mussel beds in turbid river environments. *Hydrobiologia* 743:127-137. DOI: 10.1007/s10750-014-2017-z.

**Puckett, E.E., T.V. Kristensen, C.M. Wilton, S.B. Lyda, K.V. Noyce, P.M. Holahan, D.M. Leslie, Jr., J. Beringer, J.L. Belant, D. White, Jr., and L.S. Eggert.** 2014. Influence of drift and admixture on population structure of American black bears (*Ursus americanus*) in the Central Interior Highlands, USA, 50 years after translocation. *Molecular Ecology* 23:2414-2427.

**Rabeni, C.F. and S.K. Brewer.** 2014. Linking successful careers to successful fisheries. Pages 47-52 in *Future of Fisheries: Perspectives for the Next Generation of Professionals*. American Fisheries Society Symposium, Bethesda.

**Snow, R.A. and J.M. Long.** 2015. Estimating spawning times of Alligator Gar (*Atractosteus spatula*) in Lake Texoma, Oklahoma. *Proceedings of the Oklahoma Academy of Science* 95:46-53.

**Snow, R.A. and J.M. Long.** 2016. Effects of a growth check on daily age estimates of age-0 Alligator Gar. *Journal of the Southeastern Association of Fish and Wildlife Agencies* 3:6-10.

**Starks, T.A., J.M. Long, and A.R. Dzialowski.** 2016. Community structure of age-0 fishes in paired mainstem and created shallow-water habitats in the lower Missouri River. *River Research and Applications* 32:753-762.

**Starks, T.A., M.L. Miller, and J.M. Long.** 2016. Early life history of three pelagic-spawning minnows (*Macrhybopsis* spp.) in the Lower Missouri River. *Journal of Fish Biology* 88:1335-1349.

**Stewart, D.R. and J.M. Long.** 2015. Growth and contribution of stocked channel catfish, *Ictalurus punctatus* (Rafinesque 1818); the importance of measuring post-stocking performance. *Journal of Applied Ichthyology* 31:695-703.

**Stewart, D.R. and J.M. Long.** 2016. Using an experimental manipulation to determine the effectiveness of a stock enhancement program. *Journal of Freshwater Ecology* 31:37-52.

**Stewart, D.R. and J.M. Long.** 2016. Using hierarchical Bayesian multi-species mixture models to estimate tandem hoop-net based habitat associations and detection probabilities of fishes in reservoirs. *Transactions of the American Fisheries Society* 145:450-461.

**Stewart, D.R., J.M. Long, and D.E. Shoup.** 2015. Spatial structuring within a reservoir fish population: implications for management. *Marine and Freshwater Research* 66:202-212.

**Stewart, D.R., J.M. Long, and D.E. Shoup.** 2016. Simulation modeling to explore the effects of length-based harvest regulations for *Ictalurus* fisheries. *North American Journal of Fisheries Management* 36:1190-1204.

**Tanner, E.P., R.D. Elmore, C.A. Davis, S.D. Fuhlendorf, D.K. Dahlgren, E.T. Thacker, and J.P. Orange.** 2016. Does the presence of oil and gas infrastructure potentially increase risk of harvest in northern bobwhite? *Wildlife Biology* 22:294-304.

**Tanner, E.P., R.D. Elmore, S.D. Fuhlendorf, C.A. Davis, D.K. Dahlgren, and J.P. Orange.** 2016. Extreme climatic events contain space use and survival of a ground-nesting bird. *Global Change Biology* DOI: 10.1111/gcb.13505.

**Tanner, E.P., R.D. Elmore, S.D. Fuhlendorf, C.A. Davis, E.T. Thacker, and D.K. Dahlgren.** 2015. Behavioral responses at distribution extremes: How artificial surface water can affect quail movement patterns. *Rangeland Ecology and Management* 68:476-484

**Tanner, E.P., R.D. Elmore, C.A. Davis, S.D. Fuhlendorf, D.K. Dahlgren, E.T. Thacker, and J.P. Orange.** 2016. Does the presence of oil and gas infrastructure potentially increase risk of harvest in northern bobwhite? *Wildlife Biology* 22:294-304.

**Tanner, E.P., R.D. Elmore, S.D. Fuhlendorf, C.A. Davis, D.K. Dahlgren, and J.P. Orange.** 2016. Extreme climatic events constrain space use and survival of a ground-nesting bird. *Global Change Biology*: 22 doi:10.1111/gcb.13505.

**Tanner, E.P., R.D. Elmore, S.D. Fuhlendorf, C.A. Davis, E.T. Thacker, and D.K. Dahlgren.** 2015. Behavioral responses at distribution extremes: how artificial surface water can affect quail movement patterns. *Rangeland Ecology and Management* 68:476-484.

**Taylor, A.T., J.M. Long, M.R. Schwemm, M.D. Tringali, and S.K. Brewer.** 2016. Identification of Neosho smallmouth bass (*Micropterus dolomieu velox*) stocks for possible introduction into Grand Lake, Oklahoma. Department of Interior, Fish and Wildlife Service, Cooperator Science Series FWS/CSS-121-2016, Washington D.C.

**Thompson, M., Beston, J., Diffendorfer, J., Etterson, M., Loss, S.R.** 2017. Factors associated with bat collision mortality at wind energy facilities in the United States. *Biological Conservation* 215:241-245.

**Tringali, M.D., J.M. Long, T.W. Birdsong, and M.S. Allen, editors.** 2015. Black bass diversity: multidisciplinary science for conservation. American Fisheries Society, Symposium 82, Bethesda, Maryland.

**Williams, K., S.K. Brewer, and M. Ellersieck.** 2014. A comparison of two gears for quantifying abundance of lotic-dwelling crayfish. *Journal of Crustacean Biology* 34:54-60.

**Worthington, T.A., S.K. Brewer, N. Farless, T.B. Grabowski, and M.S. Gregory.** 2014. Factors affecting the transport time of semibuoyant fish eggs in large, altered river systems. *PLoS ONE* 9:e96599.

**Worthington, T.A., S.K. Brewer, T.B. Grabowski, and J. Mueller.** 2014. Backcasting the decline of a vulnerable Great Plains reproductive ecotype: Identifying threats and conservation priorities. *Global Change Biology* 20:89-102.

**Worthington, T.A., T. Zhang, D.R. Logue, A.R. Mittelstet, and S.K. Brewer.** 2016. Landscape and flow metrics affecting the distribution of a federally-threatened fish: Improving management, model fit, and model transferability. *Ecological Modelling* 342:1-18.

## Presentations

**Alexander, J.R., N. Farless, and S.K. Brewer.** 2016. Variation in critical thermal maximum between stream fishes of two Oklahoma watersheds. Oklahoma Natural Resources Conference, Oklahoma City, OK.

**Alexander, J., Y. Zhou, S.K. Brewer, and G.A. Fox.** 2016. Assessing reservoir operations and the associated changes in downstream water quality on the persistence of stream fishes. Kiamichi River Basin Research Symposium, McAlaster, OK.

**Alexander, J. Y. Zhou, G. Fox, and S.K. Brewer.** 2015. Assessing reservoir operations and the associated changes in water quality on the persistence of stream fishes. Oklahoma EPSCoR Annual State Conference, Norman, OK.

**Artz, E. and W.S. Fairbanks.** 2015. Using a novel experimental technique to examine dietary preference in a recolonizing population of black bears. Central Plains Society of Mammalogists Annual Meeting, Maryville, MO.

**Artz, E. and W.S. Fairbanks.** 2015. Design of genetic population estimate and food preference studies of recolonizing black bears. American Society of Mammalogists Annual Meeting, Jacksonville, FL.

**Artz, E. and W.S. Fairbanks.** 2015. Design of a genetic population estimate and food preference study in a recolonizing population of black bears. Oklahoma Natural Resources Conference, Tulsa, OK.

**Artz, E., W.S. Fairbanks, and S. Lyda.** 2016. Using a novel experimental technique to examine dietary preference in a recolonizing population of black bears. Gordon Research Conference: Predator-prey interactions, Ventura, CA.

**Artz, E. S. Lyda, and W.S. Fairbanks.** 2014. Advantages of non-invasive mark-recapture for detecting black bears (*Ursus americanus*) in eastern Oklahoma. Central Plains Society of Mammalogists Annual Meeting, Bull Shoals Field Station, MO.

**Artz, E., S. Lyda, and W.S. Fairbanks.** 2016. An overview of genetic mark-recapture population estimates in Ozark region black bears. Oklahoma Natural Resources Conference, Oklahoma City, OK.

**Atuo, F. and T. O'Connell.** 2014. Quantifying the spatio-temporal distribution of multiple raptors in mixed-grass prairie. Joint annual meeting of the American Ornithologists' Union, the Cooper Ornithological Society, and the Society of Canadian Ornithologists, Estes Park, CO.

**Atuo, F. and T. O'Connell.** 2014. Predator abundance and community composition at two quail recovery sites: potential predation risk for Northern Bobwhite. Joint annual meeting of the Wilson Ornithological Society and Association of Field Ornithologists, Newport, RI.

**Atuo, F. and T. O'Connell.** 2014. Quantifying avian predator abundance and quail predation risk at Packsaddle and Beaver River Wildlife Management Areas. Joint OSU/Oklahoma Department of Wildlife Conservation Workshop on the Conservation of Northern Bobwhite, Stillwater, OK.

**Atuo, F. and T. O'Connell.** 2015. A robust approach to estimating spatially explicit resource selection by a gregarious raptor in a mixed-grass prairie landscape. Annual Technical Meeting of the Oklahoma Ornithological Society, Durant, OK.

**Atuo, F. and T. O'Connell.** 2015. Spatially explicit densities of two generalist raptors in two mixed-grass prairie landscapes: Implications for quail conservation in the Great Plains. 27th International Congress for Conservation Biology and 4th European Congress for Conservation Biology, Montpellier, France.

**Atuo, F. and T. O'Connell.** 2016. Potential influence of raptor density on quail in two western Oklahoma landscapes. Oklahoma Natural Resources Conference, Oklahoma City, OK.

**Atuo, F. and T. O'Connell.** 2016. Habitat associations of raptor communities in mixed-grass prairie landscapes. Natural Resource Ecology and Management Seminar, Oklahoma State University, Stillwater, OK.

**Atuo, F. and T. O'Connell.** 2016. Is fear the mother of safety? Risks for prey in a landscape of predators. Annual Technical Meeting of the Oklahoma Ornithological Society, Tulsa, OK.

**Atuo, F. and T. O'Connell.** 2016. The influence of landscape heterogeneity on raptor community assemblages and niche characteristics in mixed-grass prairie ecosystems. 50th Anniversary Raptor Research Foundation Annual Conference, Cape May, NJ.

**Atuo, F. and T. O'Connell.** 2016. Functional importance of spatial heterogeneity and scale in the coexistence of sympatric avian predators. North American Ornithological Conference VI, Washington, DC.

**Atuo, F. and T. O'Connell.** 2016. Coexistence of sympatric avian predators in mixed-grass prairie landscapes: functional importance of heterogeneity gradients. Central Evolution and Ecology Conference, Norman, OK.

**Begosh, A., L.M. Smith, and S.T. McMurry.** 2015. Influence of land use and the Conservation Reserve Program on native invertebrate pollinator communities in the Southern High Plains wetlands and uplands. Society of Wetland Scientists Annual Meeting, Providence, RI.

**Begosh, A., L.M. Smith, and S.T. McMurry.** 2016. Influence of playa wetlands and the Conservation Reserve Program on native invertebrate pollinator communities in the Llano Estacado. Society of Wetland Scientists Annual Meeting, Corpus Christi, TX.

**Begosh, A., L.M. Smith, and S.T. McMurry.** 2016. Influence of land use and the Conservation Reserve Program on native invertebrate pollinator communities in the Llano Estacado. Ecological Society of America Annual Meeting, Fort Lauderdale, FL.

**Beyle, R., C.A. Davis, S.D. Fuhlendorf, R.D. Elmore, and S. Durant.** 2016. Thermal constraints on reproductive processes for two sympatric ground-nesting Galliforms in the southern Great Plains. 69th Annual Society for Range Management Meeting, Corpus Christi, TX.

**Brewer, S.K.** 2014. Aquatic challenges, issues and options for bridging the conservation and management of stream and reservoir fisheries. Gulf Coast Prairie Steering Committee Meeting, Arcadia, OK.

**Brewer, S.K., M.M. Davis, and R. Mollenhauer.** 2014. Examining the usefulness of existing ecological and hydrological data to test flow-ecology hypotheses in the Gulf Coast Prairie Region. 2014 Annual Research and Watershed Conference, Arkansas Water Resources Center, Fayetteville, AR.

**Brewer, S.K. and W.C. Musselman.** 2014. Consideration of functional connectivity in establishing instream flows for aquatic biota. Illinois River Watershed Research and Extension Symposium, West Siloam Springs, OK.

**Brewer, S.K., D. Ryder, W. Andrews, R. Hart, T. Birdong, G. Fox, and Y. Allen.** 2016. Ecological Studies in the Red River Basin. Oklahoma Natural Resources Conference, Oklahoma City, OK.

**Brewer, S.K., T.A. Worthington, J.J. Dyer, N. Farless, D. Logue, R. Mollenhauer, and J. Perkins.** 2015. Pelagic-broadcast spawning cyprinids: landscape conservation opportunities. Annual Meeting of the Oklahoma Chapter of the American Fisheries Society, Tulsa, OK.

**Brewer, S.K., T.A. Worthington, N. Farless, D. Logue, J. Dyer, J. Perkin, and A. Echelle.** 2016. Threats to pelagic-broadcast spawning cyprinids. Oklahoma Natural Resources Conference, Oklahoma City, OK.

**Brewer, S.K., T.A. Worthington, N. Farless, D. Logue, J. Dyer, J. Perkin, and A. Echelle.** 2016. Threats to pelagic-broadcast spawning cyprinids. Annual Meeting of the American Fisheries Society, Kansas City, MO.

**Brewer, S.K., T.A. Worthington, N. Farless, D. Logue, J. Dyer, J. Perkin, and A. Echelle.** 2015. Pelagic-broadcast spawning cyprinids: ecology and conservation opportunities. Annual Meeting of the Southern Division of the American Fisheries Society, Savannah, GA.

**Brewer, S. K., T. A. Worthington, and J. G. Kennan.** 2016. The relationships between flow alteration and fish-trait combinations in a large Great Plains river. Annual Meeting of the American Fisheries Society, Kansas City, MO.

**Brewer, S.K., T.A. Worthington, J.G. Kennan, B.E. Vieux, and W. Andrews.** 2016. Spatial variation in responses of a large river fish assemblage to flow alteration. Oklahoma Natural Resources Conference, Oklahoma City, OK.

**Brewer, S.K., T.A. Worthington, R. Mollenhauer, and W. Andrews.** 2014. Assessing changes in fish traits and water quality in a large Great Plains river. Annual Meeting of the American Fisheries Society, Quebec.

**Brewer, S.K., T.A. Worthington, R. Mollenhauer, D.R. Stewart, and P. Kemp.** 2014. Synthesizing ecohydrology models as a management tool for landscape conservation under climate change. 23rd Annual Oklahoma Clean Lakes and Watersheds Association, Stillwater, OK.

**Brewer, S.K., T. Worthington, T. Zhang, A.R. Mittelstet, and D. Logue.** 2016. Landscape and flow metrics affecting the distribution of a federally-threatened fish: improving management, model fit, and model transferability. Annual Meeting of the Southern Division of the American Fisheries Society, Wheeling, WV.

**Brown, B., S.K. Brewer, and J. Burroughs.** 2014. First year survival and dispersal of Neosho Smallmouth Bass. Annual Meeting of the Oklahoma and Texas Chapters of the American Fisheries Society, Lake Texoma, TX.

**Brown, B., S.K. Brewer, and J. Burroughs.** 2014. First year survival and dispersal of Neosho Smallmouth Bass. 23rd Annual Oklahoma Clean Lakes and Watersheds Association, Stillwater, OK.

**Burroughs, J. and S.K. Brewer.** 2014. Tag retention of hallprint dart tags by riverine Smallmouth Bass. 68th Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Destin, FL.

**Burroughs, J. and S.K. Brewer.** 2015. Preliminary results of engineered alternatives for improving water quality in a tailwater fishery. Southeastern Association of Fish and Wildlife Agencies Annual Meeting, Asheville, NC.

**Burroughs, J. and S.K. Brewer.** 2015. Tag retention of dart tags by riverine Smallmouth Bass. Annual Meeting of the Southern Division of the American Fisheries Society, Savannah, GA.

**Burroughs, J., B. Brown, and S.K. Brewer.** 2014. Evaluating the efficiency of a collection device for quantifying densities of early life stages of Smallmouth Bass in streams. Annual Meeting of the Southern Division of the American Fisheries Society, Charleston, SC.

**Burroughs, J., B. Brown, and S.K. Brewer.** 2014. Evaluating the efficiency of a collection device for quantifying densities of early life stages of Smallmouth Bass in streams. Annual Meeting of the Oklahoma and Texas Chapters of the American Fisheries Society, Lake Texoma, TX.

**Burroughs, J., B. Brown, R. Mollenhauer, and S. K. Brewer.** 2016. First year survival and dispersal of Neosho smallmouth bass. Annual Meeting of the American Fisheries Society, Kansas City, MO.

**Burroughs, J., X. Jin, S.K. Brewer, J. Johnston, and B. Brown.** 2014. New life for a tailwater trout fishery: case study of water-quality conditions below Tenkiller Ferry Reservoir. Annual Meeting of the Southern Division of the American Fisheries Society, Charleston, SC.

**Burroughs, J., X. Jin, S.K. Brewer, J. Johnston, and B. Brown.** 2014. Benefits of two engineered water-quality improvement options in a hydropower tailwater: an evaluation of oxygen enhancements in a coldwater fishery. Annual Meeting of the American Fisheries Society, Quebec.

**Carroll, J.M., C.A. Davis, R.D. Elmore, and S.D. Fuhlendorf.** 2014. Thermal environment as a constraint on movement and habitat use of northern bobwhite broods on the western periphery of their distribution. Annual Meeting of the Southeastern Association of Fish and Wildlife Agencies, Destin, FL.

**Carroll, J.M., C.A. Davis, R.D. Elmore, and S.D. Fuhlendorf.** 2015. Thermal constraints on critical life history periods of northern bobwhite. Annual Meeting of The Wildlife Society, Winnipeg, Manitoba.

**Carroll, J.M., C.A. Davis, R.D. Elmore, and S.D. Fuhlendorf.** 2015. Proximate thermal environments constrain diurnal behavior of Northern bobwhite broods. Oklahoma Natural Resources Conference, Tulsa, OK.

**Carroll, J.M., C.A. Davis, R.D. Elmore, and S.D. Fuhlendorf.** 2016. Northern bobwhite response to thermal heterogeneity: Implications for ground-dwelling birds in rangelands. 69th Annual Society for Range Management Meeting, Corpus Christi, TX.

**Carroll, J.M., C.A. Davis, R.D. Elmore, and S.D. Fuhlendorf.** 2016. Thermal constraints on northern bobwhite site selection during two key life stages. Oklahoma Natural Resources Conference, Oklahoma City, OK.

**Cartabiano, E.C. and J.M. Long.** 2014. Fish community responses to drought in an aging Great Plains reservoir. Oklahoma-Texas Chapter American Fisheries Society Annual Meeting, Pottsboro, TX.

**Cartabiano, E., D.R. Stewart, and J.M. Long.** 2014. Comparison of methods and bait-type to minimize by-catch when sampling for Channel Catfish in reservoirs. Southern Division American Fisheries Society Annual Meeting, Charleston, SC.

**Civiello, A.P. and J.M. Long.** 2015. Influence of habitat on young-of-year shovelnose sturgeon prey use. American Fisheries Society Annual Meeting, Portland, OR.

**Civiello, A.P. and J.M. Long.** 2016. Effect of shallow-water habitat quantity on young-of-year Sturgeon prey use and condition along a longitudinal gradient. American Fisheries Society Annual Meeting, Kansas City, MO.

**Civiello, A.P. and J.M. Long.** 2016. Effects of shallow-water habitat quantity on young-of-year Shovelnose Sturgeon prey use along a longitudinal gradient. Missouri River Recovery Implementation Committee Annual Forum Webinar.

**Civiello, A.P. and J.M. Long.** 2016. Effects of shallow-water habitat quantity on young-of-year Shovelnose Sturgeon prey use along a longitudinal gradient. Missouri River Natural Resources Conference, Great Falls, MT.

**Dale, L. and T. O'Connell.** 2014. Aflatoxins in wildlife feed: Recommendations for Northern Bobwhite management. Joint OSU/Oklahoma Department of Wildlife Conservation Workshop on the Conservation of Northern Bobwhite, Stillwater, OK.

**Dale, L. and T. O'Connell.** 2014. Aflatoxin contamination of supplemental feed for Northern Bobwhite. Joint Annual Meeting of the Oklahoma Chapter of The Wildlife Society and the Oklahoma Section of the Society for Range Management, Edmond, OK.

**Dattilo, J.C., S.K. Brewer, and D.E. Shoup.** 2016. Influence of hydrology on the age distribution of fishes in the Red River Basin. Oklahoma Natural Resources Conference, Oklahoma City, OK.

**Dattilo, J., S.K. Brewer, and D. Shoup.** 2016. Relationship between hydrology and fish production: a connected river-reservoir landscape approach. Kiamichi River Research Symposium, McAlister, OK.

**Davis, C.A.** 2016. Summary of Quail Genetics Study. Oklahoma Quail Research Symposium, Oklahoma Natural Resources Conference, Oklahoma City, OK.

**Duquette, C., C.A. Davis, S.D. Fuhlendorf, and D. Elmore.** 2016. Indirect Effects of Well Pads on Arthropod, Vegetation, and Soil Temperature Characteristics. 69th Society of Range Management Conference, Corpus Christi, TX.

**Dyer, J. and S.K. Brewer.** 2014. Effects of water-level reduction and sedimentation on crayfish in the Ouachita Mountain Ecoregion. Oklahoma State University, 25th Research Symposium, Stillwater, OK.

**Dyer, J. and S.K. Brewer.** 2014. Effects of water-level reduction and sedimentation on crayfish in the Ouachita Mountain Ecoregion. Annual Meeting of the Oklahoma and Texas Chapters of the American Fisheries Society, Lake Texoma, TX.

**Dyer, J. and S.K. Brewer.** 2016. Annual space use and migration patterns of Blue Suckers *Cycleptus elongatus* in the lower Red River, Oklahoma. Oklahoma Natural Resources Conference, Oklahoma City, OK.

**Dyer, J.J., T.A. Worthington, and S.K. Brewer.** 2014. The effects of climate change and land alteration on the Mena Crayfish (*Orconectes menae*). OK-LSAMP Annual research symposium, Oklahoma State University, Stillwater, OK.

**Farless, N. and S.K. Brewer.** 2014. Critical thermal maximum of fishes occupying spring-fed systems. 23rd Annual Oklahoma Clean Lakes and Watersheds Association, Stillwater, OK.

**Farless, N. and S.K. Brewer.** 2014. Temperature tolerances of fishes from spring-fed and non spring-fed streams. 25th Research Symposium, Oklahoma State University, Stillwater, OK.

**Farless, N. and S.K. Brewer.** 2014. Temperature tolerances of fishes from spring-fed and non spring-fed streams. 3rd Annual Student Water Conference, Stillwater, OK.

**Farless, N. and S.K. Brewer.** 2014. Influences of flow regime alteration on the abiotic and biotic components of streams. 68th Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Destin, FL.

**Farless, N. and S.K. Brewer.** 2015. Comparison of maximum thermal tolerance of fishes using two methods. Annual Meeting of the OK Chapter of the American Fisheries Society, Tulsa, OK.

**Farless, N. and S.K. Brewer.** 2015. Comparing long-term temperature tolerance study with critical thermal maximum for fishes. Student Water Conference, Oklahoma State University, Stillwater, OK.

**Farless, N. and S.K. Brewer.** 2015. Potential impacts of increased stream temperature on fish assemblages. Annual Meeting of the Oklahoma Clean Lakes and Watersheds, Stillwater, OK.

**Farless, N. and S.K. Brewer.** 2015. Influences of flow regime alteration on the abiotic and biotic components of streams. Annual Meeting of the American Fisheries Society, Portland, OR.

**Gabriel, A., R. Van Den Bussche, S.K. Brewer, R. Stark, D. Fenolio, and M. Niemiller.** 2016. Using eDNA to detect presence of Cavefish and Cave Crayfish. Annual Meeting of the Southern Division of the American Fisheries Society, Wheeling, WV.

**Gabriel, A., R. Van Den Bussche, S.K. Brewer, R. Stark, D. Fenolio, and M. Niemiller.** 2016. Using eDNA to detect presence of Cavefish and Cave Crayfish. Oklahoma Natural Resources Conference, Oklahoma City, OK.

**Harris, J., F. Atuo, and T. O'Connell.** 2015. Spatial habitat use of predators suggests trouble pots for quail. Joint OSU/Oklahoma Department of Wildlife Conservation Workshop on the Conservation of Northern Bobwhite, Stillwater, OK.

**Harris, J. and T. O'Connell.** 2014. Spatial overlap of Northern Bobwhite with potential nest predators. Joint annual meeting of the American Ornithologists' Union, the Cooper Ornithological Society, and the Society of Canadian Ornithologists, Estes Park, CO.

- Harris, J. and T. O'Connell.** 2014. Habitat use of ground-based predators: understanding risk for nesting quail. Annual meeting of the American Society of Mammalogists, Oklahoma City, OK.
- Harris, J. and T. O'Connell.** 2014. Habitat use of ground-based predators: understanding risk for nesting quail. Joint OSU/Oklahoma Department of Wildlife Conservation Workshop on the Conservation of Northern Bobwhite, Stillwater, OK.
- Harris, J. and T. O'Connell.** 2014. Habitat use of ground-based predators: understanding risk for nesting quail. Joint Annual Meeting of the Oklahoma Chapter of The Wildlife Society and the Oklahoma Section of the Society for Range Management, Edmond, OK.
- Hill, J., R. Mollenhauer, and S.K. Brewer.** 2016. Synthesizing our current understanding about the effectiveness of gear types for sampling fish populations. Oklahoma Natural Resources Conference, Oklahoma City, OK.
- Holley, C.T., A.T. Taylor, and J.M. Long.** 2016. Resample, recapture, and re-analyze: Using the 3 R's to resurrect the scale method of estimating fish age. American Fisheries Society Annual Meeting, Kansas City, MO.
- Jackson, V., W.S. Fairbanks, and S. Lyda.** 2014. A comparison of black bear home ranges in two distinct populations in Oklahoma. American Society of Mammalogists Annual Meeting, Oklahoma City, OK.
- Jackson, V., W.S. Fairbanks, and S. Lyda.** 2014. A comparison of black bear home ranges in two distinct populations in Oklahoma. Southwest Association of Naturalists Annual Meeting, Stillwater, OK.
- Jaffe, N. and T. O'Connell.** 2016. Evidence for avian population responses to temperature extremes in the Great Plains. Central Evolution and Ecology Conference., Norman, OK.
- Jaffe, N., T. O'Connell, and M. Papes.** 2016. Avian response to extreme weather events: A case study using MAPS data. The Wildlife Society Annual Conference, Raleigh, NC.
- Jaffe, N., T. O'Connell, and M. Papes.** 2016. Evidence for avian population responses to temperature extremes in the Great Plains. Ecological Society of America, Ft. Lauderdale, FL.
- Jaffe, N., T. O'Connell, and M. Papes.** 2016. Avian response to extreme weather events: A case study using MAPS data. North American Ornithological Conference VI, Washington, DC.
- Jaffe, N., T. O'Connell, and M. Papes.** 2016. Impact of climate extremes on bird populations. OSU Research Week Graduate Student Symposium, Stillwater, OK.
- Johnson, G.R. and D.E. Shoup.** 2016. Estimating relative shad densities using hydroacoustics. Oklahoma Natural Resource Conference, Oklahoma City, OK.
- Johnson, G.R. and D.E. Shoup.** 2016. Hydroacoustic sampling in shallow reservoirs. 27th Annual Research Week Symposium, Oklahoma State University, Stillwater, OK.
- Johnston, J. and S.K. Brewer.** 2015. Seeking rare fish in a fragmented, hydropower driven, metro-area: exceptions to the rules. Annual Meeting of the Southern Division of the American Fisheries Society, Savannah, GA.
- Johnston, J. and S.K. Brewer.** 2015. Seeking rare fish in a fragmented, hydropower driven, metro-area, braided prairie stream: exceptions to the rules. Annual Meeting of the Oklahoma Chapter of the American Fisheries Society, Tulsa, OK.
- Johnston, J. and S.K. Brewer.** 2016. A synthesis of methods for sampling Shovelnose Sturgeon and the realities for sampling a highly-altered system of the Great Plains. Oklahoma Natural Resources Conference, Oklahoma City, OK.
- Johnston, J. and S.K. Brewer.** 2016. A synthesis of methods for sampling Shovelnose Sturgeon and the realities for sampling a highly altered system of the Great Plains. Southern Division of the American Fisheries Society, Wheeling, WV.
- Johnson, J.R. and J.M. Long.** 2016. Hydrologic factors associated with detection and occupancy of riparian areas by Asian Swamp Eel in the Chattahoochee River system, Georgia. American Fisheries Society Annual Meeting, Kansas City, MO.
- Johnson, J.R. and J.M. Long.** 2016. Occupancy modeling as a tool to delineate invasive species distribution in reservoir riparian areas. Oklahoma Clean Lakes and Watersheds Association Annual Meeting, Stillwater, OK.
- Kennan J., S.K. Brewer, T. Worthington, B. Vieux, and W. Andrews.** 2015. Spatial variation in the fish assemblage of a large Great Plains river. Annual Meeting of the American Fisheries Society, Portland, OR.
- Lanzoni, M., D. Chapman, G. Castaldelli, J. Long, and M. Milardi.** 2016. First reproduction of Asian carps revealed in an artificial canal network of Western Europe. American Fisheries Society Annual Meeting, Kansas City, MO.
- Logue, D., R. Mollenhauer, and S.K. Brewer.** 2015. Investigating the effect of a non-native broadcast spawning minnow in a Great Plains stream, an occupancy approach. Student Water Conference, Oklahoma State University, Stillwater, OK.
- Logue, D.R., R. Mollenhauer, and S.K. Brewer.** 2015. Occupancy of heavyweight rivers by a bantamweight broadcast spawning cyprinid. Annual Meeting of the OK Chapter of the American Fisheries Society, Tulsa, OK.
- Logue, D.R., R. Mollenhauer, and S.K. Brewer.** 2015. Competitive interactions of two pelagic broadcast spawning cyprinids of the Great Plains. Annual Meeting of the Southern Division of the American Fisheries Society, Savannah, GA.
- Logue, D., R. Mollenhauer, and S.K. Brewer.** 2016. Detection estimates and habitat occupancy of two pelagic broadcast spawning cyprinids. Oklahoma EPSCoR Annual State Conference, Norman, OK.
- Logue, D., R. Mollenhauer, and S.K. Brewer.** 2016. Habitat associations of two pelagic broadcast spawning cyprinids in the Arkansas River Drainage. Oklahoma Natural Resources Conference, Oklahoma City, OK.
- Masloski, K.E., C. Greenwood, M.H. Reiskind, and M. Payton.** 2014. Grasshopper (Orthoptera: Acrididae) relative abundance and density: a comparison between standard and novel methods of sampling. Entomological Society of America Southwestern Branch Meeting, San Antonio, TX.
- Melstrom, R.T. and J.M. Long.** 2016. Measuring the relationship between sportfishing trip expenditures and anglers' species preferences. Midwest Fish and Wildlife Conference, Grand Rapids, MI.
- Miller, A. and S.K. Brewer.** 2016. Effects of habitat and spatial factors on age-0 Smallmouth Bass in the Ozark Highlands. Annual Meeting of the American Fisheries Society, Kansas City, MO.
- Miller, A. and S.K. Brewer.** 2016. Interactive effects of hydrology and channel characteristics on densities of age-0 Smallmouth Bass in the Ozark Highlands. Oklahoma Natural Resources Conference, Oklahoma City, OK.
- Mollenhauer, R. and S.K. Brewer.** 2014. Incorporating a trait-based approach into effective stream-fish management and monitoring. Annual Meeting of the Southern Division of the American Fisheries Society, Charleston, SC.
- Mollenhauer, R. and S.K. Brewer.** 2014. Using fish traits to effectively detect and predict changes in stream-fish assemblages. Annual Meeting of the Oklahoma and Texas Chapters of the American Fisheries Society, Lake Texoma, TX.
- Mollenhauer, R. and S.K. Brewer.** 2014. Linking fish species through common traits to optimize stream-monitoring protocols. 25th Research Symposium, Oklahoma State University, Stillwater, OK.
- Mollenhauer, R. and S.K. Brewer.** 2014. Linking fish species through common traits to optimize stream-monitoring protocols. 23rd Annual Oklahoma Clean Lakes and Watersheds Association, Stillwater, OK.
- Mollenhauer, B. and S.K. Brewer.** 2014. Linking fish species through common traits to optimize stream-monitoring protocols. 3rd Annual Student Water Conference, Stillwater, OK.
- Mollenhauer, R. and S.K. Brewer.** 2014. All-star stream fish: uncovering the qualities of successful competitors. Natural Resources Ecology and Management Newsletters, Oklahoma State University, Stillwater, OK.
- Mollenhauer, R. and S.K. Brewer.** 2014. Establishing relationships between fish traits and capture efficiency: implications for watershed-scale monitoring. Annual Meeting of the American Fisheries Society, Quebec.
- Mollenhauer, R. and S.K. Brewer.** 2015. Comparisons of adjusted and unadjusted catch data: implications for successful long-term stream-fish monitoring. Annual Meeting of the OK Chapter of the American Fisheries Society, Tulsa, OK.
- Mollenhauer, R. and S.K. Brewer.** 2015. Using capture-efficiency models to standardize stream-fish monitoring across an ecoregion. Student Water Conference, Oklahoma State University, Stillwater, OK.
- Mollenhauer, R. and S.K. Brewer.** 2016. Using occupancy modeling to improve the accuracy of electrofishing abundance estimates for riverine Smallmouth Bass. Annual Meeting of the American Fisheries Society, Kansas City, MO.
- Mollenhauer, R., A. Miller, and S.K. Brewer.** 2016. One fish, two fish, what a lot of fish there are: comparison of Smallmouth Bass abundance estimates in wadeable streams using multiple sampling methods. Oklahoma Natural Resources Conference, Oklahoma City, OK.
- Mollenhauer, R., T.A. Worthington, and S.K. Brewer.** 2014. A trait-based approach to stream-fish conservation. Illinois River Watershed Research and Extension Symposium. West Siloam Springs, OK.
- Mouser, J., N. Farless, J. Long, and S.K. Brewer.** 2015. The influence of temperature regimes on otolith daily ring deposition in Smallmouth Bass (*Micropterus dolomieu*). Student Research Conference, Oklahoma State University, Stillwater, OK.

- Mouser, J., R. Mollenhauer, A. Miller, and S.K. Brewer.** 2016. The invasive Ringed Crayfish: understanding occurrence patterns in the Ozark Highlands. Oklahoma Natural Resources Conference, Oklahoma City, OK.
- Musselman, C. and S.K. Brewer.** 2015. Defining functional connectivity between habitats to support instream-flow recommendations in an Ozark stream. Annual Meeting of the Oklahoma Chapter of the American Fisheries Society, Tulsa, OK.
- O'Connell, T., J. Harris, and F. Atuo.** 2016. What we think we've learned about predators and quail. Oklahoma Natural Resources Conference, Oklahoma City, OK.
- Orange, J.P., C.A. Davis., S.D. Fuhlendorf, R.D. Elmore, and E.P. Tanner.** 2014. Extra-Pair Paternity, Intra-specific Nest Parasitism, and Brood Amalgamation in Northern Bobwhite Quail. Oklahoma Chapter of the Wildlife Society. Oklahoma City, OK.
- Orange, J.P., C.A. Davis, S.D. Fuhlendorf, R.D. Elmore, and E.P. Tanner.** 2015. Survival, movement, and habitat use of scaled quail and northern bobwhite chicks at the periphery of their distributional ranges. Oklahoma Natural Resource Conference, Tulsa, OK.
- Orange, J.P., C.A. Davis, R.A. Van Den Bussche, R.D. Elmore, and S.D. Fuhlendorf, J.M. Carroll, and E.P. Tanner.** 2014. Parasitism, paternity, and brood mixing in two sympatric quail species. Annual Meeting of the Southeastern Association of Fish and Wildlife Agencies, Destin, FL.
- Perez, E., M. Pfander, and W.S. Fairbanks.** 2016. Population status of the American black bears (*Ursus americanus*) in the Ouachita National Forest of Oklahoma. Central Plains Society of Mammalogists Annual Meeting, Emporia, KS.
- Peterson, J.T., C.P. Paukert, A.E. Rosenberger, and S.K. Brewer.** 2015. Standardized sampling: a call for gear calibration. 145th Annual Meeting of the American Fisheries Society, Portland, OR.
- Pfander, M. and W.S. Fairbanks.** 2015. Preliminary demographic data from a Ouachita Mountain population of American black bears. Oklahoma Natural Resources Conference, Tulsa, OK.
- Pfander, M. and W.S. Fairbanks.** 2016. Population status of American black bears in southeast Oklahoma after 7 years of harvest. Oklahoma Natural Resources Conference, Oklahoma City, OK.
- Pfander, M., S. Lyda and W.S. Fairbanks.** 2014. Population status of the American black bear (*Ursus americanus*) in the Ouachita Mountains of southeast Oklahoma. Central Plains Society of Mammalogists Annual Meeting, Bull Shoals Field Station, MO.
- Powers, J., S.K. Brewer, J.M. Long, and T. Campbell.** 2014. Developing a more efficient process to locate freshwater mussel beds using sidescan sonar. 25th Research Symposium, Oklahoma State University, Stillwater, OK.
- Rabeni, C.F. and S.K. Brewer.** 2014. Linking successful careers to successful fisheries. Annual Meeting of the American Fisheries Society, Quebec.
- Reed, M.L., W.W. Hoback, J.M. Long, and T. Farling.** 2016. Diet of *Etheostoma radiosum* among tributaries of the lower Mountain Fork. Oklahoma Governor's Water Conference and Research Symposium. Norman, OK.
- Schwemm, M.R., J.M. Long, A.A. Echelle, and J.D. Schooley.** 2015. Fine-scale genetic structuring of American Paddlefish populations in Oklahoma. Oklahoma Natural Resources Conference, Tulsa, OK.
- Shiflet, J., D. Balsman, D.R. Stewart, D.E. Shoup, and J.M. Long.** 2015. Influence of bait type on catch and bycatch in tandem hoop nets set in Kentucky small impoundments. Southern Division American Fisheries Society Annual Meeting, Savannah, GA.
- Starks, T.A. and J.M. Long.** 2014. Community responses of larval and juvenile fishes to created shallow-water habitats in the Missouri River. American Fisheries Society Annual Meeting, Quebec City, Quebec.
- Starks, T.A., and J.M. Long.** 2014. Community responses of larval fishes to created shallow-water habitats in the Missouri River. 3rd Annual Student Water Conference Stillwater, OK.
- Starks, T.A. and J.M. Long.** 2015. Early life history of three pelagic-spawning minnows (*Macrhybopsis* spp.) in the lower Missouri River. Oklahoma Natural Resources Conference, Tulsa, OK.
- Starks, T.A. and J.M. Long.** 2015. Community responses of larval and juvenile fishes to created shallow-water habitats in the Missouri River. Southern Division American Fisheries Society Annual Meeting, Savannah, GA.
- Stewart, D.R., J.M. Long, and D.E. Shoup.** 2014. Spatial structuring within a reservoir fish population by an unintended protected area: implications for management. Colorado-Wyoming Chapter of the American Fisheries Society Annual Meeting, Laramie, WY.
- Stewart, D.R. and J.M. Long.** 2016. Growth and contribution of stocked channel catfish, *Ictalurus punctatus* (Rafinesque, 1818): the importance of measuring post-stocking performance. Arizona-New Mexico Chapters of the Wildlife Society and the Arizona-New Mexico Chapters of the American Fisheries Society Annual Meeting. Flagstaff, AZ.
- Stewart, D.R., J.M. Long, and D.E. Shoup.** 2016. Effect of length-based harvest regulations for trophy and recreational *Ictalurus* fisheries. Joint Annual Meeting of the Arizona/New Mexico Chapters of the Wildlife Society and the Arizona/New Mexico Chapters of the American Fisheries Society. Flagstaff, AZ.
- Tanner, E.P., R.D. Elmore, C.A. Davis, and S.D. Fuhlendorf.** 2014. Comparative ecology of northern bobwhite and scaled quail on distribution extremes. Oklahoma Chapter of the Wildlife Society. Oklahoma City, OK.
- Tanner, E.P., R.D. Elmore, C.A. Davis, and S.D. Fuhlendorf.** 2014. Use of water by quail in western Oklahoma. Annual Meeting of the Southeastern Association of Fish and Wildlife Agencies, Destin, FL.
- Tanner, E.P., R.D. Elmore, C.A. Davis, and S.D. Fuhlendorf.** 2015. Predicting shifts in northern bobwhite and scaled quail distribution from climate change. Oklahoma Natural Resource Conference, Tulsa, OK.
- Tanner, E.P., R.D. Elmore, S.D. Fuhlendorf, and C.A. Davis.** 2016. Ecological pinch points affect usable space and survival of a ground-nesting bird. 69th Annual Society for Range Management Meeting, Corpus Christi, TX.
- Tanner, E.P., R.D. Elmore, M. Papes, S.D. Fuhlendorf, and C.A. Davis.** 2016. Pinch points on northern bobwhite. Oklahoma Natural Resources Conference, Oklahoma City, OK.
- Tanner, A.M., S.D. Fuhlendorf, and R.D. Elmore, C.A. Davis, and M. Papes.** 2016. Roosting ecology of lesser prairie-chickens. Oklahoma Natural Resources Conference, Oklahoma City, OK.
- Tanner, A.M., J.Z. Kachel, S.D. Fuhlendorf, and S.L. Winter.** 2016. Where the sagebrush burns: growing season wildfire and *Artemisia filifolia*. 69th Annual Society for Range Management Meeting, Corpus Christi, TX.
- Tanner, E.P., M. Papes, R.D. Elmore, S.D. Fuhlendorf, and C.A. Davis.** 2015. When strongholds collapse: gains in future distributions may cost current population sources under future climate projections. Annual Meeting of The Wildlife Society, Winnipeg, Manitoba.
- Taylor, A.T., and J.M. Long.** 2015. Factors influencing the decline of fluvial fishes: insights from historic and current species distribution models. 4th Annual Student Water Conference, Stillwater, OK.
- Taylor, A.T., and J.M. Long.** 2016. Using species distribution models to infer potential and restricted ranges of a fluvial-specialist black bass species. American Fisheries Society Annual Meeting, Kansas City, MO.
- Taylor, A.T., and J.M. Long.** 2016. The decline of a fluvial fish: species distribution models in a fragmented riverscape. Southern Division of the American Fisheries Society Annual Meeting, Wheeling, WV.
- Taylor, A.T., J.M. Long, M.D. Tringali, M.R. Schwemm, and S.K. Brewer.** 2016. Introgression and population structure of Neosho Smallmouth Bass. Oklahoma Natural Resources Conference, Oklahoma City, OK.
- Taylor, A.T., P. O'Rourke, and J.M. Long.** 2014. Black bass (genus *Micropterus*) community composition upstream of impoundment in two southeastern rivers. Georgia Chapter of the American Fisheries Society Annual Meeting, Athens, GA.
- Taylor, A.T., P. O'Rourke, and J.M. Long.** 2014. Black bass (genus *Micropterus*) community composition in the river-reservoir interface of two southeastern rivers. Southern Division American Fisheries Society Annual Meeting, Charleston, SC.
- Taylor, A.T., P. O'Rourke, M.D. Tringali, and J.M. Long.** 2014. Development of assessment protocols for Shoal Bass (*Micropterus cataractae*) populations in headwater rivers of the upper Chattahoochee River Basin. Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Destin, FL.
- Taylor, A.T., M.D. Tringali, S.M. Sammons, D.L. Peterson, T. Ingram, P. O'Rourke, and J.M. Long.** 2015. Genetic substructure within the native range of the Shoal Bass. Southern Division of the American Fisheries Society Annual Meeting, Savannah, GA.
- Techentin, D. and W.S. Fairbanks.** 2014. Black bear (*Ursus americanus*) responses to habitat management by prescribed fire in the Interior Highlands: Preliminary results. Central Plains Society of Mammalogists Annual Meeting, Bull Shoals Field Station, MO.
- Techentin, D. and W.S. Fairbanks.** 2015. Black bear (*Ursus americanus*) use of prescribed burn areas in the Ouachita National Forest. Central Plains Society of Mammalogists Annual Meeting, Maryville, MO.
- Techentin, D. and W.S. Fairbanks.** 2015. The role of prescribed fire in a region recently recolonized by black bears. American Society of Mammalogists Annual Meeting, Jacksonville, FL.
- Techentin, D. and W.S. Fairbanks.** 2015. A maximum entropy approach to predict black bear seasonal habitat use. Oklahoma Natural Resources Conference, Tulsa, OK.

**Teichert, D. and W.S. Fairbanks.** 2016. Potentially suitable environments for westward expansion of black bears in Oklahoma. American Society of Mammalogists Annual Meeting, Minneapolis, MN.

**Teichert, D. and W.S. Fairbanks.** 2016. Expanding ecological niche models to predict suitable environments for black bears across Oklahoma. Oklahoma Natural Resources Conference. Oklahoma City, OK.

**Teschner, C., W.S. Fairbanks, S. Lyda, C. Endicott, C. Allen, C. Farquhar, N. Kester, and D.M. Leslie, Jr.** 2014. Morphometrics of Oklahoma black bears with and without anthropogenic food. Gordon Research Conference: Predator-prey interactions, Ventura, CA.

**Thompson, M.M. and S.R. Loss.** 2015. Impacts of wind energy development on North American bats: A national assessment. 100th Meeting of the Ecological Society of America, Baltimore, MD.

**Thompson, M. and S.R. Loss.** 2015. Investigation of impacts of wind energy development on North American bats. Oklahoma Natural Resources Conference, Tulsa, OK.

**Unger, A.M., S.D. Fuhlendorf, R.D. Elmore, and C.A. Davis.** 2015. Using Citizen Science and Aerial Surveys to Develop Habitat Suitability Models for Lesser Prairie-Chickens. The 22nd Annual Conference of The Wildlife Society. Winnipeg, MB, Canada.

**Unger, A.M., S.D. Fuhlendorf, R.D. Elmore, C.A. Davis, and M. Papes.** 2015. A Maximum entropy approach to modeling lesser prairie-chicken habitat. Oklahoma Natural Resources Conference, Tulsa, OK.

**Unger, A.M., S.D. Fuhlendorf, M. Papes, R.D. Elmore, and C.A. Davis.** 2015. Using Citizen Science and Aerial Surveys to Develop Habitat Suitability Models for Lesser Prairie-Chickens. Prairie Grouse Technical Council Meeting, Nevada, MO.

**Vieux, B., S.K. Brewer, T. Worthington, J. Kennen, and B. Andrews.** 2015. Projecting hydrologic impacts on the Canadian River ecosystem under future climate-change scenarios. Oklahoma Governor's Water Conference, Norman, OK.

**Worthington, T.A., S.K. Brewer, A.S. Vowles, and P.S. Kemp.** 2014. The role of discharge and channel complexity on the downstream transport of semibuoyant fish eggs. Annual Meeting of the American Fisheries Society, Quebec.

**Worthington, T.A., S.K. Brewer, and J.G. Kennan.** 2016. The relationships between flow alteration and fish-trait combinations in a large Great Plains river. Annual Meeting of the Society for Freshwater Science, Sacramento, CA.

**Worthington, T.A., T. Grabowski, and S.K. Brewer.** 2014. Combining GIS data and species distribution models to highlight the role of landscape scale factors in the decline of an endemic Great Plains cyprinid. Sixth International Symposium on GIS/Spatial Analyses in Fishery and Aquatic Sciences, Tampa, FL.

**Yaklin, D. and W.S. Fairbanks.** 2016. Recovery of bear forage items after prescribed fire in the Ouachita National Forest of Oklahoma. Central Plains Society of Mammalogists Annual Meeting, Emporia, KS.

**Zhang, T., D.E. Storm, A. Mittelstet, and S.K. Brewer.** 2014. Evaluating the relationship between historical flow regime and declining abundance and distribution of Arkansas River Shiner. 23rd Annual Oklahoma Clean Lakes and Watersheds Association, Stillwater, OK.

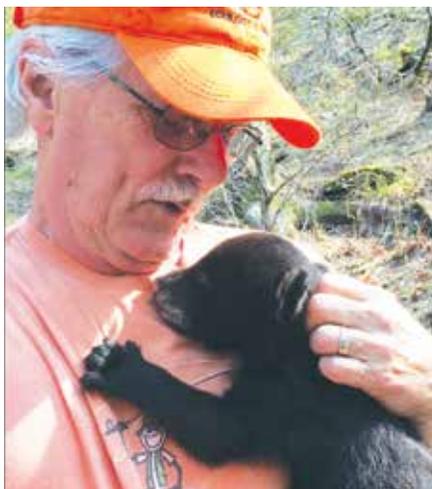
**Zhang, T., D.E. Storm, A. Mittelstet, S.K. Brewer, T.A. Worthington, and L. Gang.** 2014. Altered flow regime influences the distribution of Arkansas River Shiner. OK Governor's Water Conference, Oklahoma City, OK.

**Zhang, T.J., D. Storm, A.R. Mittelstet, S.K. Brewer, T.A. Worthington, and D.R. Logue.** 2015. Pelagic broadcast-spawning cyprinids reproductive guild: metrics affecting their declining distribution in the Arkansas River Basin. Student Water Conference, Oklahoma State University, Stillwater, OK.

**Zhang, T. J., T.A. Worthington, S.K. Brewer, D.E. Storm, A.R. Mittelstet, and D. Logue.** 2015. Influence of altered flow metrics on the declining distribution of Arkansas River Shiner. The Annual Meeting of the Oklahoma Clean Lakes and Watersheds, Stillwater, OK.

Oklahoma State University, in compliance with Title VI and VII of the Civil Rights Act of 1964, Executive Order 11246 as amended, and Title IX of the Education Amendments of 1972 (Higher Education Act), the Americans with Disabilities Act of 1990, and other federal and state laws and regulations, does not discriminate on the basis of race, color, national origin, sex, age, sexual orientation, gender identity, religion, disability, or status as a veteran, in any of its policies, practices or procedures. This provision includes, but is not limited to admissions, employment, financial aid, and educational services. The following have been designated to handle inquiries regarding non-discrimination policies: Director of Equal Opportunity, 408 Whitehurst, OSU, Stillwater, OK 74078-1035; Phone 405-744-9154; email: [eeo@okstate.edu](mailto:eeo@okstate.edu). This publication, Job# 7239 issued by Oklahoma State University as authorized by the Unit Leader -- Fish & Wildlife, was printed by Southwestern at a cost of \$2,588.00. 400/Mar/18.

## Chip Leslie Retirement



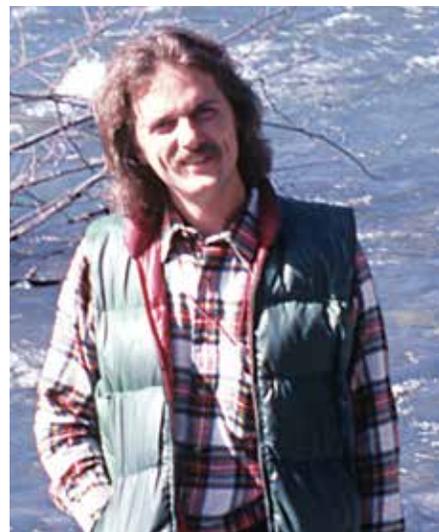
**I**N December 2016, Chip retired from federal service, which included 31 years to the Oklahoma Unit. Chip came to the OK Unit in 1985 as an Assistant Unit Leader and became Unit Leader in 1989. Chip, along with his faculty cooperators and graduate students, worked on a variety of wildlife species and topics such as white-tailed deer; elk; endangered interior least terns and Ozark big-eared bats; black bears; bobwhite quail; effects of herbicides and fire on small mammals, mesocarnivores, and birds. Interestingly, Chip bookended his career at the OK Unit on borderland conservation concerns in the Lower Rio Grande Valley of south Texas. Throughout his professional career, Chip contributed over 300 publications to scientific outlets and continues to do so in post-retirement.

The graduate students and mentees Chip had the privilege to work with are considered his greatest professional contribution. Chip directly advised

9 PhD students, 28 MS students, and 1 Honor's student, although he was also involved in nearly 100 other graduate student committees. Chip's students have gone on to hone the wildlife profession in positions as Dean, Distinguished Professor, Full Professors, USGS Coop Unit Assistant Unit Leader, USFWS refuges managers, FWS Wildlife Biologists, NPS Biologist/Supervisor, USFS Research-grade Biologist, State Biologists/Supervisors, private consultants, and even a private equity investor!

Chip had a tremendous impact to science, Oklahoma, and the Coop Unit. For his meritorious service to the American Society of Mammalogists (ASM), including time as Journal Editor of the Journal of Mammalogy and Chair of the Publications Committee, Chip was awarded the Hartley H. T. Jackson Award. With the Oklahoma Chapter of the Wildlife Society, Chip served as President and was the recipient of the Oklahoma Award, which is the chapter's most prestigious award.

CHIP AT HOLT RIVER, WA 1979



# 69 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

### ASSISTANT UNIT LEADERS

David M. Leslie, Jr., 1985-89  
Alexander V. Zale, 1985-93  
William L. Fisher, 1991-08  
Dana L. Winkelman, 1998-03  
James M. Long, 2009-present  
Shannon K. Brewer, 2010-present

