

OKNRC 2020 Oral Presentation Abstracts

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Cox|McLain Environmental Consulting, Inc.

The Livers of the Rivers, Presented by Ryan Blankenship, AWB, Senior Wildlife Biologist – Cox|McLain Environmental Consulting, Inc. 600 East John Carpenter Freeway, Suite 186, Irving, Texas 75062

This presentation will include an introduction into the freshwater mussels (Family *Unionidae*) of Oklahoma which are important elements of aquatic ecosystems and often comprise the major components of biomass. Freshwater mussels are sensitive indicators of environmental quality and are often the first organisms to decline and vanish in the face of ecological change and degradation. As a result, perhaps as much as 80 percent of Unionid species are threatened, endangered, or extinct, with populations in general decline. In Oklahoma, all species of native freshwater mussels have declined in abundance and distribution, with the conservation status of over half the remaining species listed as a major concern. The State of Oklahoma boasts as many as 57 species of native freshwater mussel species, with recent genetic analysis altering this final count from year-to-year. With creative names (some of my favorites being the heelsplitter, pocketbook, and mucket) it is difficult to not take interest in these sessile creatures that inhabit the State's waters. At first glance, freshwater mussels are not charismatic species. They are not cute, or cuddly, and they don't make good pets or viral video stars. However, I hope that this brief introduction into their world makes you take pause the next time you enjoy the waters of the State of Oklahoma and wonder what type of these unassuming, but ultimately fascinating, animals may be living there.

Keywords: Fisheries, Wildlife, non-game species, Stream and River, Species of Concern, Water Issues, freshwater mussels, aquatic, endangered species, malacology

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Oklahoma Department of Wildlife Conservation

Broken Bow Bass: Then and Now

Largemouth Bass are a very popular sportfish species in Oklahoma. Once heavily harvested, they are now valued by many for their trophy potential. This has necessitated regulation changes to fit management strategies. However, many regulation changes once enacted are rarely evaluated against their management objectives. Broken Bow Reservoir in southeast Oklahoma is known for its Largemouth Bass, Spotted Bass and Smallmouth Bass fishing. Prior to the state wide regulation change to 14 inch minimum for Largemouth Bass, the lake had a 13-16 inch slot limit. Along with the removal of the slot limit, the creel limit on Spotted Bass was removed. This provided additional harvest opportunities for anglers, while theoretically allowing Largemouth Bass the opportunity to grow to larger sizes. To evaluate the effects of this regulation change, we compared relative abundance, size structure, condition, and growth rates of Largemouth Bass, Smallmouth Bass, and Spotted Bass in Broken Bow Reservoir.

Keywords: Fisheries, Population Management, Regulation Change, Black Bass, evaluation

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Oklahoma Department of Wildlife Conservation

Show me the money: Insights from the Robbers Cave Trout Fishery Creel Survey

The Oklahoma Department of Wildlife Conservation (ODWC) operates a seasonal trout fishery within Robbers Cave State Park in southeast Oklahoma. All Rainbow Trout are purchased and stocked by ODWC and paid for with a portion of non-resident license dollars. In order to better understand anglers use, harvest, relation to the park and the sustainability of the trout fishery, ODWC conducted a creel survey between November 3, 2016 and March 27, 2017. We compared the cost of a limit of Rainbow Trout and to the cost of both resident and non-resident license fees. We then related this to the

estimated amount of money raised through non-resident license fees of non-residents who fished Robbers Cave for trout. Our results indicate that the vast majority of effort and harvest comes from local (resident) anglers, and that spending by these anglers is likely less than the average expenditure per fishing trip of \$24.00 reported in the 2011 USFWS National Survey of Outdoor Recreation.

Keywords: Fisheries, Human Demographics, Rainbow Trout, Cost Benefit, State Parks, Stocking

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Multi-species Occupancy, Detection, and Habitat Selection of Mesocarnivores in Eastern Oklahoma with a Focus on Eastern Spotted Skunks

Mesocarnivores are important ecological species that provide many significant roles in their habitats. One mesocarnivore species in particular, the eastern spotted skunk (*Spilogale putorius*), is classified as either a species of conservation concern, threatened, or endangered throughout much of its range. In Oklahoma, they are described as a Tier III species of greatest conservation urgency. We seek to understand the distribution of mesocarnivores in southeastern Oklahoma while focusing specifically on eastern spotted skunks. We are using occupancy models to determine distribution trends of eastern spotted skunks and the other mesocarnivores while taking into account differences in detectability. In addition, we are considering covariates such as habitat characteristics and the presence of other species in our PRESENCE models. We are collecting presence/absence data between the months of October and April (2018-2019 and 2019-2020) using Reconyx Hyperfire cameras. We are deploying these cameras in areas of McCurtain and LeFlore counties for a duration for one month. In locations where eastern spotted skunks have been detected, we are leaving cameras at that site for the continuation of the field season to understand occurrence frequency for the species. We are recording habitat characteristics such as, canopy cover, average tree height, understory density, forest type, land use, and terrain at each location. These characteristics are important for determining habitat preference for the mesocarnivore species. The information resulting from this study should be useful to manage a variety of mesocarnivores including eastern spotted skunks due to their vulnerability and classification as a furbearing species.

Keywords: Wildlife, game species, Wildlife, non-game species, Species of Concern, Eastern Spotted Skunks, Furbearers, Occupancy

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U.S. Geological Survey, Oklahoma Coop Fish and Wildlife Research Unit

Forging a future for stream fishes under environmental stressors.

Twenty-five years ago, the Union of Concerned Scientists and more than 1700 independent scientists penned the 1992 "World Scientists' Warning to Humanity". These concerned scientists proclaimed that fundamental changes were urgently needed to avoid the ecological consequences of our environmental trajectory. With the exception of stabilizing the stratospheric ozone layer, humanity has failed to make sufficient progress in generally solving these foreseen environmental challenges, and alarmingly, many environmental conditions have continued to decline. Scientists estimate freshwater fishes are 4-6 times more likely to go extinct when compared to their marine or mammal counterparts; in fact, when compared to rates suggested by fossils, extinction of freshwater fishes is 800 times higher than historic rates. In the eastern and central U.S., more than half our rivers are considered in poor condition. We face significant resource challenges that primarily focus on water quality and quantity. Using freshwater organisms occupying the Great Plains and adjacent ecoregions, I provide examples of ecological challenges specifically aimed at changes in flow and temperature patterns.

Keywords: Stream and River, Climate Change, stream fishes, Great Plains, flow regime

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Oklahoma State University

Northern bobwhite habitat use in Oklahoma

Northern bobwhite (*Colinus virginianus*) have experienced steep population declines in recent decades, largely attributed to broad-scale habitat loss and degradation. Though bobwhite are an intensively studied species, much is still to be learned about their habitat use patterns. For example, many studies to date have focused on relatively short-term data, though a broader perspective can be gained by examining longer term data. Long-term data can reveal seasonal and annual patterns in bobwhite habitat use which may help inform future management. Our first objective was to leverage 8 years of quail telemetry data to determine whether areas of high quail density are consistent (1) across seasons and (2) across years on Packsaddle WMA. We quantified the correlation between quail density distributions (i.e. heat maps) over time and results indicated that bobwhite hotspots are seasonally consistent, but do show annual variation. Furthermore, though it is well-established that bobwhite rely on some measure of woody plants for thermal cover and predator avoidance, at high levels of woody cover, quail no longer persist in an area. Accordingly, our second objective was to further investigate and describe the relationship between bobwhite and woody cover. Specifically, we identified optimal levels of woody cover for quail at multiple spatial scales using the Rangeland Analysis Platform continuous woody cover data (annual, 30m resolution), 8 years of bobwhite telemetry data, generalized mixed modeling and an information-theoretic approach. Results from this study may be used to support future bobwhite management strategies by expanding our understanding of the relationship between bobwhite and woody cover and describing long-term bobwhite habitat use patterns.

Keywords: Wildlife, game species, Population Management, Landscape Ecology

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Investigating Ranavirus Prevalence in Oklahoma Turtles

Ranavirus is a double-stranded DNA virus that can spread through direct contact between organisms and through water, and is therefore capable of infecting amphibians, fish, and turtles. Studies show that western ornate box turtles and red-eared sliders infected with ranavirus show several debilitating symptoms, including lethargy, internal hemorrhaging, and eventual death, in both lab and wild settings. Turtles infected with ranavirus can also spread the virus to neighboring amphibian populations, serving as reservoirs for infection. To complete the first assessment of ranavirus in Oklahoma turtles, catch-and-release tail samples from over 80 turtles were collected during Summer–Fall 2019; these turtles were caught using aquatic traps at various residential ponds and public lakes across central and southeast Oklahoma. DNA was extracted from these samples and screened for ranavirus disease presence via qPCR. Additionally, previously collected turtle tissue samples (2015–2018) were also analyzed using qPCR and compared directly to amphibian ranavirus results from the same sample sites. Given that turtles do not possess the same permeable skin as amphibians, the rate of ranavirus infection is predicted to be lower in turtles than in amphibians. Since the presence of ranavirus in turtles has a documented, negative impact on the health of turtle and amphibian populations, this investigation into turtle ranavirus prevalence will aid in the continued monitoring and protection of Oklahoma's wild amphibian and turtle populations.

Keywords: Wildlife, non-game species, Conservation Projects and Planning, Stream and River, Infectious Disease, Reptile, Herpetology

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Southwestern Oklahoma State University

When the first three invasive species maps disagree, make a fourth

One of the many challenges in controlling invasive plant species is knowing where to focus prevention and eradication efforts. Unfortunately, for most species, data about current distributions are sparse, and information about where the problems might be in the future is altogether lacking. Students from Southwestern Oklahoma State University's Terrestrial Ecology class examined 16 plant species currently on the the Oklahoma Invasive Plants Council "Watch-List". For each species, a student compared distribution maps from the USDA Plants Database, the Oklahoma Vascular Plants Database, the Early Detection and Distribution Mapping System (EDDMapS) with soil and climate information for Oklahoma and surrounding states to create a recommendation of locations and habitats likely to be at the invasion front. Using several invasive plant species as case studies, we point out the differences in the databases and the maps created from them and suggest that combining information from all three is well worth the effort.

Keywords: Invasive Species, Conservation Projects and Planning, mapping, ecology education

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The Effects of Social-Psychological Factors on Black Bass Fishing Demand in Oklahoma Ozark Streams

Black bass (*Micropterus*) stream fishing is a popular sport fishing activity in eastern Oklahoma, with participation from more than 12% of all Oklahoma anglers. Despite its popularity, little is known about economic benefits associated with black bass fishing in Oklahoma streams. Information on benefits of accessing eastern Oklahoma streams for black bass fishing may be useful for characterizing the public value of black bass management. Similarly, while recreation literature suggests an important role of psychological constructs in recreation settings, limited efforts have used social-psychological constructs such as place attachment, motivation in fishing demand studies. Using survey data collected from stream anglers, this study employed a travel cost model to estimate economic value of bass fishing in Oklahoma streams. In addition, the model combined socio-demographic attributes with social-psychological constructs such as place attachment and angler's motivation. The preliminary results show that anglers' attachment to fishing site and their motivations to go fishing have significant effects on the demand. This presentation will highlight the economic value of public access to Oklahoma streams for bass fishing and will shed lights on the social psychological factors that influence bass fishing demand. The findings will inform researchers, recreation planners and managers, as well as policy makers on the public value for bass fishing in the Oklahoma streams.

Keywords: Fisheries, Human Demographics, Black Bass fishing, Economic value, Place attachment, Motivation

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Oklahoma State University

Precipitation and Environmental Condition Monitoring: Connecting Volunteers, Technology, and Natural Resource Managers

Citizen Science projects are engaging the public in environmental and conservation science research in Oklahoma, across the country, and around the globe. Our project, the Spotty Rain Campaign, aims to encourage community participation in volunteer drought monitoring and to broadly share resources for managing drought risks. Drought experiences have significant and long lasting impacts on wildlife, rangelands, fisheries, and forests across the Great Plains. The goal of this presentation is to introduce natural resource managers to the Community Collaborative Rain, Hail, and Snow Network (CoCoRaHS), a nationwide volunteer program. The CoCoRaHS data is publicly available and used by the National Weather Service (NWS) and the National Drought Mitigation Center (NDMC). More accurate rainfall information

from CoCoRaHS volunteers can tell us where and when devastating droughts may occur. You will learn how your membership can easily participate in this citizen science effort, as well as how to access and use the public database in your research and planning. Next, we will share our efforts to use innovative educational technologies to recruit CoCoRaHS volunteers in rural areas and to partner with public libraries as host drought-related programs. The Spotty Rain catalog hosts drought reports and educational resources for education and community planning (<http://www.spottyrain.org>).

Keywords: Fisheries, Wildlife, game species, Wildlife, non-game species, Restoration, Invasive Species, Conservation Projects and Planning, Stream and River, Climate Change, Water Issues, Citizen Science, Outreach and Volunteer Engagement, Technology, Drought

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Sam Noble Museum

Survey of the Distribution, Habitat, and Current and Historical Presence of White-nose Syndrome in the Tri-colored Bat in Oklahoma

The tri-colored bat, *Perimyotis subflavus*, is a Tier II species of greatest conservation need, as identified in the Oklahoma Comprehensive Wildlife Conservation Strategy, and it is one of 12 species that have been confirmed with white-nose syndrome, which is caused by the fungus *Pseudogymnoascus destructans* (Pd). In 2015, three *P. subflavus* were the first to test positive for the fungus in the state, and a positive sample from a *P. subflavus* from Woodward County was the first in the state outside of extreme eastern Oklahoma. The species is considered to be distributed in all but the Panhandle part of the state, but it has only been documented in 31 counties. In this project, we are using acoustic detectors and mist netting surveys to document the presence or absence of *P. subflavus* in the western 2/3rds of the body of Oklahoma where the least is known about the species. To date, acoustic data has been obtained for 13 species from 9 localities in 7 counties, netting has been conducted at 17 localities in 5 counties, and 14 bats of 4 species collected or found in 2019 and 308 museum skins of *P. subflavus* collected prior to 2019 in Oklahoma were swabbed and tested for the presence of Pd.

Keywords: Wildlife, non-game species, Species of Concern, Mammals, Diseases, Bats

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Oklahoma Biological Survey & Department of Biology, University of Oklahoma

Drought impacts to stream communities and ecosystems within freshwater mussel beds

With increased drought and extraction, water scarcity is increasing and streams are drying into isolated pools which is stressful for organisms adapted to perennial systems. Using a mesocosm experiment, we investigated how drought will affect freshwater mussel beds within rivers. Mussel beds represent biodiversity and biogeochemical hotspots; mussels provide habitat with their shells and through their filter feeding regenerate nutrients for algae and macroinvertebrates, both of which are food for fishes. While our original experiment aimed at investigating trophic facilitation between adult mussels and fish, our mesocosms mimicked shrinking pools that occur during drought conditions. We found that fish residing with adult mussels survived two days longer than fish within control treatments. As adult mussels compete with fish for oxygen, we suspect the trophic subsidies by adult mussels improved fish survival. While previous research explored how drought-induced mussel die-offs alter the assemblage structure, the short-term effect of this loss on ecosystem structure and function had not been quantified. We induced a mussel die-off to address impacts on stream ecosystem function. We found that decomposing mussel carrion increased water column nutrients, which subsidize both primary production and organic matter decomposition. We combined our results with field data to develop a conceptual model on how mussel die-offs alter ecosystem function over short- and long-time spans. We provide evidence that mussels mitigate drought-induced loss of fish and that while some components stream ecosystem function show transient increases after mussel die-offs, there are long-term declines in ecosystem function with loss of mussels.

Keywords: Stream and River, Climate Change, Water Issues, drought, intermittent streams, food webs, ecosystem function

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Oklahoma State University

A burning question: Can wildfire risk be predicted through physiological drought responses in eastern redcedar?

Encroachment of *Juniperus virginiana*, eastern redcedar, due to fire suppression, is one of the greatest contributors to the degradation of Oklahoma's grassland systems. Mature trees are unlikely to burn during wet periods. However, during extended dry periods when live fuel moisture (LFM) approaches 80% they become more ignitable and combustible. Currently, the amount of drought that is necessary to cause reductions in LFM is unknown. To identify factors that contribute to wildfire risk we examined correlations between LFM in *J. virginiana* and leaf water potential (ψ) along with other abiotic influencers of drought stress. Using a dual greenhouse/field experiment we addressed both how environmental factors directly influence LFM, as well as how drought impacts eastern redcedar physiology. In the greenhouse, we watered eastern redcedar saplings to field capacity at the start of the experiment. We ceased watering on all redcedar saplings except for the randomly chosen controls. All saplings were measured twice a week for ψ and LFM. Simultaneously, we measured all pots gravimetrically for soil moisture. The field study was designed to relate greenhouse results to realistic field conditions. We chose 3 sites in Oklahoma with different levels of annual precipitation: Woodward (dry), Stillwater (middle), and Cookson (wet). We measured LFM, ψ , and soil moisture in the field through a range of seasonal variation in climate. Additionally, we used data from the Oklahoma Mesonet to further construct models for predicting LFM. In both the field and greenhouse experiments, we observed relationships between LFM and ψ , and soil moisture and ψ . Both the greenhouse and field experiment showed that eastern redcedar foliage crosses below 80% LFM under drought conditions that frequently occur in Oklahoma. Overall, our results demonstrate that increased drought conditions alongside future climate shifts could frequently cause elevated wildfire risk in Oklahoma's forests.

Keywords: Invasive Species, Fire and Prescribed Burning, Climate Change, Eastern redcedar, tree physiology

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Oklahoma Conservation Commission

Status and trends of non-point source pollution in the wadeable streams of Oklahoma

The Oklahoma Conservation Commission (OCC) is tasked with monitoring non-point source (NPS) pollution in wadeable streams throughout Oklahoma. Beginning in 2000 OCC began the Rotating Basin Program where the state was broken into five basins. Two basins were monitored each year, and each spring, one basin was exchanged for another so that each basin was monitored for 1-2 years in any 5-year interval. Although the program has resulted in nearly two decades of physicochemical and biotic data from > 300 streams throughout Oklahoma, it does leave temporal gaps in data coverage across the state. Further, the extreme wet-dry weather cycles that Oklahoma has experienced since the beginning of the Rotating Basin Program can cause potential problems in comparing basins over time, particularly when comparing metrics obtained during drought years to those obtained during wet years. We present the status of NPS in the state's wadeable streams and investigate trends in the physicochemical and biotic integrity since 2000, while gaining a better understanding of the effects of weather on our water quality indices. Our analyses allow us to make inferences about NPS during years that a particular area was not monitored and adjust our estimates according to extreme weather patterns.

Keywords: Stream and River, Water Issues, Non-point source pollution, Environmental monitoring, wadeable streams

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Leopard Darter population and Percid community variability in the Little River Drainage of Southeast Oklahoma and Southwest Arkansas

Long-term monitoring of the Federally threatened Leopard Darter, *Percina pantherina*, has occurred at 19 permanent and numerous rotating sites in five river drainages in the Little River system of southeast Oklahoma and southwest Arkansas since 1998. Leopard Darter populations exhibit high annual fluctuations, but have generally remained stable in the Oklahoma portion of their range (Little, Glover, and Mountain Fork Rivers). Survey results in the drainages in Arkansas suggest declines to near extirpation (Cossatot River) and likely extirpated (Robinson Fork of the Rolling Fork River). We used estimations of search efficiency from depletion surveys, measured water quality data, and derived seasonal weather patterns to explore the sources of variation in yearly surveys. Additionally, we used detrended correspondence analysis to find associative trends within the Little River drainage darter community.

Keywords: Fisheries, Stream and River, Population Management, Species of Concern, Water Issues, Threatened species, Long term monitoring

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Oklahoma State University

Identifying Potential Spawning Habitat for Paddlefish in the Verdigris River

The American Paddlefish (*Polyodon spathula*) was once widely distributed through the Mississippi River Valley and adjacent Gulf slope drainages, but has been extirpated from much of their native range due to overfishing and habitat degradation from channelization and damming of American waterways. To mitigate these losses, restoration stocking has occurred in the reservoirs created by dams in Oklahoma with variable success. One factor thought to effect restoration success in these reservoirs is spawning habitat availability. To complete their life history, Paddlefish make spawning migrations upriver in the spring when an increase in flow, temperature, and photoperiod all coincide. Once these parameters meet a sufficient level, Paddlefish lay adhesive eggs on hard substrates, without which they may be unsuccessful. Using recreational grade side-scan sonar, we mapped potentially suitable spawning habitat in 50 river km of the Verdigris River, the only tributary to Oologah Lake, which was successfully restored through Paddlefish stocking in 1995-2000. In spring of 2019, side-scan imagery and depth points were simultaneously collected and a habitat map of the Verdigris River in a 3-D environment (through creation of a Triangular Irregular Network (TIN)) was created. Using these data, we identified four classes of potentially suitable substrate (Gravel, Cobble, Boulder, Bedrock) that are abundant throughout the mapped area.

Keywords: Fisheries, Restoration, Stream and River, Species of Concern, Sampling Techniques, Paddlefish, Reservoirs, Restoration, Habitat

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Oklahoma State University

The Influence of *Cyprinus carpio* on Macroinvertebrate Communities in the Nebraska Sandhills.

Invasive species like the common carp (*Cyprinus carpio*) threaten the health and integrity of aquatic ecosystems. The Nebraska Sandhills region consists of 19,000 square miles of large grass-stabilized sand dunes and topographic lows between the dunes are generally occupied by shallow lakes, wetlands, or wet meadows. These wetlands and their associated shallow lakes are an ideal environment to evaluate the impacts of carp infestation and removal because of the large number of water bodies in the Sandhills that are vulnerable to carp invasions. To help understand the influence of carp on these ecosystems, we collaborated with the Nebraska Game and Parks Commission (NGP) to conduct an ecological assessment of 21 Sandhills lakes. We collected water quality samples and characterized benthic and littoral macroinvertebrate community data from 12 lakes infested with carp, and 9 carp-free lakes in 2018 and 2019. We created a macroinvertebrate Index of Biological integrity (IBI) that shows carp have a significant negative effect on both benthic and littoral macroinvertebrate communities in these lakes. We also used ordination methods to assess the relative influence of various abiotic and biotic factors on macroinvertebrate community composition, since carp can directly and indirectly influence aquatic ecosystems. As part of this ongoing research, we will compare our IBI with data collected by the NGP on aquatic bird usage, fish community, and vegetation structure of these same lakes to better understand how common carp are influencing these important shallow aquatic ecosystems.

Keywords: Fisheries, Restoration, Invasive Species, Water Issues, Macroinvertebrates, Wetlands

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Oklahoma State University

The diet selection and grazing distribution of beef cattle with varying efficiency scores.

Improved cow efficiency could drastically reduce input costs since feed is the single largest source of input cost in the beef industry. One measure of efficiency, residual feed intake (RFI) is the difference between an animal's actual feed intake and expected intake based on body weight and growth. Little is currently known about if foraging behaviors are associated with RFI and if selection against high RFI cattle could affect cattle diet selection and grazing distribution. This study used global positioning system (GPS) collars to collect spatial data on 38 Angus and 5 Brahman × Angus heifers with known RFI values in a 69ha pasture in the south-central Great Plains over a 30 day period and DNA-barcoding to identify plant species in their diet. No differences were observed in plant community selection among RFI groups. In addition, low-RFI (efficient) heifers did not select diets that differed in percent crude protein ($P=0.60$) or digestible organic matter ($P=0.38$) from mid-RFI (average efficiency) or high-RFI heifers (inefficient). RFI groups were similar in the amount of protein acquired from each plant family; only two of ten families differed in protein abundance among RFI groups ($P<0.03$) in the conservative classification and in the extreme classification only one of ten families differed in protein abundance ($P<0.01$). High-RFI heifers traveled further ($P=0.04$) than low-RFI heifers from midnight to sunrise and had greater spatial search patterns ($P=0.01$) but had similar distance traveled over the 24-hour period. Area explored, shade use, water use, and slope use were all similar among RFI groups ($P>0.05$). Within RFI groups, low-RFI heifers tended to have greater variability within each distribution variable.

Keywords: Prairie, GIS/Remote Sensing, Grazing Management, Range management

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Oklahoma State University

Crayfish – how they invade and what it means for Oklahoma

Invasive species are among the leading causes of imperilment and extinction within aquatic organisms in North America. They displace native congeners through direct interactions via competition and hybridization, act as disease vectors, disrupt trophic structures, and alter the abiotic factors of an aquatic system. Invasive crayfishes have spread throughout the world via human mediated translocation and have changed the aquatic landscape. Their success is attributed to their adaptive life history strategies, dispersal capability, and rapid population growth. Here we discuss major effects of invasive crayfishes and management control plans to limit invasion. We also highlight major knowledge gaps pertaining to invasive crayfishes within Oklahoma including potential invaders, dispersal capability, and ecological impacts to native species and novel environments. We will focus on modeling invasive species occupancy within an urban environment, define the role of reservoirs as source populations of invasive crayfish, and model dispersal potential of invasive crayfish including life history difference within the Ozark Highlands ecoregion.

Keywords: Invasive Species, Crayfish

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Evaluation of Water-Energy-Food nexus and Sustainable Livelihoods of Local community in Gidabo River Basin, Southern Ethiopia.

Access to clean water, modern energy services and sufficient food supply i.e., Water-Energy-Food (WEF) nexus is fundamental for sustainable livelihoods of local community. Despite the WEF nexus focus for food security, addressing trade-off and realizing synergies are overlooked and received limited attentions from livelihoods perspectives. Therefore, the current study aims to investigate its response to sustainable local livelihoods. The qualitative and quantitative data is

used to draw causal loop diagram to map complex system interconnections of nexus variables. The result of analysis shows that there is a missing links among WEF nexus implementation. Even though, there is a potential source of water and land, the livelihoods of local community face challenges of water and food security. Therefore, systematic dynamic approach integrating water and agricultural land is needed to feed fast growing populations in the basin; these avoid nexus trade-off and enhance the sustainable wellbeing of local community.

Keywords: Conservation Projects and Planning, local community, livelihoods, sustainability, water-energy-food nexus.

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Effects of acclimation on cattle response to humans while being handled.

The objective of this study was to evaluate the impact of previous human interaction on the behavior of beef cows while they are being handled. To achieve this, 84 F-1 Angus x Brahman cows were randomly assigned to one of two human interaction treatments. The positive human-animal interaction group (P) was subjected to daily contact with a herdsman (on foot) for 15 minutes and was fed supplement by the herdsman. The control group (N) was checked daily and fed from a vehicle, with no direct human interaction. Each acclimation procedure was replicated in 2 pastures/herds (n=16 to 26 cows in each herd). During routine processing times for these herds (d 0, 256, and 317), herds were gathered from their pastures and temperament was assessed. Chute and alley scores were assigned to individual animals by the same trained observer and ranged from 1 (calm) to 5 (aggressive). Chute exit velocity was also measured. Temperament variables were evaluated with ANOVA as a split plot with acclimation procedure in the whole plots and pasture as the whole-plot experimental unit, and processing time in the split plot. Neither human interaction (P=0.99) nor time (P=0.13) affected chute exit velocity. Chute score increased through time (P=0.01) but was not affected by human interaction (P=0.70). Alley score was not affected by human interaction (P=0.32) or time (P=0.81). Neither time nor the specific type of human acclimation we implemented affected cattle temperament, indicating other traits may be more important. Alternatively, different acclimation procedures may be more effective to improve cattle temperament.

Keywords: Prairie, Livestock handling, Behavior, Acclimation

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Oklahoma Department of Wildlife Conservation

Identifying Factors Influencing Constituent use of ODWC Management Areas

The Oklahoma Department of Wildlife Conservation is the lead agency responsible for the management and protection of our State's fish and wildlife populations and habitats. For decades the Department has set about the task of identifying and purchasing additional lands and access areas to help aid this vital mission, as well as increase constituent opportunity, use, and enjoyment. Useage patterns were needed to better inform management efforts, guide fund allocations, and advise possible future acquisitions. From July 2018 to September 2019, we fielded a series of 24 TRAFx counters at 6 separate areas representative of a broad range of variables thought to influence constituent use. Trail cameras were used in tandem with counters at select locations to validate counter data and provide additional insight. We used regression techniques to model counter data and found gun range presence and distance to major metropolitan areas to be highly influential on area useage. Time of year (i.e., hunting season) was also an influential factor. The TRAFx counters, though not without their flaws, proved to be useful tools for providing useage insight, prioritizing limited resources, as well as informing enforcement efforts.

Keywords: Fisheries, Wildlife, game species, Human Demographics, Land use, Adaptive management, Resource allocation

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What makes a weed? Comparison of native annual vine and problematic invaders.

Squirting cucumber vine, *Cyclanthera naudiniana* (formerly *C. dissecta*) is an annual vine native to Oklahoma that shares many traits with problematic invasive plant species. Researchers from Southwestern Oklahoma State University have monitored a local population of squirting cucumbers for ten years. During that time, the population has fluctuated from a low of 14 individuals to a high of nearly 3,000. Here we examine this data set in light of common hypotheses about invasion. We investigate the roles of season length, biological threats (insects and disease), disturbance, and dispersal, in population size and distribution of squirting cucumber, further analyzing how these factors may play different roles in population dynamics of this native ruderal vine compared to problematic invaders.

Keywords: Invasive Species, Native, Vine

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ODWC

Go Big or Go Home: Florida Largemouth Bass Introduction into a Northeastern Oklahoma Reservoir

Largemouth Bass has long been the most sought after fish by Oklahoma anglers according to angler surveys dating back to the early 1980's. Oklahoma has successfully influenced bass genetics in southern Oklahoma reservoirs by stocking fingerlings of the Florida subspecies *Micropterus salmoides floridanus*. These stockings have been ongoing since the 1970's, and for the first thirty years it was implemented statewide. During the 1990's, through advances in technology, it was found that stocking success of *M. s. floridanus* in northern Oklahoma reservoirs was poor. The success and failure of this subspecies correlated with a 3400 heating degree days threshold, which virtually made a horizontal line through Oklahoma in the area of Interstate 40. After the year 2000, most of the reservoirs north of this line were no longer stocked with fingerling *M. s. floridanus*. For the last twenty years southern Oklahoma has flourished with record-sized bass, of which most have had *M. s. floridanus* genes. The Oklahoma Department of Wildlife Conservation state fish hatchery in Durant retains some *M. s. floridanus* fingerlings to replace aging broodstock. The numbers of fish that have been reared to one year of age has increased, and there are now excess fish. The past four years (2016-2019) some of these excess fish have been stocked north of the 3400 heating degree days line into Eucha Lake. Prior to this project, there were no records of *M. s. floridanus* stockings into Eucha Lake. Genetic samples of largemouth bass from Eucha Lake in 2015 and 2016 showed 100 percent northern strain largemouth bass (*Micropterus salmoides salmoides*). Genetic samples were again taken in 2018 and 2019. *M. s. floridanus* genes were found in 2.5 percent of the samples from 2018, and 14.5 percent of the samples from 2019.

Keywords: Fisheries, Population Management, Largemouth Bass, Oklahoma, Florida, Trophy

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Thermal ecology and multi-scale nest site selection of scaled quail

Temperature is a critical component of wildlife habitat. Temperatures near the ground can vary at fine scales across the landscape, and the resulting microclimates may provide refuge for organisms during extreme temperatures. Thermal refuge is particularly critical for ground-dwelling birds during the nesting life stage. Nest temperatures influence both embryonic development and adult incubation behavior, with important implications for nest survival. Scaled quail (*Callipepla squamata*) demonstrate selection for cooler nest temperatures on the far eastern edge of their distribution. Given the large geographic distribution of this species, more research is needed to better understand how temperature

influences nest site selection and nest fate among disparate populations. We investigated nest site selection of scaled quail in southeastern New Mexico at two spatial scales: the nest bowl and the area surrounding the nest bowl. We measured microsite temperatures, vegetation, and topography at both nest locations and stratified random locations. Nests were characterized by taller, denser grass cover at both scales. Quail only selected for shrub cover at the nest bowl, and nest bowl temperatures remained distinctly cooler than nearby microsities. However, selected nest site characteristics were not found to influence either nest fate or daily nest survival. Our results suggest that scaled quail make hierarchical decisions when selecting nest sites, and these decisions influence temperatures at the nest. Examining nest site selection at multiple scales may illuminate the relative benefits of selected characteristics and provide insight into mechanisms influencing nest fate.

Keywords: Wildlife, game species, Landscape Ecology, Quail, Thermal ecology, Habitat selection

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Influence of Spring Run Tributaries on Temperature and Fish Assemblages in the Blue River and Little Blue Creek in South-Central Oklahoma

Lotic systems are generally thermally unstable, with temperatures fluctuating seasonally. In contrast, springs and spring runs are often thermally stable due to groundwater discharge influence, and may provide thermal refugia within the springs and within the mainstems into which they feed. Our objective was to assess the thermal influence of spring runs on the Blue River and Little Blue Creek in Johnston County, Oklahoma. We used data from transects along the longitudinal and lateral gradient of the mainstem systems along with Global Information Systems (GIS) technology to construct two-dimensional thermal maps. Distinct longitudinal and lateral temperature shifts were found in mainstem systems associated with seasonal shifts and spring run temperature influence. We found that thermally stable spring run tributaries influenced mainstem temperatures, creating a gradient of thermal habitat extending at least 100 m downstream of tributary confluences. These thermal regimes may be important thermal refugia for fish, and illustrate an important ecological function of active, flowing springs.

Keywords: Fisheries, Stream and River, GIS/Remote Sensing, Springs, Temperature

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Hierarchical Habitat Selection and Behavioral Trade-offs By Greater Prairie-Chicken Broods

Alternative management strategies that result in heterogeneous grasslands have been put forward as important conservation strategies for grassland birds. These practices result in grasslands composed of a mosaic of seral stages that differ in vegetation composition and structure and can influence the availability of resources important to grassland birds. In particular, Greater prairie-chickens (*Tympanuchus cupido*) have been shown to respond positively to these practices as this species will use different seral stages for different parts of its life cycle. Relatively few studies have focused on habitat selection of female greater prairie-chickens with broods. The objectives of our study are to investigate brood selection for vegetation structure and thermal cover in a grassland managed for heterogeneity with fire and grazing. Broods showed strong selection for patches that had been burned and grazed in the previous 12 months. Within recently burned patches, selection for vegetation structure did not differ from what was available on the landscape at locations where broods were located in the mornings; however, afternoon locations had greater grass cover and visual obstruction, and less bare ground. Additionally, brood locations appeared to be thermally buffered compared to morning and random landscape locations, with afternoon sites experiencing fewer temperature extremes. These results underline the importance of grassland heterogeneity for wildlife habitat selection at both patch and within-patch levels.

Keywords: Wildlife, game species, Prairie, Landscape Ecology, Greater Prairie-Chicken, Habitat Selection, Grasslands, Thermal Ecology

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Angler Catch and Attitudes Toward Black Bass in Oklahoma Ozark Streams

Natural resource biologists have often focused on black bass fisheries management within impounded waters, however, streams offer a variety of black bass angling opportunities that differ from those in impoundments. To better understand how anglers interact with these resources, we conducted an angler tag-return study and a creel survey in three tributary streams of Lake Tenkiller, OK, from May to August of 2019. The three study streams varied in size and accessibility, from the large and easily-accessible Illinois River to the small and difficult-to-access Caney Creek, with Baron Fork an intermediate of both aspects. We tagged a total of 948 black bass (in proportion to species availability at each site), and completed a total of 114 angler interviews. Both datasets indicated that Smallmouth Bass made up 78-100% of angler catch, with very little harvest reported. Angler demographics also varied greatly by stream, with Caney Creek anglers traveling less distance on average, and from areas representative of lower mean household incomes, than anglers using the other two streams. Interestingly, when anglers were asked about whether their fishing interest would decrease, increase, or remain the same when told about the unique Neosho subspecies of Smallmouth Bass in the area, anglers at the Baron Fork and the Illinois River had 30-38% of responses indicating an increase in interest, whereas Caney Creek anglers had no increase in interest. Caney Creek anglers were also more harvest-oriented – generally favoring a lower length limit and an increased bag limit – in comparison to anglers at other streams. Our results illustrated that different socioeconomic populations of anglers are drawn to different streams, yet trends in catch and harvest appeared consistent across the study area.

Keywords: Fisheries, Stream and River, Human Demographics, river access, creel survey, exploitation

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Defining "Fish Regions" for Oklahoma

The species of fishes in Oklahoma exhibit a variety of distributional patterns across the state, with some species confined to discrete areas (e.g., Ozarks or far southwest Oklahoma) and others occurring statewide. We are currently preparing a regional identification guide for Oklahoma fishes and, in that context, are working to define regions that capture distributional differences and are also user-friendly for both professionals and lay persons. Using our own dataset of 170 locations within the Red and Washita River basins, we will match fish community variation with Hydrologic Units (HUCs), EPA Ecoregions, and biotic regions defined by Blair and Hubbell in 1938. Our final designation of Fish Regions will be related to the concordance of fish distributions with these predefined areas but may differ somewhat. The Fish Regions must also allow users to easily identify the boundaries of the region and may therefore be modified to include major landforms or even highways. For the book, this approach will be expanded to include all watersheds in Oklahoma.

Keywords: Stream and River, native fishes, fish distribution, fish communities

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Assessment of the conservation status of the Western Fanshell (*Cyprogenia aberti*) and update on the continuing assessment of other freshwater mussels (*Bivalvia: Unionoidea*) occurring in Oklahoma

The U.S. Fish and Wildlife Service (Service) is currently reviewing the conservation status of many species that may qualify for protection as federally-listed endangered or threatened species. Species under recent review by the Service and whose ranges extend into Oklahoma include three freshwater mussels (*Bivalvia: Unionoidea*): the Western Fanshell (*Cyprogenia aberti*), the Louisiana Pigtoe (*Pleurobema riddelli*), and the Purple Lilliput (*Toxolasma lividum*). The Western

Fanshell's range includes a portion of the Verdigris River in northeastern Oklahoma, the Louisiana Pigtoe's range includes portions of the Little River in southeastern Oklahoma, and the Purple Lilliput's range may include various streams in eastern Oklahoma. The Service's review process involves performing a particular procedure, termed a Species Status Assessment (SSA). While the Service initiated SSAs on the Louisiana Pigtoe and Purple Lilliput in 2018, it initiated an additional SSA on the Western Fanshell in 2019. The SSA procedure includes compilation of available information on the species' populations and habitats, analysis of factors that influence the species' condition, and forecasts of probable future scenarios and the species' likely responses. In the case of the Western Fanshell, performance of the SSA is complicated by the existence of cryptic diversity within the genus *Cyprogenia*, which has confused understanding of species boundaries and distributions. For all species under status review, the Service wishes to incorporate the best available scientific information into its SSAs, and requests pertinent information from interested parties who may be knowledgeable about the species' life histories, populations, and habitats, and the range of conditions potentially affecting them.

Keywords: Conservation Projects and Planning, Species of Concern, Freshwater mussels, Species Status Assessment, SSA, Cryptic species

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Keeping your ducts in a row: Defense mechanism and annual growth response to drought and fertilization treatments in *Pinus taeda*

Pinus taeda L. is a plantation species worth billions of dollars industrially. Bark beetles are known to cause widespread mortality to the species. As cold winters are a key constraint for bark beetle populations, concern of predation is increasing with drier and warmer climates constantly approaching. This study utilizes Tier III PINEMAP sites consisting of various treatments and strategic site placement to simulate future climate change with interactions of fertilization and drought treatments. By focusing on resin flow, resin duct characteristics, and annual growth, this study seeks responses in *P. taeda* to predicted climate variations within plantation-like management. With this information, we may predict the best methods to proactively manage *P. taeda* stands for bark beetle predation in a changing environment.

Keywords: Species of Concern, Climate Change, Dendrochronology, Resin ducts, Bark beetles, Drought response

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Understanding Climate Change resiliency of Oklahoma forests using FVS and Conjoint Analysis

The forest-grassland ecotone in the southcentral US is the tension zone between two major biomes and provides a number of important ecosystem services. Active management in the region using prescribed fire, forest thinning/harvesting, grazing, and herbicides can optimize desired benefits for landowners with a variety of management objectives. However, periodic severe droughts that plague this area and increasing climate variability will profoundly affect the productivity, resilience, and stability of ecosystems. We aim to facilitate sustainable management of the forest-grassland ecotone for different combinations of objectives such as timber, grazing, and wildlife habitat based on recent conditions and to adapt management to mitigate the negative effects of future drought and potential climate change. To this end, we are assessing the value of timber, cattle forage, and deer habitat. The preliminary findings suggest that a cumulative impact of management intensity, market value of natural resource commodity, and the production potential determine the economic value. Tailoring research findings with the appropriate outreach materials will help educate traditional and non-traditional forest stewards in the region.

Keywords: Wildlife, game species, Climate Change, Active Management, Economic Valuation, Conjoint Analysis, FVS

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Gear Bias of Low-Frequency Electrofishing for Flathead Catfish *Ptyodictis olivaris* in Reservoirs

Flathead Catfish are popular among anglers and many anglers favor the development for trophy catfish fisheries. Unfortunately, information about sampling Flathead Catfish is limited. Inadequate sampling and potential sampling bias are primary concerns of agencies managing Flathead Catfish. Low frequency electrofishing (LFE; < 30 pulses per second [pps], commonly 15 pps) is the preferred method for sampling Flathead Catfish. Although, the accuracy and precision of this gear is unknown, many think it may be biased against fish >600mm. Our goal was to quantify the accuracy and precision of LFE for Flathead Catfish at different temperatures using marked populations. Since May 2019, we tagged Flathead Catfish in Lake Carl Blackwell (n=563) and Lake McMurtry (n=485) with numbered modified Carlin Dangler tags. Preliminary results suggest that Flathead Catfish catch rates begin to decrease when the temperature is <21°C, and we have had disproportionately fewer recaptures of fish > 500 mm TL. We plan to continue our mark-recapture study throughout September 2020 to compare the catch rates over a range of temperatures.

Keywords: Fisheries, Sampling Techniques, Catfish, Electrofishing, Gear Bias, Reservoirs

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Native bee biodiversity, Oka'Yanali and Pontotoc Ridge Preserves.

There are around 20,000 species of bees in the world, many of which play an important role in the pollination of plant species. It has been estimated that 90% of flowering plants must be pollinated by some biotic vector and approximately 75% of these plants serve humans directly as food. From this point of view, bees, besides being a key element in ecological dynamics, also play a preponderant role in human society and economy. For example without crop pollination by bees, possible food shortage with subsequent societal domino effects could result. Additionally, studies of ecosystem service estimate that bees provide valuable monetary input, supporting our economy. Here, we collect and identify local bee species. Our study sites, located in South-Central Oklahoma, were Nature Conservancy preserves: Oka'Yanahli and Pontotoc Ridge. Collections, using entomological nets, were made twice weekly from May to September 2018. Specimens were subsequently pinned and labeled with collection information. To date we have identified 44 bee species belonging to 5 different families. Out of over 500 collected samples, half have been identified to species, thus, we expect that our list is presently conservative. Knowing the diversity of our pollinators could and should be fundamental. Oklahoma is poorly represented relative to the rest of the United States and this list helps to rectify this deficiency. Our lack of local knowledge is alarming, especially given the honey bee *Apis mellifera* colony collapse disorder and an inability to quantify the decrease in native pollinators. Management plans that consider native bees, landscape ecology and environmentally friendly practices are encouraged.

Keywords: Wildlife, non-game species, Conservation Projects and Planning, Anthophila, Apoidea, Hymenoptera, Entomology

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Occurrence of diminutive Great Plains fishes related to seasonal flow patterns

Flow alteration is hypothesized to contribute to the decline of pelagophil fishes within the Great Plains. Our study objective was to develop relationships between flow metrics and the occupancy of Arkansas River Shiner, *Notropis girardi* and Plains Minnow, *Hybognathus placitus* while accounting for imperfect detection. We used existing fish-assemblage data collected from the Southern Great Plains and discharge data from U.S. Geological Survey stream gages to examine species occupancy related to flow patterns. We selected flow metrics representing components of the flow regime (magnitude,

frequency, duration, timing, and rate of change) and hypothesized to be ecologically important to pelagophils. We included a precipitation gradient and a disturbance index to account for natural range restrictions related to climate while considering possible land-use effects. Longitudinal river fragment length was also included to account for occurrence related to connectivity. Average detection probability was higher for Plains Minnow. Detection probability for Arkansas River Shiner was highest in warmer months. Higher seasonal predictability of flooding decreases the occurrence of both species. Occurrence of Plains Minnow also decreases with increased variability of high flow pulse count and had higher occurrence probability in longer river fragments. These flow relationships are useful for informing future conservation strategies for pelagophil fishes.

Keywords: Fisheries, Prairie, Stream and River, Species of Concern, Native, Non-game

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Environmental Solutions & Innovations, Inc.

Population Status, Home Range and Foraging Habitat of Northern Long-eared and Tri-colored Bats during Fall Swarm at Ozark Plateau National Wildlife Refuge

Ozark Plateau National Wildlife Refuge (OPNWR) is comprised of 1,700 hectares in the Boston Mountains and Ozark Plateau region, and is home to several federally listed bat species, including: gray (*Myotis grisescens*), Ozark big-eared (*Corynorhinus townsendii ingens*), northern long-eared bats (*Myotis septentrionalis*). Starting in 2015, harp trapping was conducted biannually at three cave entrances during fall swarming and spring emergence as part of an ongoing population study. In 2016 these caves tested positive for the fungus causing white nose syndrome and have since seen drastic decreases in populations of northern long-eared and tri-colored bats (*Perimyotis subflavus*), with decreases in capture rates as high as 99 percent. During fall swarming in 2018, a ground-based foraging study was completed, in tandem with the population study, on these two species. Four northern long-eared and 13 tri-colored bats were radio tagged and synchronized azimuths were gathered from five stations for five nights. Mean home range of northern long-eared bats was 196.0 ± 83.7 ha, and mean location distance ($n=84$) from the swarm site was $1,337.8 \pm 192.3$ m. Mean home range for the tri-colored bat was 91.6 ± 11.8 ha, and mean location distance ($n=103$) from the swarm site was 609.0 ± 76.6 m. Field surveys provided finer-scale habitat data than available from the National Land Cover Dataset; compositional analysis and linear regression showed that both species use breaks in the forested landscape, such as trails, to a greater degree than those habitats are available on the landscape. Both species used second-order and larger streams more than first-order streams, wetlands, ponds, or lakes. These data will continue to be used by resource managers tasked with decisions about the future viability of these species on conservation and management lands.

Keywords: Wildlife, non-game species, Species of Concern, Endangered Species, Habitat Use, Spatial ecology

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Potential climate impacts and conservation strategies for stream fishes in the Red River

Climate change is expected to alter the distributions of species around the world, but estimates of species' outcomes vary widely among competing climate scenarios. Here, we quantify variation in fish species distributions across future climate scenarios and explore conservation strategies that account for uncertain outcomes across climate scenarios. First, we investigate projected changes in water availability and demand across the Red River to identify regions of potential future water stress. We then model historical and future stream fish distributions using a suite of environmental covariates derived from high-resolution hydrologic and climatic modeling of the basin. We quantify variation in outcomes for individual species across climate scenarios and across space, and identify hotspots of species loss by summing changes in probability of occurrence across species. Under all climate scenarios, we find that the distribution of most fish species in the Red River Basin will contract by 2050. However, the variability across climate scenarios was more than 10 times higher for

some species than for others. Despite this uncertainty in outcomes for individual species, hotspots of species loss tended to occur in the same portions of the basin across all climate scenarios. Our results suggest that while it may be difficult to predict which species will be most impacted by climate change, it may nevertheless be possible to identify spatial priorities for climate mitigation actions that are robust to future climate uncertainty. We discuss strategies for stream fish conservation that account for potential climate impacts and variability across future climate scenarios.

Keywords: Restoration, Conservation Projects and Planning, Stream and River, Climate Change, Fish, Climate, Conservation, Red River

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Understanding How Differences in Vegetation Change Across Landscapes Impact the Daily Movement Decisions of Northern Bobwhite

Understanding how animals move across a landscape is critical to understanding how landscape change impact the ecology of a species. In addition, animals likely select for different landscape features across different scales. In a world that is increasingly becoming fragmented, understanding how landscape change across different scales impact movement patterns of species is increasingly important. Until recently, answering these questions has been challenging; however, because of the recent accessibility and advancement in geographic positioning system (GPS) technology we are now able to begin to ask how animals are making movement decisions across landscapes at different scales. Northern Bobwhite (*Colinus virginianus*) is a species that has declined across most of its range over the last 30-40 years in large part due to habitat fragmentation. Little is known about how this species makes daily movement decisions at different scales across the landscape. In order to better maintain populations of this species, answering this question is key to guiding future conservation decisions for bobwhite. Oklahoma has one of the largest population of this species left in North America making this state one of the best places to address these movement questions. Since February 2018, we have placed GPS transmitters on bobwhite across Beaver River, Sandy Sanders, Packsaddle, and Crosstimbers Wildlife Management Areas in Oklahoma. In addition, we have used aerial imagery to create a normalized difference vegetation index (NDVI) across all four sites to better understand how these vegetation communities differ amongst themselves and between sites. This allows us to assess vegetation change in and between sites aiding in determining how Northern Bobwhite make movement decisions across a single landscape and a group of landscapes. Having this knowledge will allow us to better understand how to conserve landscapes that allows this species to persist on them.

Keywords: Wildlife, game species, Prairie, Landscape Ecology, Northern Bobwhite, Landscape Ecology, Vegetation Change, Geographic Positioning System

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The University of Oklahoma, Oklahoma Water Survey

Shore Bank Erosion due to Wave Action: An Experimental Study on the Effectiveness of Floating Wetlands in Reducing Wave Propagation in Reservoirs, Potential Implementation into Lake Thunderbird, Ok

Reservoir wave action can negatively impact shorelines from the constant displacement of soil from wave energy. Many reservoirs in Oklahoma have significant erosion along much of their shorelines which has resulted in significant deposition of eroded material, an increase in turbidity, diminishing fish/wildlife habitat, a loss of abundant amounts of trees, jeopardized utilities, and a decrease in the public use of the lake. In cooperation with the Central Oklahoma Master Conservancy District and the U.S. Bureau of Reclamation the focus of this study is to evaluate the effectiveness of floating wetland designs to reduce near-shore wave action in a central Oklahoma public water supply reservoir, Lake Thunderbird. Preliminary designs were researched and the wetland frames were installed and planted with native wetland plants in Lake Thunderbird in 2019 with the ultimate objective of stabilizing banks and reducing shoreline erosion. Objectives of the field implementation include: (1) wave reduction to reduce wave energy hitting the shoreline; (2) provide structural integrity of

the system under a variety of harsh conditions; (3) provide for vegetation growth and survival; and (4) provide habitat for birds, fish, and other aquatic organisms. The research team had varying degrees of success in meeting each of these objective. The accompanying presentation will address each of these objective through discussion of the field installation and design improvements of the floating wetlands, preliminary site data, and the future direction of the project.

Keywords: Restoration, Water Issues, Reservoir, Floating Wetlands, Shore Bank Erosion

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Oklahoma Department of Wildlife Conservation

Utilizing Mesonet Soil Temperature Data as a Surrogate for Real-Time Water Temperature in Oklahoma Reservoirs

Fisheries resource managers have a need to obtain real-time water temperature readings from local reservoirs in order to plan and carry out fishery management activities such as sportfish sampling and surveys. This study was conducted to determine if Mesonet soil temperature data could be used as an indicator of actual reservoir water temperatures. Onset tidbits were deployed to monitor water temperatures at eight study lakes in 2017 and 2018. Mesonet data were located at 119 locations throughout Oklahoma with appropriate local Mesonet towers assigned to each study reservoir. Soil temperatures at 10 cm below the sod strongly correlated to 32 inch depth tidbit water temperatures. Water temperatures were generally within 2 degrees F of the corresponding Mesonet tower 10 cm soil temperature throughout the year. Water temperatures were slightly cooler than sod temperatures from September through May, and were slightly warmer than sod temperatures during summer months (but still within 2 degrees F). This relationship between water temperature and 10 cm sod temperature is valuable to resource managers for conducting fish sampling events, and to resource users (anglers) to know when conditions are favorable to catch fish.

Keywords: Climate Change, Water, Temperature, Mesonet, Oklahoma

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Assessment of functional diversity of a managed pine-oak forest in southeastern Oklahoma using remote sensing techniques

The implementation of successful and sustainable management strategies is vital for conserving biodiversity and protecting vulnerable ecological communities from a number of anthropogenic effects. To quantify and monitor biodiversity in vegetation communities, trait-based measurements, such as functional diversity, are emerging as effective metrics. Physiological and morphological traits of plants can be measured using remote sensing techniques and used to calculate functional diversity to gain a better understanding of the role of management and disturbance on the functional diversity of a community. The objective of this study is to utilize multispectral imagery and light detection and ranging (LiDAR) to determine relationships between functional diversity and forest management strategies implemented at Pushmataha Forest Habitat Research Demonstration Area (FHRA). FHRA is a well-established mixed pine-oak experimental forest that includes management treatment units with various combinations of selective thinning, prescribed fire, and timber harvest. Across FHRA, we used discrete-return LiDAR data to calculate morphological traits, including Canopy Height, Foliage Height Diversity, and Total Vegetation Density. We calculated physiological traits, including Enhanced Vegetation Index, Chlorophyll Vegetation Index, and Normalized Difference Water Index, using Sentinel-2 multispectral satellite imagery. Preliminary results indicate differences between physiological and morphological traits between FHRA management units. For functional diversity analyses, we plan to calculate and compare three metrics of functional diversity, functional richness, evenness, and divergence, for each FHRA management unit. Information gained from this study can provide insight on the relationship between management practices and functional diversity, with significant implications for forest management throughout the region.

Keywords: Fire and Prescribed Burning, GIS/Remote Sensing, forest management, functional diversity, LiDAR

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Habitat preferences and temporal distribution of forest dwelling bats in northeastern Oklahoma.

Bats play important roles as aerial insect predators in the terrestrial ecosystems of northeastern Oklahoma. The bat community of northeastern Oklahoma is comprised of at least 10 species of vespertilionid bats, two of which are listed as threatened or endangered and one that is a species of conservation concern. The hibernation and overwintering requirements of cave-dwelling bats have been the subject of intense research. Less well known, however, are the foraging habitat requirements of these species along with information on habitat use and resource partitioning among competing species. We propose to better define the foraging habitats and vegetative associations of northeastern Oklahoma vespertilionid bats. We also intend to identify and model temporal and spatial patterns of habitat use among these species. Bat species will be acoustically sampled using passive monitoring equipment. Acoustic call data are identified to species and compiled according to habitat. This research more accurately identifies the foraging habitat preferences of bat species in northeastern Oklahoma. We expect to be able to better define patterns in temporal habitat use and provide more complete information regarding the spatial habitat associations of Oklahoma vespertilionid bats. The purpose of this research is to better define the foraging habitats and vegetative associations of Oklahoma vespertilionid bats. We hope to also be able to identify any seasonal shifts in habitat preferences of these bat species.

Keywords: Wildlife, non-game species, Sampling Techniques, bat, habitat

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Oklahoma Department of Wildlife Conservation

Feeding ecology of introduced Rainbow Trout and interactions with the native food web in an Ozark Highland stream

The introduction of nonnative salmonids in North America began prior to the 1900s in order to provide additional recreational opportunities for anglers. The body of literature surrounding effects of nonnative salmonids on aquatic ecosystems is prolific, but conclusions from these studies are often conflicting, which suggests ecological responses may not be generalizable across systems. Recent paradigm shifts in fisheries management have moved away from single-species management towards a holistic approach that values native fish communities. However, wildlife agencies continue to receive pressure to stock nonnative salmonids. Recently, a permit was requested to stock large Rainbow Trout in Spavinaw Creek. Spavinaw Creek is a spring-fed, Ozark Highland stream in northeast Oklahoma that supports a diverse native fish assemblage that includes several state species of conservation concern and the Neosho Smallmouth Bass. A multi-year, multi-faceted, field and laboratory study was developed to evaluate the potential effects of this stocking on the native fish assemblage. Part of the project includes assessing seasonal diet habits of Rainbow Trout, Neosho Smallmouth Bass and Redspot Chub to determine potential shifts in native predator prey use and diet overlap. Data from this project will guide management decisions regarding stocking Rainbow Trout in spring-fed Oklahoma streams.

Keywords: Fisheries, Invasive Species, Stream and River, Diets, Ecology, Rainbow Trout

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Wintering ecology of longspurs in the Southern Great Plains

Declining grassland bird populations of North America require full life-cycle conservation strategies. Prairie habitats of Oklahoma represent major portions of the stopover and wintering range for many species, in particular those of the longspur complex. Yet, because of grassland birds' non-breeding plumage and wandering flock behavior, along with inherent biases against conducting winter field work, there remains a paucity of information about how these species are using Oklahoma and northern Texas grasslands. Given the importance of knowing how longspurs and associated species are

using grasslands in the winter and how well they are surviving and thriving during these non-breeding periods, we are conducting ongoing surveys of grassland bird occupancy and abundance throughout open habitats of the region and supplementing these with targeted tracking of one focal species, the Chestnut-collared Longspur (CLO). Our aim is to develop habitat association models at both local and landscape scales to inform predictions of non-breeding distributions of grassland birds, in particular species of concern such as CLO along with McCown's and Smith's Longspurs. Our efforts to radio-track CLO are also affording us the ability to examine sex and age-class stratification by wintering latitude and within local flock hierarchies that may provide valuable insights into possible critical-mass thresholds for supporting non-breeding populations of the species.

Keywords: Wildlife, non-game species, Species of Concern, Landscape Ecology, Grassland birds, Species distribution modeling, Non-breeding

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University of Oklahoma

Assessing the impact of invasive brown widows (*Latrodectus geometricus*) on the ecological niche of four native black widow species in the United States

Unintentional transportation of invasive species due to globalization has extensive ecological implications for native communities. Invasive predators can have especially widespread ecological impacts, spanning from biodiversity loss to displacement of native species through competition and transmission of disease. Brown widows, *Latrodectus geometricus* (Araneae: Theridiidae), were first introduced to the United States in 1935 and have rapidly spread to many other states, including Oklahoma, in the past two decades. Unlike their native counterparts, brown widows are only known to reside in urban areas in close association with humans. Although brown widows' ecological niche has been previously studied, a more thorough analysis of the variables that influence their realized niche in conjunction with native widow niches is necessary to better understand the impact of invasion on native communities and the mechanisms behind their dispersal and successful colonization.

We expect invasive widows to be poorly modeled by the same variables as native species. Native species are expected to be restricted by climate and other ecological variables, while brown widows are expected to be restricted by anthropogenic variables associated with urban development.

Keywords: Invasive Species, Climate Change, Landscape Ecology, GIS/Remote Sensing, Species distribution, Community ecology, Invasive species, Dispersal

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Forest Bird Monitoring to Inform and Evaluate Silvicultural Treatments of Bottomland Hardwood Forests at Little River National Wildlife Refuge

Little River National Wildlife Refuge was established to protect bottomland hardwood habitats used by migratory birds. Current forest conditions were determined by a baseline timber inventory to develop the Refuge's Forest Habitat Management Plan (FHMP, 2005). The FHMP implements silvicultural treatments to produce Desired Forest Conditions developed by the Lower Mississippi Valley Joint Venture's Forest Resource Working Group. The Refuge's focal bird species require extensive bottomland hardwood forest with structural diversity, large trees, and frequent canopy gaps to maintain understory and midstory vegetation and permit regeneration of light seeded tree species. The species were selected due to their conservation importance, strong habitat associations with forested wetlands, and/or detectability using point count surveys. The FHMP identifies focal species for each forest structure component. In conjunction with FHMP implementation, the Refuge has been conducting standardized bird point counts since 2007. This survey consists of three components: probability of presence during a survey, probability of availability given presence, and probability of detection given availability and presence. We developed an integrated model to separate these three detection components and provide

abundance estimates for the available, present, and superpopulation of individuals, but the survey and models performance to estimate FHMP focal species and conditions remains untested. We tested this survey to estimate density of the focal species. We provide results of simulations using data collected on the refuge during 10-years of standardized point counts and recommendations for changes to long-term data collection to ensure forest bird monitoring data can: 1) be used to estimate abundance, density, and trend, 2) determine if bird response is attributable to forest treatments, and 3) if the habitat parameters needed by the focal species are attributable to forest treatments.

Keywords: Wildlife, non-game species, Species of Concern, Sampling Techniques, bottomland hardwood forest, land birds, detection, availability

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Epidemiology and genetic variation in the cnidarian parasite of Sturgeon and Paddlefish eggs, *Polypodium hydriforme*

The cnidarian roe parasite, *Polypodium hydriforme*, has a one-host life cycle with free-living adults and a parasitic larval stage that develops in oocytes of Acipenseriform fishes (sturgeons and paddlefishes). Morphological similarity suggests a single *Polypodium* species with a widespread distribution (Eurasia to North America). A stolon of connected tentaculate individuals emerges from spawned eggs, and subsequent fragmentation releases up to 100 benthic individuals. A specialized multicellular stage in mature individuals enables infection via contact with a fish larvae host. Post-infection life history is unknown prior to maturation of the fish host, when development within oocytes has been characterized. High infection rates (78%) and intensities (up to 100% of oocytes) for Sterlet *Acipenser ruthenus* is cause for concern given potential impacts on caviar production or wild recruitment of sturgeon or Paddlefish stocks. As part of larger investigations, we collected *Polypodium* from roe of American Paddlefish (*Polyodon spathula*) in Oklahoma and Montana, USA, and from Russian Sturgeon (*A. gueldenstaedtii*) for genomic analyses. Covariate data such as fish size, age, condition (gonadosomatic index), and year of collection aided in describing presence and intensity of infection. Results of this collaborative work include evidence for genetic divergence of Old and New World *Polypodium* based on housekeeping genes, however, little divergence between New World populations was observed, perhaps reflecting connectivity within river systems. Approximately half of fish were infected each year and infection intensity was negatively skewed. Presence of infection was positively associated with fish size and age, though negatively with fish condition while infection intensity showed no significant association with these variables. Relationships were consistent across years. Research on genetic variation among stolons within individual hosts is ongoing and will also be reported.

Keywords: Fisheries, Population Management, Species of Concern, parasite, caviar, conservation, epidemiology

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Behavior responses by native warmwater fishes in response to introduced Rainbow Trout

Rainbow Trout *Oncorhynchus mykiss* is among the most commonly stocked fish species, and the fish are often stocked at high densities outside of their native range. Non-native Rainbow Trout may compete for limited resources with ecologically-similar native species under particular environmental conditions. In the southern United States, Rainbow Trout are frequently stocked in warmwater streams where Smallmouth Bass *Micropterus dolomieu* is the native top predator. Correspondingly, our study objective was to determine the behavioral responses (i.e., aggressions and cover use) by Smallmouth Bass in response to introduced Rainbow Trout. Four density treatments were assigned to a series of artificial streams comprising a low Smallmouth Bass density, high Smallmouth Bass density, Smallmouth Bass with low Rainbow Trout density, and Smallmouth Bass with high Rainbow Trout density. Cover use by native Smallmouth Bass in the presence of non-native Rainbow Trout was assessed by establishing a PIT tag array that recorded fish use of cover over 24-hour periods of each trial. Results indicate that level of aggression by Smallmouth Bass was the highest at low densities of stocked trout and the frequency of these behaviors was always higher with trout compared to bass. The most common

aggression displayed was a charge. Our results also indicated Smallmouth Bass cover use was altered in the presence of introduced Rainbow Trout. Collectively, our results suggest behavioral adjustments by Smallmouth Bass in response to the introduced predator and could have bioenergetic consequences for our native sportfish.

Keywords: Fisheries, Behavior, Native species, Rainbow Trout, Smallmouth Bass

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Response of loblolly pine plantations to fertilization and eight years of simulated drought

Determining the long-term effects of reduced soil moisture availability on loblolly pine in the southern U.S. is central to refining plantation silviculture in response to climate change. Initially part of the Pine Integrated Network: Education, Mitigation, and Adaption Project (PINEMAP), the Broken Bow, Oklahoma Tier III site was installed in 2012, with treatments consisting of a factorial combination of 30% throughfall reduction and fertilization. During 3-years of severe drought (2012-2014), throughfall exclusion decreased diameter growth by 9% and height growth by 8%. In Spring 2017, stands were re-fertilized and half of each stand was thinned by stem injection of herbicide. Leaf area index (LAI) from the 2019 growing season indicate a 20% increase with refertilization and 7% decrease with throughfall reduction. Decreased LAI was associated with an 11% decrease in soil moisture (0-12 cm) during July 2019. Between 2012-2019 there was a significant relationship between tree basal area growth and Standard Precipitation-Evaporation Index (SPEI). Compared to the control treatments, the throughfall exclusion treatments showed greater sensitivity to SPEI and larger recovery in growth during periods of above average rainfall .

Keywords: Invasive Species, Climate Change, silviculture

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Estimating occupancy of Least Darter and sympatric spring-associated species

Least Darter *Etheostoma microperca* is a stream fish species of conservation concern that was historically sampled in Oklahoma from only a few locations with high groundwater flow. However, the realized Least Darter distribution and underlying habitat associations are unknown. Our study objective was to estimate occupancy for Least Darter while comparing ecologies of other spring-associated species such as Southern Redbelly Dace, Redspot Chub, and Smallmouth Bass in the Ozark Highlands and Cross Timbers ecoregions. These species are considered spring-associated species, so we included all species to determine how their occupancy differed from Least Darter. We sampled in summer 2018 and 2019 using repeat surveys with both snorkeling and seining. At each site, we measured a variety of physicochemical conditions that we hypothesized would affect species occupancy. Overall, our detection probability was relatively high at occupied sites for all species (> 0.5); however, snorkeling detection probability was higher. The probability of occupancy by Least Darter was positively related to low water velocity and cooler water temperatures. Additionally, we observed a strong relationship between Least Darter occupancy and backwater sloughs. Southern Redbelly Dace probability of occupancy was also positively related to cooler water temperatures. Smallmouth Bass and Redspot Chub were positively related to drainage area. This information will be useful for identifying the current Least Darter distribution in Oklahoma and improving stream fish conservation strategies in these ecoregions.

Keywords: Fisheries, Stream and River, Species of Concern

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Oklahoma Department of Wildlife Conservation

Assessing the loss of a diverse native mussel community

The Oklahoma Department of Wildlife Conservation (ODWC) and the US Fish and Wildlife Service (ODWC) assessed the loss to the native mussel community within the Arkansas River Drainage due to a dewatering event in Webbers Falls Reservoir. Methodology derived from the American Fisheries Society (AFS) special publication #30 were used to enumerate the mussel kill and calculate the spatial extent. The field assessment documented 17 species of mussels including species of greatest conservation need. This event has been classified as a catastrophic loss to the mussel community within this system and there are likely to be various ecological service losses for years to come.

Keywords: Fisheries, Stream and River, Species of Concern, Sampling Techniques, Water Issues, Non game, Mussels, Aquatics, Mussel Kill

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Exploring The Genetic Diversity Of Smallmouth Bass Within The Interior Highlands

The Smallmouth Bass (*Micropterus dolomieu*) is one of the most popular freshwater sportfishes in North America. In 1940, ichthyologists Carl Hubbs and Reeves Bailey described a morphologically distinct subspecies from tributaries of the Ozark Mountains, the Neosho Smallmouth Bass (*M. d. velox*), from the more wide-ranging Northern subspecies (*M. d. dolomieu*). The Neosho subspecies designation has been met with some criticism, but an allozyme survey by Stark and Echelle (1998) supported the distinctiveness of the Neosho and Northern lineages and discovered a third distinct lineage from the Ouachita Mountains. In recent years, we have conducted several microsatellite-based investigations that have quantified hybridization among lineages related to recent interbasin transfers and revealed complex patterns of spatial population structuring. In our most recent line of investigation, we conducted next-generation sequencing and used SNPs to: 1) reconstruct a phylogeny of Smallmouth Bass across its native range; and 2) build a conservation-oriented SNP panel. Our results confirmed three reciprocally monophyletic lineages of Smallmouth Bass. Each lineage also had varying degrees of geographic subdivision; for example, the Ouachita lineage contained two distinct monophyletic groups that corresponded to the Little and Ouachita river basins. The resulting phylogeny served as a blueprint for designing a medium-density (192 loci) SNP panel. We specifically designed the SNP panel to diagnose species- and subspecies- level identities, quantify introgressive hybridization, and delineate population-genetic boundaries within the Interior Highlands. Considering that the Neosho and Ouachita lineages occur along the southwestern extent of the Smallmouth Bass's geographic range, these lineages may harbor important adaptations that could be of heightened significance considering climate change projections in the region.

Keywords: Fisheries, Stream and River, Conservation Genetics, Sportfish Management

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Developing a Rapid Assessment Method for Determining the Condition of Floodplain Wetlands in Oklahoma

The continuing loss and degradation of wetlands emphasize the importance of being able to effectively assess the condition of remaining wetlands. Such assessments provide assistance in mitigating further loss of wetlands as well as provide guidance for restoring the functional capacity of degraded wetlands and creating mitigation wetlands. Rapid Assessment Methods (RAMs) have been developed throughout the U.S. to better assess the condition of wetlands. The benefits of RAMs are that they can provide reliable measures of wetland conditions without being prohibitively costly.

While many RAMs exist, they are either too broad in scope to be useful for assessing Oklahoma wetlands or they are too specific to cover the range of wetlands found in Oklahoma. A RAM (the Oklahoma Rapid Assessment Method [OKRAM]) has recently been developed for Oklahoma wetlands but has not been calibrated or validated for all wetland types in the state. The objective of this research is to apply the OKRAM to floodplain wetlands across the state to determine the OKRAM's effectiveness. In the first two years of the study, We assessed 58 floodplains on multiple river systems throughout Oklahoma. The data from these two years are being used to determine useful metrics and to calibrate OKRAM. We assessed each site using three assessment types: A Landscape Development Intensity (LDI) index calculated for each wetland using the Oklahoma Vegetation Project raster layer in ArcGIS, the OKRAM, and a biotic assessment consisting of a vegetation survey and soil analysis.

Keywords: Conservation Projects and Planning,Landscape Ecology,GIS/Remote Sensing,Sampling Techniques, Wetlands, Floodplains, Ecological Assessment

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Oklahoma Conservation Commission

Oklahoma's Abandoned Mine Land Reclamation Program

Oklahoma's Abandoned Mine Land Reclamation Program protects lives, repairs scarred land and improves the environment. Why does Oklahoma have an Abandoned Mine Land Reclamation Program and how does it protect lives, repair scarred land and improve the environment? This presentation answers those questions while educating the audience on the history, needs and natural resource challenges of reclaiming abandoned mine lands, concluding with an emphasis on soil health principles, practices and application.

Keywords: Restoration,Conservation Projects and Planning,Landscape Ecology,GIS/Remote Sensing, Reclamation, Health, Safety, Soil

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Striped bass exploitation, movement, and population dynamics in the lower Arkansas River basin

Striped Bass *Morone saxatilis* is an anadromous fish that has been introduced into various river-reservoir systems throughout the contiguous United States, with some populations completing their entire life cycle in fresh water. The land-locked populations of Striped Bass in the lower Arkansas River and its tributaries are some such populations. We know land-locked Striped Bass have temperature and dissolved oxygen limitations. However, the requirements for reproduction and recruitment in freshwater systems are not well understood. Physiological mechanisms for Striped Bass reproduction likely do not change. Nevertheless, water quality could have an effect on the fecundity of adult fish, a constraint rarely encountered by ocean-going Striped Bass. Improving our understanding of interactions between exploitation, movement, and tailwater habitats is critical to understanding population dynamics and successfully managing and conserving Striped Bass. Our objective is to evaluate the current exploitation rate, movement, and population dynamics of Striped Bass that use tailwater habitats in the lower Arkansas River Basin. We will tag Striped Bass with dual acoustic radiotelemetry transmitters in the lower Illinois and Canadian rivers. A combination of passive and active telemetry will be used to track Striped Bass movement between the lower Illinois, Canadian, and Arkansas rivers on a seasonal basis from 2020 to 2022. In addition, we will PIT and reward tag Striped Bass to estimate exploitation rate and population demographics. These data will be analyzed with a yield-per-recruit model that will estimate maximum sustainable harvest rate of Striped Bass. We will use the results of telemetry, PIT, and reward tag data in combination to determine Striped Bass population dynamics and susceptibility to overharvest. This study will determine the sustainability of Striped Bass angling, movement, and population dynamics of Striped Bass in the lower Arkansas River basin.

Keywords: Fisheries,Stream and River,Population Management,Water Issues, dams, sportfish, telemetry, harvest

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Climate change, freshwater mussels, and ecosystem services.

Ecosystem services are the benefits that humans derive from ecosystems. Freshwater mussels perform many important functions in rivers and lakes that can be in turn framed as the ecosystem services they contribute to or provide, such as biofiltration, nutrient cycling and storage, structural habitat, and food web support. Oklahoma rivers are home to a high diversity of freshwater mussels. Riverine mussels are threatened by the low water levels and high water temperatures that result from hydrologic drought, which in turn impacts ecosystem services. For example, losses of mussels linked to drought and water management in the Kiamichi River over the past 30 years have led to a 60% decrease in mussel-provided ecosystem services. Both the frequency and severity of hydrologic drought are predicted to increase in Oklahoma with climate change, thus we need to understand how this will impact mussels and the services they provide.

Keywords: Stream and River, Species of Concern, Climate Change, Water Issues

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Growth Patterns, Survivorship, and Space Use of Young Age Classes of Texas Horned Lizards on Tinker Air Force Base

With continued urbanization worldwide, many native species feel the strain of habitat loss and fragmentation. The Texas horned lizard is one such species, listed as a Species of Special Concern in the state of Oklahoma as it faces declining population numbers throughout its range. This study focuses to understand the population dynamics of the most vulnerable and understudied life stages, hatchlings and juveniles. From 2016 to 2019, a small, urban population of Texas horned lizards was monitored on Tinker Air Force Base in Oklahoma City, Oklahoma. Monitoring techniques included the use of VHF transmitters, harmonic radar, and morphometric data collection. Data analyses included home range mapping, Kaplan-Meier survival curves, the creation of a morphometric database, and varying statistical analyses. Many natural history questions will be addressed and answered, such as: What is the expected survival rate of wild-born hatchlings during their first active season? What are the growth patterns of wild-born juveniles during their second active season? And, what factors contribute to the movement patterns and establishment of a home range during that second active season? We expect this information to be of use to land managers and natural resources professionals helping to protect populations of this vulnerable species, as well as those interested in establishing new populations of horned lizards.

Keywords: Wildlife, non-game species, Population Management, Species of Concern, Herpetology

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Examining the relationship between Prairie Chub *Machrybopsis australis* spawning and environmental variables within the upper Red River basin.

Quantifying relationships between environmental conditions and reproduction is key to understanding recruitment dynamics. The upper Red River basin is a variable and extreme environment, where periods of both excessive rainfall and drought are common. Human alterations to the Red River stream network have placed additional stress on aquatic organisms by exacerbating extreme flow events. The Prairie Chub *Machrybopsis australis* is a pelagic-broadcast spawning cyprinid (i.e., pelagophil) endemic to the Red River basin and a species of greatest concern need in Oklahoma. The vulnerability of Prairie Chub to changes in flow alteration is thought to be largely attributed to its reproductive ecology. The reproductive strategy of Prairie Chub is relatively common among Great Plains minnows and relies on adequate discharge for successful recruitment. Synchronized spawning events are considered advantageous and may be related to changes in discharge and water temperature. We collected Prairie Chub young-of-the-year (YOY) from 6 locations within the upper Red

River basin between May through September 2019. We aged YOY otoliths and used back calculation to determine hatch dates. We modeled discharge and temperature variation for ten days prior to hatch to examine the relationship between environmental variability and spawning initiation. We found that Prairie Chub spawning events had positive relationships with both increased discharge and temperature. Our findings emphasize the importance of maintaining a natural flow regime during their summer reproductive season. Examining spawning cues and discharge requirements for Prairie chub reproduction can inform management regulations on water use that may have broader implications for this reproductive guild.

Keywords: Fisheries, Stream and River, Species of Concern, Pelagophil, Great Plains, Endemic, Recruitment

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Effects of eastern redcedar encroachment on ecosystem productivity and water use

Eastern redcedar (*Juniperus virginiana*) is encroaching tallgrass prairie ecosystems in the southern Great Plains disrupting multiple ecosystem services. These lands could be restored to native prairie or planted with switchgrass (*Panicum virgatum*) for use as a biofuel feedstock. While removal of redcedar tends to increase runoff, the tradeoff is unknown between ecosystem productivity and water use among redcedar, switchgrass, and native prairie ecosystems. Our objective was to determine the water use efficiency (WUE), of redcedar woodland, switchgrass and native tallgrass prairie ecosystems. Data were collected in northcentral Oklahoma on six experimental watersheds, four of which were initially redcedar and two of which were native prairie. Redcedar was cut from two watersheds and removed. One watershed was allowed to reestablish as native prairie and the other was planted with switchgrass. Tree aboveground biomass was determined using annually measured diameters and calculated using allometric equations. Herbaceous biomass was determined with annual clip plots. Runoff was continuously measured on each watershed using H-flumes. Annual ET was estimated as the difference between precipitation and runoff. Annual WUE was calculated as the ratio between ANPP and annual ET. In 2018, ANPP of the switchgrass growing on cut redcedar watershed was 10.1 Mg ha⁻¹ which was greater than for the other watersheds (4.7 to 7.1 Mg ha⁻¹). Runoff was greater from the switchgrass watersheds (56.7 mm) and least from the redcedar (4.3 mm) watersheds. WUE(s) of switchgrass watersheds (11.0 kg ha⁻¹ mm⁻¹) were greater than those of native prairie (7.2 kg ha⁻¹ mm⁻¹), and redcedar (6.6 kg ha⁻¹ mm⁻¹) watersheds. Redcedar watersheds had higher ET, lower runoff and lower ANPP than switchgrass watersheds indicating that productivity, water yield and WUE can be increased by restoring encroached watersheds to native grassland or switchgrass systems.

Keywords: Restoration, Prairie, Water Issues, Eastern redcedar, productivity, water use efficiency, switchgrass

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Practicality of non-lethal aging structures for catostomids

Age estimates are useful metrics in fisheries management and ecology and are important for calculating population dynamics and vital rates. Incorrect age estimates result in improper management decisions that may facilitate overfishing. Otoliths typically provide reliable age estimates but require individuals to be sacrificed. Therefore, non-lethal aging structures may be preferred if they provide similar age estimates as otoliths. The family Catostomidae contains several species that lack non-lethal age-structure verification. Therefore, our study objective was to explore the viability of non-lethal methods for estimating age for five species of catostomids. Fin rays and otoliths were collected from Spotted Sucker, White Sucker, Black Redhorse, Golden Redhorse, and Northern Hogsucker gilled or sampled on the Lake Eucha stream-reservoir complex during 2018 and 2019. Fin rays were removed at the pectoral joint and sectioned in ~1 mm increments. Sagittal and asteriscus otoliths were also removed from each individual and cross-sectioned to increase readability. Analysis of fin rays showed extreme variation in age estimates (e.g., differences up to 6 years) based on section location. Preliminary analysis of fin rays suggest age estimates decrease as distance from the pectoral joint increases. The

maximum age estimate is usually attained within ~10 mm of the pectoral joint. However, the first ~ 2 mm of fin ray adjacent to the pectoral joint is generally unreadable. This suggests a relatively narrow section of fin ray contains the maximum age estimate. Preliminary comparisons between maximum age estimates from fin rays and age estimates from sagittal otoliths suggests relatively high agreement, though more comparisons need to be conducted.

Keywords: Fisheries, Age and Growth, Suckers, Catostomids, Aging Structures

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Sediment response to converting eastern redcedar to grassland

Oklahoma is characterized by variable climate, various erosive soil types, and many impaired streams. Historically, the conversion of native prairie to intensive agricultural use in the region increased soil erosion, leading to challenges in natural resource management. In recent decades, rangelands have been in transition due to the encroachment of woody species, particularly eastern redcedar (*Juniperus virginiana* L.). This change has been reported to result in reduction in surface runoff. However, it is unknown how the sediment concentration will respond to the change in surface runoff, therefore the sediment yield, and how will conversion of encroached watersheds back to grassland change the sedimentation processes and sediment yield.

To assess the impact of redcedar encroachment and the temporal evolution of surface runoff and sedimentation processes after redcedar removal, we used before-after control-impact (BACI) experimental design using five experimental watersheds under different vegetation types and various land use in north-central Oklahoma. We collected runoff and sedimentation data on all runoff events from these watersheds from 2015 through 2018 water years. Two-way ANOVA in conjunction with t-test, and non-parametric test were used to determine the effects of redcedar encroachment, removal, and subsequent land use on sediment concentration and sediment yield.

Results showed that the mean sediment concentration was significantly greater from eastern redcedar encroached watersheds than that from native prairie watersheds, but there was no significant difference in annual sediment yield. After redcedar removal, the annual sediment yield increased significantly, irrespective of restored prairie ($p = 0.004$) or established switchgrass ($p = 0.003$) compared with the pre-treatment period. During the initial establishment phase of grassland, no significant difference in annual sediment yield between the restored prairie and planted switchgrass was detected.

Keywords: Restoration, Prairie, Stream and River, Landscape Ecology, Water Issues, Soil erosion, Juniper, Switchgrass, Oklahoma