



Missouri Natural Resources Conference 2020 **Agenda - Overview**

Tues Feb 4

1:00 – 9:00 p.m.

Registration

Foyer

5:30 – 7:00 p.m.

Conservation Career Expo

Paradise C

Job fair, speed networking, resume critique and mock interviews.

7:00 – 9:00 p.m.

Poster Session

Windgate Hall

Join the poster authors for a special session. See poster topics.

7:00 – 11:00 p.m.

Mixer

Windgate Hall

Join us for famous Lutz's BBQ, beer and wine! Purchase tickets for a 50/50 raffle to raise money for student scholarships.

Wed Feb 5

6:00 – 8:00 a.m.

Prayer Breakfast

Island ([open map](#))

6:30 – 7:45 a.m.

Breakfast

Wingate Hall ([open map](#))

Free for attendees. Sausage, egg and cheese biscuit sandwich, juice, coffee and tea.

7:30 a.m. – 8:00 p.m.

Registration

Foyer

8:00 – 9:30 a.m.

Welcome and Plenary: Missouri Forests of the 21st Century - Opportunities & Challenges

Paradise A, B



[James M. Guldin, Ph.D.](#)

Center for Forest Restoration and Management, USDA Forest Service

10:00 – 11:30 a.m.

Plenary Panel Discussion: Adaptation and Evolution of Management Strategies for Wildlife, Soil, Water and Forest Resources in Missouri

Paradise A, B

Ask our experts about the past, present and future management of natural resources in Missouri and the Ozark region with regard to forests, soils, fisheries, and overall landscape management, whether it be about past exploitation, restoration, reclamation or adaptive management.



[James M. Guldin, Ph.D.](#)

Center for Forest Restoration and Management, USDA Forest Service



[Jeff Boxrucker](#)

Reservoir Fisheries Habitat Partnership



[John Kabrick](#)

Northern Research Station, USDA Forest Service



[Newell Kitchen](#)

Soil Scientist, USDA ARS

11:30 a.m. – 1:00 p.m.

Lunch

Windgate Hall

Available for purchase. Available for purchase. Meat lasagna, penne pasta with alfredo sauce, salad, vegetable, bread sticks, dessert, coffee, iced tea.

1:00 – 3:00 p.m.

Fisheries Student Papers

Paradise A

MOAFS sponsored session.

Management Evaluation of White Bass Population Dynamics and Exploitation in a South Central Missouri Reservoir

Presenter: Joey Root, Southeast Missouri State University

The White Bass is an important sport fish species in Missouri's large reservoirs. As such, developing consistent and objective methods for assessing White Bass populations, as well as understanding population dynamics of this species is critical in developing and implementing appropriate management strategies. Through the use of different approaches previous studies have shown a large array of factors, especially recruitment, affect the fishery characteristics of White Bass. In recent years, Lake Wappapello anglers have voiced concerns about declining White Bass catches. Thus, we are evaluating White Bass population dynamics and exploitation in this reservoir and attempting to determine what variables are having the largest influence on year-class strength. In terms of year-class strength, White Bass recruitment appears to be inconsistent. Length-frequency and age-frequency data show missing year classes, and a total of four year classes were not present in our sample. Age-1 and age-2 cohorts dominated the population age structure. Additionally, low catch per unit effort (CPUE) values of 0.024/hr for experimental gill nets and 2.86/hr for electrofishing indicates a low population abundance. The cause of decline in the White Bass fishery is unknown after year one of this two year study and is still being evaluated. Further data collection and population modeling will likely help us better understand the cause of these poor recruitment years.

How does electrofishing power and environmental factors affect Smallmouth Bass catchability in mid-sized Ozark Rivers?

Presenter: Mike Thomas, Missouri Cooperative Fish and Wildlife Research Unit, School of Natural Resources

Boat electrofishing is widely-used to sample Smallmouth Bass (*M. dolomieu*), but unknown estimates of catchability has limited our ability to evaluate management actions in medium-sized streams. We sought to determine how power levels (i.e., at, and 20% reduced, power goal), fish size, and water temperature affect electrofishing catchability in Missouri Ozark Rivers. We conducted mark and recapture trials ($n > 14$) with known numbers of Smallmouth Bass ($n > 850$) in mid-sized rivers ($n > 7$) in summer and fall 2018 and 2019. Fish were marked using passive integrated transponder (PIT) tags and held overnight in net pens prior to release 1-2 hours before recapture attempt. Preliminary analysis suggests that catchability increased from 17% ($\pm 6\%$) for 25 cm fish to 35% ($\pm 8\%$) for 43 cm fish at the recommended power goal. At a reduced power (80%), catchability was more variable and increased from 15% ($\pm 12\%$) for 25 cm fish to 25% ($\pm 18\%$). We mapped the electrical field from a boat electrofisher at three depths (i.e., 0.46 m, 0.91 m, 1.83 m) and found a 35% reduction in immobilization field size (0.2 V/cm) from 0.46 m to 0.91 m, but did not measure a field intensity sufficient to elicit immobilization at a depth of 1.83 m. Smallmouth Bass managers may find our methods useful for future research involving electrofishing and our results may assist in the development of standard electrofishing protocols for this popular sportfish.

Assessing Gizzard Shad Population Dynamics in the Upper Mississippi River

Presenter: Katelyn Bebee, Department of Biology, Missouri State University

Filter-feeding fishes (e.g., Gizzard Shad, Bigmouth Buffalo) are important links to higher trophic levels in riverine ecosystems. In the Mississippi River basin, Gizzard Shad represent an important forage species for various recreationally and commercially important species (e.g., Blue Catfish, Largemouth Bass). As such, changes in Gizzard Shad demographics have the potential to affect upper trophic levels. The Upper Mississippi River (UMR) basin Silver Carp populations can be broadly classified into two categories along a longitudinal gradient. The northern portion of the Upper Mississippi River basin (i.e., above Lock and Dam 15) has low densities, while locations further south have hyperabundant Silver Carp densities. Additionally, in the Mississippi River basin Silver Carp have been purported to negatively impact Gizzard Shad. However, we are unaware of any studies that have evaluated Silver Carp impacts on Gizzard Shad population dynamics. Gizzard Shad were collected via daytime electrofishing carried out by United States Army Corps of Engineers' Long-Term Resource Monitoring (LTRM) element across six field stations in the Mississippi and Illinois rivers. Additionally, otoliths were removed and used to evaluate Gizzard Shad population dynamics. Insights into population demographics can elucidate Silver Carp impact on an important forage base in the UMR.

Impacts of wastewater effluents on Ozark fish community structure

Presenter: Kelly Hoyer, University of Central Missouri

The effects of a wastewater treatment plant (WWTP) on fish community structure and population densities of the Mottled sculpin (*Cottus bairdii*) were investigated along two tributaries of the Niangua River. Biotic and abiotic data were collected from 26 sites, including 16 in the West Fork (WWTP present) and 10 in the East Fork (WWTP absent). At each site, fishes were collected via kick seining in riffles and abiotic data including temperature, dissolved oxygen, stream discharge, and substrate size were collected. Multivariate analyses of fish community structure revealed a significant difference between the East and West Fork sites. These differences were characterized by higher abundances of several benthic riffle dwelling species in the East Fork (WWTP absent). In addition, there was significant correlation between stream gradient and *C. bairdii* abundance in the East Fork. Specifically, we found increases in *C. bairdii* abundances moving downstream. Moreover, there were higher abundances of young of the year (YOY) *C. bairdii* in the East Fork which potentially indicates a reduction of spawning success in the West Fork as a result of wastewater effluents. Our findings highlight significant differences in fish assemblage structure that may relate to effluent presence. Structural differences seem to be driven by the presence of certain benthic fishes indicative of ecosystem/stream health where wastewater is absent.

Quantifying morphology of *Cyprinella lutrensis* x *venusta* hybrids in a Missouri reservoir

Presenter: Topher Hockaday, University of Central Missouri

Non-native *Cyprinella venusta* (Blacktail shiner) are known to occur in Truman reservoir (West Missouri), and in 2017 hybridization between *C. venusta* and native *C. lutrensis* (Red shiner) was documented. Our study objective was to quantify hybrid morphology in relation to the two parent species. Geometric morphometric data, based on fourteen homologous landmarks, were collected from both hybrid and parent individuals. Principal Component Analysis was then used to describe and visualize body shape variability among individuals, and ANOVA was employed to test for body shape differences among hybrid and parent species. In addition, meristic relationships among individuals were examined based on four different counts including: lateral line scale number, anal fin ray number, below lateral line scale rows, and circumferential scale rows. Geometric morphometric data showed that hybrid individuals were intermediary between *C. lutrensis* and *C. venusta* in morphospace, and this was mainly driven by an intermediate body depth in hybrids. Meristic comparisons showed a greater similarity between hybrid and *C. venusta* individuals. These results compliment findings of previous genetic research conducted on *C. lutrensis* and *C. venusta* hybrids which lacked full morphological comparisons. The possibility of hybrid persistence and the implications of these hybrid individuals in Truman reservoir will be discussed.

Application of a Traditional Fisheries Management Technique on a Newly Established Fish Species in North America

Presenter: Kim H. Hae, Department of Biology, Missouri State University

Northern Snakehead were first discovered in the Potomac River basin in 2004. Obtaining demographic data is especially important for invasive species. Relative weight and size structure indices are useful tools for fish biologists to characterize fish condition and fish size structure. These indices can provide insight into population dynamics (i.e., recruitment, growth and mortality). Obtaining age data is the most accurate method to quantify population dynamics. A standard-weight (W_s) and size structure indices do not currently exist for Northern Snakehead. Further, no ageing structure has been validated for Northern Snakehead. We used the regression line-percentile (RLP) method to develop a standard-weight equation for Northern Snakehead. Based on this approach, we propose a metric standard-weight equation as $\log_{10}(W_s) = -5.142 + 3.0418 * \log_{10}(TL)$ with a minimum length of 200 mm; W_s is weight in grams and TL is total length in millimeters. For calculating proportional size distribution (PSD) we proposed the following length categories: stock, 190mm (7.5 in); quality, 340 mm (13 in); preferred, 420 mm (16.5 in); memorable, 550 mm (22 in); and trophy, 700mm (27.5 in). Marginal increment analysis is one method that has traditionally been employed to confirm annual annuli deposition. A subset of Northern Snakehead otoliths ($n=200$) were subjected to marginal increment analyses (ages 2 – 10). Differences in index of completion scores occurred among months ($F_{7,192} = 18.26, P < 0.001$) but were lowest in July. These population level indices can provide biologists important tools to describe Northern Snakehead populations in North America.

1:00 – 3:00 p.m.

Shortleaf Pine Silviculture: Silvicultural Secrets of Shortleaf Pine – for Better or Worse

Paradise B

MOSAF sponsored workshop. Organized by James M. Guldin, Senior Research Silviculturalist, Southern Research Station, USDA Forest Service.

Shortleaf pine is the most widely distributed of the four major species of southern pines, and yet, the most poorly understood. Forest Survey data show that the area of shortleaf pine-dominated stands has declined by 53% since 1980 to comprise less

than 10% of the original range of the species. Therefore, there is keen interest in restoring this species to sites where it has become reduced or been locally extirpated, on both public and private lands. The workshop will discuss three main issues. First, a timberland manager interested primarily in the growth and yield of southern yellow pine may find it difficult to muster a good deal of enthusiasm for shortleaf pine, though as recently as 1944, publications in mainstream forestry journals spoke about mixed stands of pine as “shortleaf-loblolly pine” stands. Second, the physiology of shortleaf pine has increasingly come under scrutiny—especially the characteristic basal crook, which gives shortleaf pine the unique ability to sprout if top-killed. Third, awareness has been heightened in the past decade about increasing prevalence of hybridization between loblolly and shortleaf pine. Hybrids have attributes of growth and appearance that are intermediate between the two species, but re-sprouting from the intermediate crook on hybrids is poor. The workshop will provide the ‘state of the art’ information based on practical application and peer-reviewed science to support land management decisions that favor shortleaf pine, and also to give land managers and researchers an opportunity to share thoughts and experiences with shortleaf pine ecology and management.

1:00 – 3:00 p.m.

Managing Floodplains in 21st-Century Streamflows: Impacts to Habitat, Water Quality, Agriculture and Development

Paradise C

MOTWS sponsored workshop. Organized by Adam Jones.

2019 was a great example of the large and medium river volatility our wildlife and floodplain public lands will encounter moving forward. This workshop will focus on wetlands and wildlife management, water quality and stream channel/riparian management, as well as climatology and dynamics behind streamflows in recent history. The future of Missouri’s water resources depends on how these communities remain resilient through changing conditions and how we mitigate impacts of sediment loads from historical flooding events. Speakers will include wildlife biologists with wetland specialties, climatologists, stream flow experts, and industry professionals who rely on river traffic. This diversity of viewpoints will provide the framework of how all these professions will need to work together on mitigating the impacts of how water flows across Missouri.

1:00 – 3:00 p.m.

Land Management for Soil Health Improvement

Room 60-61 ([open map](#))

SWCS-Show Me Chapter sponsored workshop. Organized by [Steve Wilson, USDA](#).

The Show-Me Chapter of the SWCS is hosting a 2 hour workshop on land management and appropriate activities to improve soil health to a healthier state. This healthier state is assessed by an active and diverse biological activity and increasing carbon sequestration represented by soil organic matter. The workshop will emphasize activities that can be implemented on Missouri landscapes that can improve the ecosystems resilience to climate stresses; thereby, lower the risk to Missouri based production systems for annual row crop, forages, and timber.

1:00 – 3:00 p.m.

Missouri Cave Workshop: A Toolbox

Room 62-64 ([open map](#))

Organized by David Ashley, Missouri Western

Speakers: Tom Aley, Ozark Underground Laboratory/Tumbling Creek Cave Foundation; (Moderator) Scott House, Cave Research Foundation; David Ashley, Missouri Western State University; Shelly Colatskie, MDC; Ken Grush, Cave Research Foundation; Denise Vaughn, L-A-D Foundation

Karst features and biodiversity are important natural history resources in the Ozarks Region of Missouri. The intended audience for this workshop includes the foresters, wildlife managers, park naturalists, and agency staff responsible for managing these fragile resources. The topics covered in this workshop constitute a toolbox of information on karst topography and accessing individuals and organizations with experience dealing with karst management. The topics include: cave

inventories and mapping, biological surveys, gating considerations, protecting water supplies for caves, cultural considerations, and common land use problems affecting caves.

Getting Cave Inventory, Mapping and Gating Done: The Butler Hollow Project – Scott House – 20 min
Biological Survey and Monitoring – Mick Sutton – 20 min
Missouri Cave Bats, a Primer – Shelly Colatskie – 20 min
Missouri Cave Database and Cave Archives – Ken Grush – 20 min
Management Strategies for Protecting Water Supplies in Caves and Springs – Tom Aley – 20 min
Living on Karst video (Perry County MO) – Denise Vaughn – 20 min

3:30 – 5:00 p.m.

Society Meetings

American Fisheries Society: *Paradise A*

Missouri Society of American Foresters: *Paradise B*

Show-Me Chapter of the Soil and Water Conservation Society: *Room 60-61*

Missouri Chapter of The Wildlife Society: *Room 62-64*

7:00 – 10:00 p.m.

Awards Social

Awards include the Missouri Leopold Conservationist of the Year Award. Each society will also present their achievement awards. Following the awards, there will be a dessert buffet with ice cream, cobblers and cakes.

Paradise C

Thur Feb 6

6:30 – 7:45 a.m.

Breakfast

Wingate Hall ([open map](#))

Free for attendees. Fruit, muffin, danish, donut, juice, coffee, tea.

7:30 a.m. – 1:00 p.m.

Registration

Foyer

8:00 – 10:00 a.m.

Fisheries/Aquatic Systems Papers 1

Paradise A

Macroinvertebrate Drift Dynamics: Implications for Sturgeon Conservation

Presenter: Maddie Cogar, Missouri State University

Two sympatric Scaphirhynchus sturgeon species are present in the Middle Mississippi River. Shovelnose Sturgeon Scaphirhynchus platyrhynchus and Pallid Sturgeon S. albus exhibit similar life history traits. Both sturgeon species have declined due to overfishing and loss of habitat. However, in the Middle Mississippi River, Shovelnose Sturgeon are considered

more common while Pallid Sturgeon are rare and may be close to extirpation. Both species are known to feed on macroinvertebrates. Despite the importance of certain invertebrate taxa (e.g., Diptera, Ephemeroptera, Trichoptera) as sturgeon prey items, few studies have investigated macroinvertebrate drift dynamics in large rivers. Our objective was to quantify macroinvertebrate drift dynamics in the Middle Mississippi River. We sampled above and below the confluence of the Missouri River, above Chain of Rocks and below Chain of Rocks on the Middle Mississippi. We employed two 1000- μ m mesh, rectangular framed-nets with weights (45kg) affixed to the bottom. Flow-meters were attached to the mouth of the nets to measure volume of water filtered. Nets were deployed from the boat (i.e., surface, middle, bottom) via an electric winch. Approximately 3,700 drift samples were collected from April to June. Insight into macroinvertebrate drift dynamics can help inform important reaches for sturgeon conservation.

Water Quality and Seasonal Macrophyte Cover in a Heavy Metal Contaminated Urban Stream

Presenter: Jessica Wilson, University of Missouri

The Tri-State Mining District in southwest Missouri and portions of northeast Oklahoma and Kansas, was the world's leading producer of lead and zinc for over 100 years. Legacy mining effects such as heavy metal laden discharge into surface waters from abandoned mine shafts is common throughout this region. In-stream vegetation, including macrophytes, cycle nutrients between stream surface waters and bed sediments while also trapping contaminants such as heavy metals, thereby improving water quality. However, inputs of mine drainage may alter the availability of nutrients such as nitrogen and phosphorus, essential for macrophyte growth. This study explores the relationship among dissolved heavy metal and nutrient concentrations and seasonal macrophyte cover in an urban stream receiving mine drainage.

A Cursory Look into the Striped Bass Population in Norfolk Lake

Presenter: Alexandria Beezel, Missouri State University

While high water years can be advantageous for many species, promoting productivity and growth, these same events can be detrimental to Striped Bass *Morone saxatilis*. This historically anadromous fish has been able to adapt to a landlocked lifestyle and is now found in many of our inland fisheries, including that of Norfolk Lake in northern Arkansas. As temperatures increase, many Striped Bass seek thermal refuge in the Hypolimnetic Oxygen Maxima. This becomes an issue when faced with high water years and there is a need to evacuate water from the flood pool. Increased outflows erode this area of refuge, ultimately dissolving it completely at a rapid pace. This is likely the cause of substantial fish kills exhibited in Norfolk Lake from 2002-2019. The objective of this study is to assess the population dynamics of this fishery and understand the effects that these fish kills have on the Striped Bass population in Norfolk Lake and take adaptive management steps for prevention. Fish were collected from these die-off events and otoliths were removed for subsequent aging, allowing for the quantification of vital rates.

Investigating the Role of Stocking Location and Tracking Methods on Dispersal and Survival Estimates of Stocked Lake Sturgeon in the Osage and Gasconade rivers

Presenter: Michael Moore, University of Missouri

Lake Sturgeon were nearly extirpated from Missouri by the 1970's and recovery efforts commenced in 1984. However, biologists have not documented natural reproduction in the Missouri River Basin. Therefore, short-term recovery efforts rely on stocking of hatchery-reared individuals. Although Missouri has stocked over 400,000 Lake Sturgeon, MDC lacks information on survival and dispersal. We implanted 100 age-0 Lake Sturgeon with acoustic telemetry tags. In October 2018, we introduced the Lake Sturgeon at four stocking sites across the Gasconade and Osage rivers. We monitored their movements using a network of 31 stationary receivers and monthly boat tracking until February 13 when tag batteries expired. Within rivers, survival was not influenced by stocking location. Survival estimates were greater and had less uncertainty when manual and passive tracking methods were used and averaged 0.69 in the Osage River and 0.62 in the Gasconade River. Upstream dispersal was higher than expected with some individuals traveling at least 140 km. Final locations for surviving fish was not related to stocking location in the Osage River but was affected by stocking site in the smaller Gasconade River. Only three tagged Lake Sturgeon emigrated out of tributaries. These findings contrast studies in other rivers (including the Meramec River) which showed rapid dispersal downstream into the Mississippi River. The results indicate that Missouri River tributaries may provide important nursery habitat for juvenile Lake Sturgeon. Managers can use these survival estimates to predict growth of the recovering Lake Sturgeon population.

Habitat Selection of Alligator Gar in Southeast Missouri

Presenter: James Studdard, MDC

Alligator gar (*Atractosteus spatula*) are declining throughout their native range. In recent decades, conservation agencies including the Missouri Department of Conservation, have been working on recovering Alligator Gar populations to self-sustaining levels. In many areas of the native range, disconnection of floodplain habitat due to river channelization and flood control have greatly reduced alligator gar habitat diversity and availability. To better manage stocked Alligator Gar in Missouri, Vemco V16 ultrasonic transmitters were implanted in hatchery reared juvenile and wild-caught adult alligator gar. The fish implanted with transmitters were used to track movement and habitat use in four floodplain habitats selected for this study, based on previous stocking abundance. Sidescan sonar was used to collect habitat data and determination of habitat

type. Habitat available was assigned to one of six categories; submerged log, log complex (two or more logs), submerged tree limbs, open water, standing trees, tree roots, and other (man-made habitat). Depth, temperature, pH, dissolved oxygen, and conductivity were also collected and factored into habitat selection. The information gathered in this study regarding seasonal habitat use will help inform future management actions, including habitat restoration efforts and identification of additional reintroduction sites within Missouri.

Progress Toward a Predictive Egg Quality and Spawning Potential Index in Paddlefish

Presenters: Ben Thomas and Martin Leslie, University of Central Missouri

In the past, Blind Pony Fish Hatchery (BPH) operated by the Missouri Department of Conservation (MDC) has experienced inconsistent ovulation, fertility, and development rates with female paddlefish. Even if ovulation occurs, some paddlefish eggs stop developing prematurely; at times only half of the paddlefish spawned have resulted in usable fry. This inconsistency decreases the effective management of the put-grow-take paddlefish fishery, as well as drives up MDC's production costs. This project aimed to develop a paddlefish broodstock ranking index for both egg quality and spawning readiness. The goal is to improve MDC's efficiency in selecting fish that will spawn in response to the hormonal injection and produce high-quality progeny that are more likely to survive the rearing process. Due to the limited knowledge available on paddlefish reproduction there are sparse techniques and spawning protocols available, and even fewer molecular assays. Because of this, the creation of a broodstock ranking index of about 20 female fish a year required the development and optimization of the required scientific endpoints. The specific endpoints evaluated were spawning readiness indicators (i.e., egg polarity index [PI] and an egg bioassay) and egg/progeny quality indicator (i.e., plasma estradiol, testosterone, and cortisol concentrations). The data presented was developed from tissues collected during the spawning of the 2015, 2016, 2017, 2018, and 2019 year classes and include the optimization data required to validate the following endpoints: PI, egg bioassay, and the hormone concentrations of estradiol, testosterone, and cortisol.

8:00 – 10:00 a.m.

Forestry Papers

Paradise B

Pecans, Ripgut Prairie and Marsh of the Swans: The Marais des Cygnes and the Upper Osage River Basin

Presenter: Stuart Miller, MDC

Why would French traders call this region the Marsh of the Swans? What natural conditions would lead to a marsh of the swans? Why would the powerful Osage make this region central to their existence? How did European –American alterations change the marsh of the swans? What is today's natural and human environmental legacy of the marsh of the swans? Multiple government agencies, not-for-profits, businesses and private landowners have invested in the natural resources of this unique region for prairie, forest and water.

Landscape-Scale Burning and Tree Regeneration

Presenter: Benjamin Knapp, University of Missouri

Prescribed fire is an important land management tool, particularly for restoration of open ecosystems such as woodlands and savannas. Burning at the landscape scale may provide operational benefits, such as achieving more burn acres when the number of good weather days is limited, as well as possible ecological benefits through variability in fire behavior across the landscape. In the central hardwood region, previous studies have demonstrated that frequent fire return intervals (< 5 years) inhibit hardwood tree recruitment by causing repeated top-kill and resprouting of small diameter stems, suggesting that deliberate fire-free intervals would be important for managing tree regeneration. This creates a woodland regeneration paradox, in that removing fire to allow tree recruitment would result in the loss of the open vertical structure associated with woodlands. One possible benefit of landscape-scale burning is that variability in fire behavior across the landscape may allow some individuals or patches of trees to recruit in areas of locally low fire intensity. We test this idea using data from the Chilton Creek Management Area (CCMA), in which four landscape-scale units (each ~500 acres) have been burned on fire return intervals < 4 years since 1998. The CCMA is located near the Missouri Ozark Forest Ecosystem Experiment (MOFEP), an unburned forest landscape-scale forest management study that is used as a control for comparison. Over nearly 20 years, frequent landscape-scale prescribed burning significantly reduced the number of trees that recruited into the overstory size class and nearly eliminated the midstory size class through top-kill. We also evaluate variability in recruitment rates by site type or tree species and discuss recommendations for managing tree regeneration with frequent fire in woodlands.

From Sternwheelers to Towbarges: a History of Floodplain Forest Exploitation on the Mississippi River

Presenter: Bruce Henry, USFWS

A study of historical ecological observations.

Long-Term Effects of Different Timber Harvest Intensities on the Composition of Ground Flora (MOFEP)

Presenter: Justin Dee, University of Missouri

The Missouri Ozark Forest Ecosystem Project (MOFEP) is a century-long experiment within Ozark Highlands examining the impacts of alternative forest management practices on a wide array of ecosystem attributes. In this study, we concentrate on the effect of even-aged management (EAM), uneven-aged management (UAM), and no-harvest management (NHM), and the 15-year rotation among these practices, on the composition of ground flora through time, and how this may differentiate between different ecological land types (ELTp's). In 1996 these three management systems were initiated and in 2011 the sites received their second prescribed management treatment. Woody and herbaceous ground flora data was documented in 1993, 1994, 1995, 1999, 2000, 2001, 2009, 2010, 2013, and 2014 from 645 plots randomly placed within different ELTp's nested under each management practice. Using ordination techniques, starting in 1999 there is a large dissimilarity of species composition between EAM and all other treatments no matter the ELTp type. By 2010, this dissimilarity in composition remained but was less pronounced. In 2013, two years after the 2011 treatments were implemented, EAM from 1996 composition was close to similarity with UAM from 1996. At this point the EAM from 2011 represented the largest treatment dissimilarity as EAM from 1996 did in 1999, still with no difference between ELTp type. Our analyses demonstrates that within a 17 year timeframe EAM can return to the ground flora composition to that of UAM no matter the ELTp. Further analysis concentrating on species level effects will take place over the next two months.

Smoke, Goats and Oaks: Prescriptive Goat Browsing and Prescribed Fire as a Means to Halt Woody Encroachment and Promote Biodiversity in Ozark Hardwood Ecosystems

Presenter: Gina R. Beebe, School of Natural Resources, University of Missouri

The suppression of fire in the 20th century led to a dynamic shift in woodland structure and composition in the eastern United States. Woody stems are encroaching the midstory, competing with ground flora for available nutrients, and suppressing biodiversity due to increased canopy cover and homogenous light conditions. Woodlands in the Ozark highlands have the capacity to support both prairie and forest-type ground floras due to a wide array of microclimates; mesophication threatens these localized conditions. Frequent disturbance is key to achieving minimal midstories and low levels of stocking within Ozark Hardwood ecosystems; prescribed burns are often used. However, smoke sensitive areas such as cities and highways can complicate the use of fire due to smoke and visibility concerns. Prescriptive goat browsing holds the potential to mimic fires' role in woodland restoration. Goats' capacity to consume lignified species make them an ideal candidate to increase spatial heterogeneity by reducing midstory canopy and disturbing soil. This research seeks to examine the separate and combined effects of goat browsing and prescribed burning as land management approaches that may impede mesophication and promote ground flora. This study is located on the Mark Twain National Forest. There are three browsing events during the course of this study: a dormant bud, spring, and fall browse. These are compared to a dormant season prescribed burn and an interaction between browsing and fire.

Rapid Assessment and Monitoring of the Ecological Integrity of Missouri Terrestrial Natural Communities

Presenter: Michael Leahy, MDC

Inventory, assessment and monitoring of terrestrial natural communities are important tasks for field biologists and natural resource managers. The Missouri Natural Heritage Program tracks significant terrestrial natural community sites statewide. However, the methods used to evaluate natural communities for the program have been criticized as being overly subjective. There is a need to be able to assess and monitor natural communities that is more objective, but not as time consuming and expertise dependent as plot sampling. In recent years we have begun to investigate methods of better quantifying natural community condition in the field that are rapid and efficient – methods we call natural community health indices. Components of natural community health indices include landscape context and size of the natural community, composition of the plant and animal species, vegetation structure, critical ecological dynamics, and negative impacts. Rather than conduct a full botanical inventory, we focus on conducting a modified floristic quality assessment, limited to identification of characteristic and conservative species that are readily identifiable. Animal data are also incorporated as available. As a natural community site changes through time, resource managers can track which components of the community are improving or declining which can help with allocating management resources. The presentation will discuss the development and deployment of natural community health indices in a variety of Missouri natural communities including tallgrass prairies, oak-hickory woodlands, and glades. The pros and cons of this approach will be discussed in the context of the variety of methods available for natural community assessment.

8:00 – 10:00 a.m.

Wildlife Papers 1

Paradise C

UV-C Light Exposure as a Possible Treatment Method Against *Pseudogymnoascus destructans* on Susceptible Bat Species Fibroblasts

Presenter: Susan Anderson, Missouri State University

The *Pseudogymnoascus destructans* (P.d.) fungus, since 2006, has caused major declines to native bat populations in North America causing many bat species to become endangered. It has recently been discovered that the P.d. fungus is vulnerable to UV-C light due to it lacking the UVE1 gene enzyme for nucleotide repair in the AER (alternate excision repair) pathway. Because of this, using UV-C light is a possible treatment for bats infected by the P.d. fungus, as well as treating their habitats with UV-C light. However, there has no published research on the possible effects that the UV-C light would have on bats themselves. For this experiment, Northern long-eared bats (*Myotis septentrionalis*) fibroblasts were used due to this species high vulnerability to P.d.. Fungal spores and bat skin cells were all tested under the same conditions of UV-C exposure of an intensity of 10 mJ/cm² at exposure length of 5, 15, and 45 seconds. As time of exposure increase, both the spore and cell death increase due to an increase in duration of the high frequency of UV-C light. However, using UV-C light could be a possible source of treatment for bats if properly and carefully regulated. Furthermore, artificial skin protection was made using materials to mimic the protective properties of melanin on fibroblast cells. The cells were then tested under the same methods as the previous test to assess how the protective layer would affect fibroblast in susceptible bat species.

Characterizing Drivers of Fine-scale Habitat Selection in a Recolonizing Black Bear Population

Presenter: Melanie Boudreau, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University

Extirpation and population reductions of large carnivores have occurred across the globe in the last century. However, in many areas, large carnivore populations are rebounding. In Missouri, American black bear (*Ursus americanus*) numbers have been increasing since near extirpation, creating a need for management and conservation planning. Understanding the driving forces behind fine-scale movement and behavior of this large carnivore is an important step in this endeavor. We used GPS collar data collected from 2011-2018 to examine Missouri black bear (n = 71 bears) resource selection using an integrated step selection framework. We examined if selection was driven by: i) the avoidance of risk from roads and humans, ii) landscape productivity, iii) habitat fragmentation, or iv) landscape features known to facilitate carnivore movement (e.g., riparian zones and aggregated habitat patches). Given responses of individuals can be spatially heterogeneous across the landscape, we also examined selection across individual bears. Black bear resource selection was mediated by several drivers, with most bears (37% of individuals) selecting for contiguous forests, followed by risk avoidance (28%) and food abundance (27%). Further investigation of selection patterns among sex, age, and maternal behavior will help identify whether black bear resource selection is a consequence of individual characteristics or spatial placement on the landscape. This information will help inform management decisions, including human-bear conflict mitigation, by improving understanding of landscape features preferred by black bears and characterizing areas likely to be colonized by this large carnivore.

Twenty Five Years of Deer Management at KCI Airport

Presenter: Dan McMurtry, USDA

USDA Wildlife Services has assisted the Kansas City International Airport (KCI) to manage white-tailed deer on their property for the last twenty five years. When white-tailed deer are present in an Airport Operations Area (AOA) they pose a serious threat to human health and safety and have the potential to cause significant aircraft damage, therefore zero tolerance of white tailed deer inside the AOA is followed on KCI or any airport. From 1996 to 1999, 39 deer were observed inside the AOA at KCI for an average of 9.75 deer incursions per year. For the last twelve years, from 2007 to 2019, only 2 deer have been observed inside the AOA for an average of 0.17 deer incursions per year. Wildlife Services started assisting KCI in 1995 that lead to the development of the KCI Wildlife Hazard Management Plan, which includes managing white-tailed deer. Several methods have been used to reduce the threat that deer pose to KCI including: removal or crops inside the AOA (1995), establishment of a 2000' no crop buffer zone around all runways (1997), removing wooded areas next to the perimeter fence (1997), converting row crops to cattle grazing (2000), raised perimeter fence (2000-2003), USDA lethal removal of deer (2001-2006 & 2015-2016), building additional parking lots (2002) and public archery hunting (2006-present). An adaptive, integrated management methodology is required to solve wildlife issues on airports and the ongoing cooperation between KCI and USDA Wildlife Services is an excellent example of a successful wildlife management approach that took years to effectively develop.

Voluntary Use of Nonlead Ammunition: Attitudes of Natural Resource Professionals

Presenter: John H. Schulz, School of Natural Resources, University of Missouri

Hunting is a popular activity but use of lead ammunition poses a risk to wildlife and human health. To improve voluntary nonlead messages, we surveyed natural resource professionals who were both hunters and nonhunters. We focused on attitudes related to mortality factors facing bald eagles, lead poisoning in bald eagles, human health risks from lead bullet fragments in venison, and other issues related to nonlead ammunition. We examined differences in attitudes if participants were deer hunters, choice of ammunition, and behavioral intentions toward ammunition. Of 168 natural resource professionals, 61.9% reported being a deer hunter and 38.1% as a nonhunter, with 57.0% of deer hunters using lead ammunition and 43.0% using nonlead. Alternatively, 63.6% of hunters reported likely intentions to use nonlead, while 36.4% reported nonlead use was unlikely. Important variables related to nonlead use included firearm compatibility, minimal complexity, usefulness of shooting demonstrations, and ballistic characteristics. Other factors affecting nonlead intentions included reduced eagle mortality, seriousness of the issue and reduced human health risk from lead bullet fragments in venison. In comparison, variables affecting lead ammunition use included the high cost and reduced availability of nonlead,

perceived damage to firearms, and reduced accuracy and lethality of nonlead. Factors supporting continued lead use included insufficient scientific information, belief that most eagles likely recover from lead poisoning, and lack of friends or relatives who use nonlead ammunition. Because this study focused on natural resource professionals, our results likely represent a best-case scenario for voluntary use of nonlead ammunition among deer hunters.

Sub-lethal Effects of Neonicotinoids on Native Bees: Evaluating Cavity-nesting Wild Bee Reproduction in Missouri Agroecosystems

Presenter: Robert Abney, University of Missouri

Native bee populations have experienced declines throughout North America. Potential causes for these population declines are complex, with factors including habitat loss, climate change, parasites, and pesticides. However, habitat loss and increased pesticide exposure are considered to be the two principal contributors to wild bee declines. Neonicotinoid insecticides are used extensively in the Midwest and are associated with declines in native bee abundance and diversity. However, data evaluating neonicotinoid effects on wild bee reproduction in a true field setting remain limited. Therefore, to assess effects of neonicotinoid exposure on cavity-nesting bee reproductive success, we placed bee nest boxes in agricultural field margins of 18 soybean fields in north-central Missouri in 2018. Soybean fields were planted using one of three treatments: imidacloprid-treated seed (n = 6 treated fields); untreated seed (n = 6 untreated fields); and treated (2016) to untreated seed (n = 6 previously treated fields). Initial assessments indicate nest box occupancy was greatest in treated field margins, with 99 nest cells per treated field compared to 75 in previously treated fields and 78 in untreated fields. However, percent emergence from nest boxes was lowest in treated fields (11% treated; 30% previously treated; 25% untreated). Additional research includes analyzing bee biomass and nesting material samples for pesticide residues and expanding the experiment to fields in private ownership. If native bees are establishing more nests near neonicotinoid treated fields but experiencing overall lower emergence rates, neonicotinoid treated fields have the potential to act as an ecological trap for native bees. Presentation preferred, but poster is also an acceptable option.

Assessing Microhabitat Influences on Captured Eastern Cottontails (*Sylvilagus floridanus*) on Restored Prairies

Presenter: Dottie Stimac, School of Natural Resources, University of Central Missouri

After European settlement in North America, Missouri's tallgrass prairie experienced a drastic reduction in total area due to land-use change and habitat fragmentation. Less than 30,000 of the original 5.7 million hectares remains today. This reduction in land area and habitat connectivity has greatly limited the ecosystem services provided by the few remaining prairies. In an attempt to restore these ecosystem services, the Missouri Department of Conservation (MDC) has begun restoration projects on several conservation areas within the state to restore these native grasslands. One particular avenue of restoration includes restoring habitat connectivity to encourage population growth and health of the primary consumer trophic level. Eastern cottontail (*Sylvilagus floridanus*) are a critical component to restoration because they provide hunting opportunities for public stakeholders and serve as a large component of the trophic food base for many species. Thus, assessing population trends of this species could yield important information related to restoration efforts. To monitor the restoration progress, MDC partnered with the University of Central Missouri (UCM) from 2015–2019 to complete a mark-recapture study estimating population trends and movement patterns of the Eastern Cottontail (*Sylvilagus floridanus*) on Schell Osage Conservation Area and Linscomb Wildlife Area. This study used spatially explicit capture-recapture (SECR) modeling to estimate population trends and spatial movement of rabbits across the length of the study. Resource selection functions were included in the final SECR model to assess habitat preferences of the Eastern Cottontail after grasslands were reestablished. Results will be discussed in light of this ongoing study.

8:00 – 10:00 a.m.

Odysseys in Soil Health: Harnessing the Power of Partnerships

Room 60-61

Organized by: Steve Wilson, USDA

Network with partners to understand and promote the values of soil health in all land uses. Keynote speaker and a panel of experienced soil health leaders will help us as conservation professionals to discover better ways to influence customers and as well as promote the four principles of soil health within our programs. This workshop will provide tools to assist you in meeting the demand generated by the public's quest for greater soil health. The workshop is for those that work with wildlife, pasture, crop, and forest lands.

8:00 – 10:00 a.m.

Strategic Use of 404 Mitigation Projects

Room 62 – 64

Organized by: Robert Stout, MITICO

Stream and wetland mitigation projects are developed to offset unavoidable impacts under Section 404 of the Clean Water Act. These projects are designed to develop and restore stream and wetland habitat and function. They are environmental restoration projects. The process of developing these projects is complex, involving various public and private sector developers and multiple regulatory agencies. Developers often wait to address these mitigation requirements at the very end of the planning process. While the State of Missouri has developed specific methods to guide the development of these projects, they seldom provide the optimal environmental benefit to the watershed. The opportunity exists to use mitigation credits strategically to address watershed problems at no (or greatly reduced) cost to landowners. This workshop will explain the mitigation process, provide examples of mitigation projects and techniques, and consider how resource agency staff can help to identify watershed priorities and sites in order to address watershed problems using this resource.

10:30 a.m. – 12:30 p.m.

Fisheries/Aquatic Systems Papers 2

Paradise A

Aquatic Landscape Conservation Tools: Helping Manage Missouri's Aquatic Systems

Presenter: Craig Paukert, US Geological Survey

Conservation of Missouri's fish and wildlife resources has recently emphasized landscape conservation. The University of Missouri, in collaboration with the Missouri Department of Conservation, the Missouri Department of Natural Resources, and the US Geological Survey have developed numerous tools to aid conservation of Missouri's aquatic systems. Recent work has helped identify metrics of habitat degradation related to land use, stream fragmentation, impoundments, and water quality impairment, and how fish communities may shift under a changing climate. In addition, we have also developed species distribution models and vulnerability scores for most stream fishes in the state, and developed a process to link the response of fish and invertebrates communities to altered instream habitat that can be applied to develop metrics of biotic condition across unsampled stream reaches. Future work will help classify streams based on least altered hydrology, a framework to identify where to place best management practices on the landscape, and identify areas that may be high quality stream reaches based on spatial connectivity of Priority Geography landscapes. Many of these tools are available for download from online mappers, tables in peer reviewed publications, or available at the request of the researchers. We believe these tools are useful for conservation efforts of aquatic systems at a landscape scale.

Assessment of the Fish Community of the Lower Niangua River in Relation to the Niangua Hydroelectric Project

Presenter: Jason Persinger, MDC

Fish community sampling was conducted on the Niangua River as part of an effort to evaluate the effects of the Niangua Hydroelectric Project's (Project) operation on flow, habitats, and aquatic biota. The objective of this sampling effort was to evaluate the fish community in three reaches of the Niangua River that are affected by the creation of Lake Niangua (Tunnel Dam) and the operation of the Project. Those reaches were the Niangua River upstream of Lake Niangua, the bypass reach located between Tunnel Dam and the Powerhouse, and the return reach located between the Powerhouse and Lake of the Ozarks. We selected four sites (one upstream, two in the bypass, and one in the return) and sampled each site in the Fall of 2017 and Spring, Summer and Fall of 2018. Sampling was conducted with a multi-gear approach using boat electrofishing, tote- barge electrofishing and seining. A total of 72 fish species were found across all four sites during sampling efforts. This included 11 species not found during the previous survey in 1989-1990, two of which were new records for the entire Niangua River Basin. The total number of species found at each of the four sampling sites was very similar, although there were differences in the actual assemblages and relative abundances at each site. The bypass reach had the most species, with many of them only found in low numbers with less than five individuals. Ten species were only found downstream of Tunnel Dam, raising concerns about fish passage.

Examining the Influence of Altered Stream Flow on the composition of Headwater Fish Communities

Presenter: Nicholas Sievert, Missouri Cooperative Fish and Wildlife Research Unit, University of Missouri

Alterations to stream flow can have substantial impacts on the suitability of habitat for stream fish. In 2017 and 2018 we monitored stream flow and sampled fish communities in 6 (2017) and 12 (2018) streams in the Salt, Cuivre, and Loutre River

basins in Northern Missouri. The year 2017 had several major precipitation events, while 2018 had fewer major precipitation events and included a substantial period of drought. Stream flow was monitored by deploying level loggers which took measurements of stream stage at 15 minute intervals at each of our sites. Fish communities were sampled via backpack electrofishing and seining in the summer and fall of each year. Bank-full flow exceedance events ranged from 5 to 8, while isolation of pool habitat occurred on 12% to 75% of days across our sites. Species richness ranged from 4 to 23. In 2017 the lowest richness came at the site with the highest number of bank-full flow events and the lowest level of pool isolation, while the site with the highest species diversity occurred at an intermediate level of bank-full exceedance flows and pool isolation. In 2018 sites which experienced the greatest duration of zero flow days had the lowest species richness. We believe these results can help link stream flow characteristics with fish community structure and contribute to our understanding of how altered stream flow characteristics influence stream fish communities.

Evaluating Fish Community Changes to Stream Flow Alterations

Presenter: Emily Tracy-Smith, School of Natural Resources, University of Missouri

Flow is the master variable that determines the complexity and heterogeneity of stream ecosystems. Land use change, river impoundment, surface and groundwater abstraction and inter/intra-basin transfers alter natural flow regimes. Hydrologic alteration is a critical risk to stream ecosystem health especially in regions heavily influenced by impoundments and growing water needs from population growth. To improve our understanding of fish community responses to stream flow alterations, we established a spatial framework using existing fish sampling and habitat data for Missouri streams and developed flow alteration metrics to understand how flow alterations affect riverine systems and their biota. In the Grand River Basin, we incorporated attributes of impoundments (reservoir area, maximum storage, and percent of watershed upstream of impoundment) to calculate alteration metrics related to high flow and low flow alterations. In the Spring-Elk River Basin, we evaluated the hydrologic effect of water withdrawals, using losing streams as a natural surrogate, and incorporating the influence of groundwater springs to estimate percent reduction of median flow. Working downstream from each headwater segment, we accumulated values of these metrics for every stream segment within the Missouri stream network. Accumulated values of impoundment and withdrawal metrics were applied for every fish community-sampling site of the MDC Resource Assessment and Monitoring Program. The resulting datasets were used to evaluate differences in fish communities as a function of flow alterations, and to test flow-ecology hypotheses about potential responses to flow conditions.

Assessment of Water Quality Relative to Current and Potential Placement of Best Management Practices

Presenter: Joanna B. Whittier, University of Missouri

Best Management Practices (BMPs) are conservation practices aimed at addressing an environmental problem and have become increasingly common over the last few decades. In aquatic systems, BMPs typically focus on issues such as soil erosion and non-point source pollution to improve or maintain water quality. Examples of BMPs include no-till of agricultural lands, planting cover crops, and leaving a vegetated buffer between an agriculture field and a water body. Our objective was to develop a watershed model to estimate current water quality which could be used to identify optimal placement for and types of best management practices to further improve water quality. In addition, we identified fish species sensitive to nutrient or sediment levels. We demonstrate our approach using two watersheds in differing ecoregions. We developed a baseline model of water quality in each watershed using the Soil and Water Assessment Tool ([SWAT](#)). BMPs were categorized by type (e.g. no tillage, grassed waterway) and intent relative to aquatic condition (e.g. reduce soil erosion, reduce flooding). We then estimated the cumulative impact of current BMPs on water quality parameters and identified where specific BMPs might further improve the overall water quality. We leveraged a regional dataset of standardized sampling for aquatic taxa and water quality to identify fish species sensitive to total phosphorus, total nitrogen, and total suspended solids. Sensitivity was based on changes in abundance across gradients of each water quality measurement. The information on species sensitivity could be used to identify subsequent watersheds to target for BMPs.

Freshwater Mussels of the North Fork River and Bryant Creek, Missouri

Presenter: Stephen E. McMurray, MDC

During 2012-13 we surveyed freshwater mussels at 37 locations in Bryant Creek and the Missouri portion of the North Fork River, including 15 from a 1981-85 survey, with timed visual and tactile searches. We calculated metrics to determine richness, diversity, and community composition for both surveys, and calculated the colonization and extirpation proportions for species, tribes, and life history strategies. We tested for significant differences between streams (2012-13 only), between surveys (locations surveyed during both periods only), and between the colonization and extirpation values for species. Our results suggested significant declines in species richness and abundance and a change in community composition, especially prominent in Bryant Creek, over a 30-year period. These declines occurred across species, tribes, and life history strategies, but the cause is unknown. Given the preponderance of forested land in public ownership and the small amounts of urban areas and agriculture and associated point and nonpoint source impacts in the watershed, if the threats to freshwater mussels can be identified and ameliorated, the Missouri portion of the basin may be a viable candidate for restoration of the mussel fauna.

10:30 a.m. – 12:30 p.m.

Community Conservation Opportunities

Paradise B ([open map](#))

Organizer: Jon Skinner, MDC

Speakers: Ronda Burnett, MDC; Carrie Lamb, MDC; Mark Grueber, MDC; Danny Moncheski, MDC; Cindy Garner, MDC; Jon Skinner, MDC

Various conservation opportunities exist in urban and community settings. These offer the chance to include native plants to improve the diversity of plants in a community, improve water quality, and add to wildlife habitat. Unfortunately, not all topics can be discussed in a workshop. We will introduce the following:

Native Plants in Urban Rainwater Management Systems – Ronda Burnett, MDC and Carrie Lamb, City of Springfield – 1 hour

Silva Cells for Difficult Planting Locations – Mark Grueber, Danny Moncheski – 20 minutes

Stem Girdling Roots and Proper Tree Planting – Cindy Garner – 20 minutes

Forest ReLeaf of Missouri – Jon Skinner – 20 minutes

10:30 a.m. – 12:30 p.m.

Wildlife/Prairie-Grassland Papers

Paradise C

Assessing impacts of Patch-Burn Grazing on Small Mammal Communities at Hi Lonesome Prairie Conservation Area

Presenter: Cori L. Brown, University of Central Missouri

Tallgrass prairie is one of the most endangered habitats in North America. Historically, 33% of Missouri consisted of tallgrass prairie; however, less than 0.05% of that prairie remains. A stable prairie system is an extremely diverse system that contains many endemic plant and animal species. Historically, interactions between wildfire and grazing by large herbivores (bison) served to enhance this diversity by removing dominant plant species and allowing for a release of species that may have been suppressed by the dominant species. Wildfire suppression, the loss of wild bison herds, and habitat fragmentation continue to degrade the little tallgrass prairie that remains. Patch-burn grazing is a land management technique that aims to recreate the disturbances created by wildfire and grazing using prescribed, patchy fires and cattle. In the absence of these disturbances, the prairie habitat becomes simplified or homogenized, and species diversity is adversely affected. While studies have been performed evaluating the effects of patch-burn grazing on many plant and bird species, there is a need to assess the impacts of this management technique on small mammal communities. This study will assess small mammal communities in Hi Lonesome Prairie Conservation Area in Benton County, Missouri, where patch-burn grazing is currently being utilized. Sampling efforts are currently underway in all patches at Hi Lonesome as well as the un-grazed unit of the conservation area.

The Effects of Habitat Management and Landscape Context on N. Bobwhite Winter Survival and Habitat Selection in SW MO

Presenter: Alisha Mosloff, School of Natural Resources, University of Missouri

Long-term declines in northern bobwhite quail and more recent questions regarding patch-burn grazing and extensive grassland management suggest additional information on habitat and management effects on bobwhite demographics is needed. Our objectives were to determine habitat and landscape effects on winter survival and habitat selection in the context of traditional intensive bobwhite habitat management versus extensive grassland management. We tracked 220 bobwhite 3 times per week from 1 November through 31 January in 2017-2018 and 2018-2019 on 5 conservation areas in southwest Missouri. Two sites were traditionally managed with landscape features comprising hedgerows, strip crops, and food plots, while 3 conservation areas were extensively managed with prescribed burning and grazing. We classified land cover as native prairie, shrubby thickets, and mature edges based on aerial photography. We used logistic exposure known-fate survival models in a bayesian framework to evaluate drivers of survival and estimated survival with the most supported models. Prescribed burning within the last 2 years decreased survival (posterior mean: -0.90, CRI: -1.71, 0.08). Greater distances to mature edges increased survival (PM: 0.38, CRI: 0.03, 0.76), as did higher woody edge densities (PM: 0.51, CRI: 0.01, 1.01). Similarly, increased contagion of woody cover also increased survival (PM: 0.32, CRI: 0.05, 0.60). We evaluated habitat selection using discrete choice habitat selection models in a bayesian framework to determine habitat and management factors influencing habitat selection. The relationships between survival and habitat and management will inform conservation and management that promotes bobwhite survival during winter.

Summer Bobwhite Brood Survival and Resource Selection: Effects of Habitat, Management and Landscape

Presenter: Emily A. Sinnott, School of Natural Resources, University of Missouri

Bobwhite populations have declined by nearly 80% in Missouri since 1967. We address critical information gaps around brood ecology, a vulnerable life stage affecting population growth. We determined habitat and landscape factors affecting survival and resource selection during the first 114 days of life. Seventy-five broods and 219 radio-tagged young were captured and tracked from 2016—2018. We estimated bobwhite juvenile survival under a known fate modeling framework and evaluated habitat selection patterns using step selection analysis. Survival increased with age and 114-day period survival was 26.7%. Survival was greatest on native grasslands burned and grazed at least once in the previous two years, followed by croplands and grazed mixed grasslands. Shrub cover within 50-m had weak positive effects on survival. Resource selection results complemented survival patterns. Broods had strongest selection for native grasslands burned and grazed and croplands. Broods older than 35-days showed stronger selection for idle native grasslands, shrubs, and croplands than younger broods. Woody composition had a stronger influence on space use than survival; tree cover within 50-m was selected against, while broods selected for shrub cover and proximity to mature trees. Juvenile survival and brood habitat selection were sensitive to the quality and availability of alternative habitats in the surrounding landscape, cover type and management practices, and composition of local woody vegetation and our results can be used to inform management. Future research could evaluate interactive effects of seasonal and extreme weather on brood survival or sensitivity of annual population trends to breeding season dynamics.

Updated Population Census of an Uncommon Prairie Forb, Royal Catchfly, at Wilson's Creek National Battlefield, Republic, MO

Presenter: Kathleen A. Kull, American Conservation Experience, National Park Service Heartland I&M Network

The royal catchfly (*Silene regia*, Caryophyllaceae) is a rare, tap-rooted, perennial forb known to occupy Midwestern prairies, glades, and savannas, which are increasingly fragmented. While not federally listed, it is recognized as threatened or endangered in five states. We resurveyed fifteen population sites identified in 1980s and 1990s monitoring at Wilson's Creek National Battlefield, Republic, MO. Abundance at each site was collected in six years and analyzed using TRIM; measures of plant height and proportion of stems browsed were collected in four years and analyzed using two-way ANOVAs. Fire history and precipitation were also explored. Abundance of royal catchfly declined significantly ($p < 0.0001$) over the study period, and only five of fifteen populations had detectable individuals in 2019. Year, site location, and the interaction between the two were highly significant factors (all $p < 0.001$) in explaining variation of height measures and proportion of stems browsed. Plant height was significantly higher in 2019 than any other year ($p < 0.05$), corresponding with overgrowth of competing vegetation and a wet spring; however, no year ($p > 0.50$) or month ($p > 0.07$) had significantly different precipitation than any other. Over the monitoring period, prescribed fires became less frequent, and over the entire period the mean fire return interval was higher than the historical regime of the region (9.7 years versus 4 – 8 years). The marked decline in royal catchfly at Wilson's Creek National Battlefield speaks to the need for reinigorated fire management and restoration of prairie and savanna ecosystems.

Patterns of Anthropogenic Fire within the Midwestern Tallgrass Prairie: Evidence from Historical Records (1673-1905)

Presenter: Charles M. Ruffner, Southern Illinois University

We conducted searches in literature from Illinois, Indiana, Iowa, Missouri, Minnesota, North Dakota, Ohio, and Wisconsin for descriptions of wildland fires occurring between 1673 and 1905. A total of 797 landscape fires were identified within or near the eastern tallgrass prairie-forest transition, including 33 attributed to Native Americans, 195 to Europeans during early settlement in the nineteenth century, and 569 European ignitions from Minnesota during the agricultural/industrial years of the late nineteenth and early twentieth centuries. Overwhelming evidence suggests a two- to three-week period during October and November, known as Indian summer, was the primary season of occurrence for wildland fire in this study. Our records indicate Native Americans used fire primarily for hunting, whereas Europeans set fires to reduce fire hazards near habitations, eliminate crop residues to facilitate plowing, or mere carelessness. Only five lightning-caused fires were identified. Individual fires frequently burned thousands of hectares, creating dense smoke, damaging trees, personal property, and occasionally burning inhabitants to death. South and southwest were the most frequent wind directions for wildfires; a few were driven by east winds. Drought years, including 1796, 1819, 1856, and 1871, were characterized by extensive fires which ultimately resulted in legislation to protect property owners and public welfare. Fire frequency for the study period is thought to be underestimated because only large, spectacular, threatening fires were recorded during European settlement. In addition, we suggest Native American fires are under-represented due to their widespread population collapse following contact with Europeans.

Quantifying Seed Rain Patterns in a Remnant and Chronosequence of Restored North-Central Missouri Tallgrass Prairies

Presenter: Katherine Wynne, University of Missouri

Seed rain, or the dispersal of seeds into an area, is an understudied phenomenon that is closely related to the colonization, establishment, and persistence of species in a community. However, little is known about natural seed rain patterns in

grassland communities and how these patterns change during the restoration process in comparison to remnant systems. To address these knowledge gaps, we revisited a seminal grassland seed rain study conducted by Rabinowitz and Rapp (1980) and quantified the seed rain patterns in the same remnant tallgrass prairie and a chronosequence of restorations. In May of 2019, we deployed 200 turf-grass seed carpets (0.1 x 0.1 m) in 3, 6, and 15-year-old restored prairies and a remnant prairie. We collected and replaced seed traps every 2-weeks, and captured seeds were identified and counted. From May to August 2019, we collected over 27,000 seeds representing at least 70 species. We found differences in the abundance of seeds falling in restored vs remnant grasslands, and differences along the chronosequence. In general, we found that restored prairies had higher abundances of captured seeds than the remnant. Over the same time interval, we captured more seeds and species in the remnant prairie in 2019 than in 1980. Although this study is ongoing, we expect to find differences in species composition and timing of seed dispersal between the remnant and restored prairies varying with restoration age. Overall, our work further informs management efforts on how to better utilize spatiotemporal patterns of seed dispersal in creating high-quality restorations.

10:30 a.m. – 12:30 p.m.

Historic and Current Management of the Mark Twain National Forest

Room 60-61

Organizer: Theresa Davidson, Mark Twain National Forest

Speakers: Jim Cornelius; Theresa Davidson; Kelly Whitsett; Daniel Cain; Casey Hawes

The Mark Twain National Forest, as we know it today, was created on February 17, 1976. However, the Mark Twain National Forest was once known as both the Clark National Forest and the Mark Twain National Forest – both being proclaimed on September 11, 1939. The Mark Twain National Forest manages approximately 1.5 million acres of public land in Missouri. We will explore the history and management of Missouri's only National Forest in this workshop.

Brief overview of the National Forest System in Missouri – TBA

The History of Fire and Fuels Management on the Mark Twain – Jim Cornelius

Wildlife and Fisheries Management on the MTNF through the Years – Theresa Davidson

The History of Cave and Karst Management on the MTNF – Kelly Whitsett

Natural Resources as Cultural Resources – Daniel Cain

Timber Resources and Management on the MTNF – Casey Hawes

10:30 a.m. – 12:30 p.m.

Addressing Risks of Invasive Plants to Songbirds, Livestock & New Control Approaches

Room 62-64

Organizer: Carol Davit, Missouri Invasive Plant Task Force, Missouri Prairie Foundation

Speakers: Sarah Kendrick, MDC; Mike Leahy, MDC; Steve Clubine; Matt Arndt; Carol Davit; Bill Ruppert

The threats of invasive plants on ecology and economies are real. For example, research indicates clear negative impacts of bush honeysuckle and other non-native invasive plants on the life cycles of songbirds—invasives play a role in songbird nest predation, decreased nutrition, and loss of native habitat cover. Farmers and cattle producers must learn to manage new threats such as the toxicity of perilla and the spread of Caucasian bluestem, as well as continually expanding threats, including sericea lespedeza and spotted knapweed. Expert speakers will share the ways invasive plants threaten songbirds and also impact livestock production. This information will serve to increase control of invasives to benefit songbird habitat and to benefit livestock production/farming operations, and also to build broader coalitions of support among key stakeholder groups. Speakers will also demonstrate the Missouri Invasive Plant Task Force's (MoIP) database technology to create tailored lists of invasive plant priority control regions of the state. Finally, speakers will share how MoIP is using advocacy and outreach to cease the sale of certain invasive plant species in the state. Attendees will understand the latest paths toward meaningful action in protecting Missouri's natural and agricultural resources, and they will gain new tools for communicating invasive plant threats and opportunities to their colleagues, clients, and stakeholders.

Impact of invasive plants on songbirds – Sarah Kendrick, Mike Leahy — 30 minutes

Managing threats of invasive plants in livestock pastures – Steve Clubine – 30 minutes

Moving from Excel to the Cloud: utilizing web technology to improve capacity for invasive species management and outreach – Matt Arndt – 30 minutes

Ceasing sale of invasive plants – Carol Davit, Bill Ruppert – 30 minutes

12:30 – 1:30 p.m.

Lunch

Windgate Hall

Available for purchase

1:30 – 3:30 p.m.

Natural Resource Papers

Paradise A

Growth Response of a Giant Cane Nursery to Disturbance from Prescribed Fire and Mowing

Presenter: Matthew Ganden, Southern Illinois University Carbondale

Giant cane (*Arundinaria gigantea*) is a species of bamboo native to the southeastern United States including Missouri. Giant cane is a disturbance-dependent species that forms large monotypic stands called canebrakes. Canebrakes provide valuable ecosystem services such as wildlife habitat for unique and rare species, water quality enhancement and soil conservation. However, canebrakes only encompass 2% of its original habitat because of agricultural conversion, reduced fire frequency, and urban development. Consequently, there is much interest by land managers for restoring canebrake habitat on the landscape. Preliminary studies have shown that anthropogenic disturbances such as prescribed fire and mowing have a positive effect on the regeneration of small remnant giant cane patches. Southern Illinois University has established a giant cane nursery that is 10 years old containing five different sources (putative genotypes). This unique giant cane nursery was established to provide planting stock that can be used to rehabilitate sites that should host giant cane. The goal of our study is to determine the growth response of a giant cane nursery to prescribed fire and mowing. Establishing cane nursery management practices will improve the ability of land managers to restore canebrakes. Results relating height and density relative to pre and post disturbance will be discussed. Various recommendations for establishment and management of canebrakes will be given.

Using a Marking Study to Describe the Metapopulation Dynamics of the Regal Fritillary Butterfly to Inform Management

Presenter: Daniel A. Marschalek

The regal fritillary (*Speyeria idalia*) butterfly is a prairie endemic species that is declining across much of its range, primarily due to habitat loss. Considering their declining status and a current status review being conducted by the United States Fish and Wildlife Service, it is important to assess the size of remaining populations and delineate those populations. In 2019, we quantified population sizes and assessed movements of the regal fritillary in the Sedalia area prairies. Uniquely marking individual butterflies yielded a maximum daily population size of around 80 butterflies at Friendly Prairie Conservation Area and movement was detected among Friendly, Paint Brush, and Drover's Prairie Conservation Areas. Detection of dispersal among these prairies suggests that the population is much larger than what is found on a daily basis at individual isolated Conservation Areas. In fact, the regal fritillary population structure is better represented as a metapopulation. This information will contribute to large-scale conservation planning (USFWS status review) and also valuable in terms of determining if populations are declining and how they respond to management. Since the current landscape is composed of disjunct habitat patches, it is also important for the management of the species to understand the relative importance of each subpopulations within a larger metapopulation structure.

The Development of an eDNA Survey for the Rare Longnose Darter in MO Against the Background of Rangewide Taxonomic Uncertainty

Presenter: Leah Berkman, MDC

Longnose Darters occurred historically in the White River drainage of Missouri but were last observed there in 1959, shortly after the creation of Table Rock Lake. The only extant population of Longnose Darters in Missouri occurs in the main stem St. Francis River, where only 34 individuals were observed prior to 2017. No Longnose Darters have been captured in tributaries to the St. Francis River, but adequate sampling has not occurred to confidently support their absence. Recent visual surveys using mask and snorkel yielded 49 additional individuals in 2017 but the conditions that permitted such surveys at the

appropriate time are rare. In general, main stem St. Francis River habitats are not conducive to traditional fish sampling methods (e.g., electrofishing, seining, trawling). Environmental DNA (eDNA) sampling methods have gained popularity in recent years and presented an alternative to traditional sampling methods for the Longnose Darter. We designed a qPCR assay for Longnose Darter eDNA using the *cytb* region of the mitochondrial genome and tested water samples from 27 sites. eDNA surveys were validated with field methods though detection probability was lower (0.72; 0.56 – 0.84 95% CI) than visual surveys (0.86; 0.55 – 0.97 95% CI) where conditions permitted the latter (22 sites). However, lingering taxonomic uncertainty within the Percina complex may limit the portion of the range where our assay may be effective. Thus, we demonstrate the usefulness of eDNA for hard-to-survey species of concern but emphasize the need for better phylogenetic coverage and research.

Surviving Missouri's Waters: an 80-year History of Fish Kills

Presenter: Rebecca O'Hearn, MDC

The year 2019 marked the 80th anniversary of Missouri's Fish Kill and Pollution Investigation Program. The formalized program was initiated in 1939 by the Missouri Department of Conservation (MDC) to tackle the significant pollution problems in Missouri at the time. The goals of the program are to protect aquatic resources and to maintain high-quality fishing and recreational opportunities through pollution abatement and mitigation, and to increase awareness of water pollution and aquatic life mortality through reporting of events. Staff in the program played an important role in the enactment of Missouri's first water quality laws and formation of a pollution control agency. The MDC Fish Kill and Pollution Investigation Program works in collaboration with the Missouri Department of Natural Resources, the state's pollution control agency, to investigate, mitigate, and enforce water pollution incidents negatively affecting aquatic life. This partnership has resulted in a significant decline in fish kills and pollution incidents in Missouri waters.

Morphological Variation Among Native and Non-Native Populations of Mayan Cichlid *Mayaheros urophthalmus*

Presenter: Cory Blackwelder, University of Central Missouri

The Mayan Cichlid *Mayaheros urophthalmus* is a widely distributed freshwater fish found in the southern-most areas of North America (Southern Mexico), Central America, and is invasive in Florida. It is unknown whether *M. urophthalmus* morphological features (jaw shape, head shape, and intestinal length) differ across populations, and whether these features are related to diet. Our overall goal was to understand relationships between diet and morphology within and among populations of *M. urophthalmus*. Morphological and dietary relationships were examined within and among populations from sites in the Usumacinta and Grijalva drainages in Guatemala and Mexico, the Belize River drainage in Belize, and from invasive populations in South Florida. Geometric morphometric techniques were employed to determine variation in jaw shape, head shape, and body shape among populations. Diets were quantified by examining stomach contents and through measuring intestinal lengths. Findings indicate general morphological differences exist among most populations, and invasive populations from Florida were quite morphologically distinct from native populations examined. Specifically, Florida individuals vary greatly in head shape and mouth position, where some individuals have superior mouths not found in native populations. No significant differences were found in intestinal lengths among populations. Morphological results suggest invasive populations may be better equipped for surface feeding. The potential processes through which this novel morphological variation may have been acquired (e.g., natural selection and or phenotypic plasticity) will be discussed.

Economist, Environmental Economics – Feral Swine

Presenter: Nicole Didero, USDA APHIS

Feral swine (*Sus scrofa*), also referred to as "wild pigs", are a prolific and destructive invasive species that have increased in range from 17 to 38 states in the United States over the past 30 years (Barrios-Garcia et al., 2012; Bevins et al., 2014). Primary impacts of feral swine include significant damage to property, agricultural crops, natural resources, and native ecosystems, and they present a significant risk to domestic animals and human health (USDA, 2019). In the 1990's feral swine were identified as a serious problem for the state of Missouri (Missouri Feral Hog Partnership, 2017). The Missouri Department of Conservation (MDC) and the United States Department of Agriculture (USDA) Animal Plant Health Inspection Service (APHIS) Wildlife Services (WS) have joined efforts to prevent the spread of wild pigs in Missouri with a unique management goal of population eradication. This research highlights private and public land damage caused by feral swine in Missouri. In particular, field reports regarding damages caused by feral swine were collected from private landowners in Missouri in 2019, and a follow up survey of Missouri recreationists will be collected in the spring of 2020. We highlight how alternative economic valuation methods and human dimensions of natural resources can contribute to a more robust understanding of invasive species impacts on dynamic landscapes.

1:30 – 3:30 p.m.

The Bees Knees: Native Pollinator Habitat How-to

Paradise B

Organizer: Bill White, MDC

Speakers: (Moderator) Brent Vandeloecht, MDC; Bill White, MDC; Susie Van de Reit, St. Louis Native Plants LLC; Jerod Huebner, Missouri Prairie Foundation

Habitat is being identified as the key ingredient to increasing our native pollinator populations and viewed as a means of overcoming the impacts of climate change, pesticides and diseases. We know that more native wildflowers mean more pollinators and the more diverse the wildflowers the more diverse the pollinators. While much of the headlines on pollinator declines focuses on non-native honeybees the real crisis involves the 450 species of native bees and the hundreds of species of native moths and butterflies we find in Missouri. This workshop will focus on the basics habitat needs of butterflies and native bees.

Native Pollinator Reliance on Native Plants – Bill White, Community and Private Land Conservation Branch Chief, MDC

Butterfly Nectar and Host Plants, Monarch Butterfly Habitat Needs – TBA

Native Bee Habitat Considerations for Design of Pollinator Gardens – Susie Van de Reit, Owner/Designer/Consultant, St. Louis Native Plants LLC

Field Planting and Management Basics for Native Pollinators – Jerod Huebner, Director of Prairie Management, Missouri Prairie Foundation

1:30 – 3:30 p.m.

Cattle and Conservation: Gaining a Consistent Message on Grazing and Haying Practices in Missouri

Paradise C

Organizer: Adam Jones, MFA

With Missouri being consistently ranked in the top 5 states in the US for beef cows, there is significant acreage within the state devoted to cattle and other livestock production. This alone brings a suite of challenges from a wildlife habitat and water quality perspective as it relates to landscape conservation. This workshop will provide a variety of topics including stream flows and riparian restoration options, making the most of wildlife habitat on cattle and livestock farms in Missouri, and ways producers can become more efficient with grazing practices. Speakers will provide a diverse perspective on both livestock production and making the most of habitat and conservation. The goal is to provide useful information for biologists and others working with production minded landowners in Missouri to provide small and useful suggestions that provide conservation but don't hinder production.

1:30 – 3:30 p.m.

Climate Science: Our Role As Natural Resource Managers

Room 60-61

Organizer: Jody Miles, Earths Classroom

Speakers: Jody Miles, Co-Executive Director, Earth's Classroom, Rosebud, MO; Gary Leabman, Climate Reality Specialist; Dr. Anthony Lupo, Atmospheric Scientist, University of Missouri – Columbia; Dr. Christine Li, Climate Scientist, University of Missouri – Columbia

Latest data from NASA and NOAA atmospheric scientists and Missouri's state climatologist, Dr. Patrick Guiana. A panel of 3-4 professionals will be available to lead discussion the last 30 minutes of the 2 hour workshop. This presentation is designed to initiate direction for our management tools of our natural resources for the decades to come.

Climate Science Data Slides from NASA and NOAA – Jody Miles –1.5 hours

Question and Answer Panel Session—30 minutes includes:

Gary Leabman—10 minutes

Dr. Anthony Lupo—10 minutes

Dr. Christine Li—10 minutes