MNRC 2022 – Oral Presentations

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Evan Aljundi	eaakb3@mail.missouri.edu	Evan Aljundi and Dr. Samniqueka Halsey	University of Missouri	Identifying patterns of Chronic Wasting Disease prevalence in Odocoileus virginianus in Missouri	Chronic Wasting Disease (CWD) is a transmissible neurodegenerative prion disease infecting populations of antlered, hooved mammals across a wide range of North America. To prevent the outspread of CWD, wildlife managers in multiple states, including Missouri, have turned to culling white-tailed deer (Odocoileus virginianus) in known positive locations (Core Areas) to reduce contact and spread of the disease. Researchers have previously found that adult male deer have a more than threefold higher risk of CWD infection than female deer in Wisconsin. However, we understand very little knowledge on how culling methods affect CWD prevalence in white-tailed deer populations across various landscapes in Missouri. The objective of this study is to not only discover if culling is working in Missouri to reduce the CWD prevalence, but to also understand how wildlife managers can be more efficient when creating a framework of who and where to cull white-tailed deer. Missouri's Department of Conservation (MDC) began monitoring CWD cases in 2002, before finding their first positive case in 2013. As of 2018, 116 positive cases were found, and by 2021, 206 positive cases. Using the data collected by MDC, we will use computational methods such as generalized linear modeling over population variables, such as sex and age of white-tailed deer, and the landscape indices, like crop and forested land, of CWD Core Areas. With such growing concerns, results of this study will offer MDC viable information when creating feasible protocols for CWD monitoring and management.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Megan Alkazoff	maayrp2@siu.edu	Megan Alkazoff, Charles Ruffner	Southern Illinois University Carbondale	Effects of Fire on Vegetation of the Prairies and Black Oak Sand Savannas of Kankakee, Illinois	In northeastern Illinois, The Nature Conservancy (TNC) manages five sites containing fragments of remaining tallgrass prairies and sand savannas within the Kankakee Sands section of Illinois using techniques such as prescribed burning and invasive species removal. The objective of this study was to conduct a twenty-year resampling of transects established on these five sites during the Phillipe et al. 2002 study. During the summer of 2020, permanent transect lines were resampled using a 1m² quadrat to determine the % Cover Class of each species rooted inside the quadrat. Data gathered in the field were later analyzed using linear regression to illustrate the relationship between fire occurrence and species composition on the landscape over 18 years. Species composition was characterized by three values: Shannon-Wiener Index (H'), the Floristic Quality Index (FQI), and the mean Coefficient of Conservatism (). ANOVA was used to test for physiognomic changes in vegetation. To test whether frequency of management has a significant effect on a site's FQI, H', $\bar{C}$, a Kruskal-Wallis one-way nonparametric analysis of variance test was used. Fire had a non-significant effect on the H', Floristic Quality Index, and $\bar{C}$ of a site. The ANOVA test indicates that there is a highly significant difference in floristic quality among examined sites as measured by the frequency distribution of the C values. Another ANOVA test revealed highly significant differences in forb, sedge, and shrub coverage between 2002 and 2020 data, however the difference was not in relation to fire frequency. No significant difference was found among the coverage of grasses, rushes, ferns, vines, and trees between 2002 and 2020. Lastly, the Kruskal-Wallis test results suggest that there was no significant effect of management frequency on a site's FQI, H', and $\bar{C}$.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Patrick R. Bailey	prb66540@ucmo.edu	Patrick R. Bailey, Daniel M. Wolcott	University of Central Missouri	Evaluating Occupancy of Mammalian Mesopredators along an Urban-Rural Gradient	Anthropogenic activity, in the form of urban expansion and development, have been noted as significant factors in range reduction of large mammalian predators. Conversely, mammalian mesopredators (i.e., lower trophic level predators) have seemingly adapted to these same anthropogenic disturbances, with many species expanding beyond historical ranges. Urban to rural areas typically develop along a gradient, which may affect the composition of mesopredators that inhabit a given area. More adaptable mesopredators are expected to be found closer to urban development, while more specialized mesopredators prefer a less disturbed rural area. Further, due to spatial and temporal constraints in more urban environments, mesopredators may display plasticity in behavioral patterns, often in the form of overlapping territory and temporal activity patterns. Understanding species occupancy, and temporal use of landscapes along an urban-rural gradient will be beneficial to urban planning and wildlife management. In this study, a total of 20 camera traps were placed along a prominent urban-rural gradient in west-central Missouri. Urbanization variables were collected using remotely sensed data (NAIP and VIIRS imagery). These variables included proportion of urban surfaces (e.g., streets, buildings, etc.), proportion of potential habitat (e.g., forest, fields, greenspaces, etc.), and amount of artificial light. Models assessing species occupancy and assemblage transitions were developed using habitat covariates representing different levels of urbanization. Predictive modeling for mesopredator species occurrence along an urban-rural gradient will aid in determining what features are important for maintaining stable and diverse mammal communities.

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Sougata Bardhan	bardhans@lincolnu.edu	Sougata Bardhan, Jamshid Ansari, and Frieda Eivazi	Lincoln University of Missouri	Impact of Hydrological Extremes on Soil Microbial Community Dynamics in Soils Maintained Under Different Land Use Practices	Agricultural sources continue to account for significant proportions of global anthropogenic greenhouse gases (GHG) emissions. Soil-based fluxes of GHG are produced primarily through plant and microbial processes and are affected by soil physical, chemical, and biological properties. The lower Missouri River Floodplain (MRF) region encompasses many different land use systems including agriculture, agroforestry, and riparian forest. Likelihood of climate change induced frequent flooding may alter the GHG fluxes from these landscapes further. Since, microbial processes are big drivers of GHG emissions, we wanted to evaluate the soil microbial communities in these landscapes in response to flooding. The specific objectives are to evaluate the changes in the soil microbial communities due to the different hydrological parameters. We collected intact soil cores from plots maintained under different land use management. The cores were subjected to different moisture levels – field capacity, intermittent flooding, and saturated condition for a period of eight weeks. Soil samples were collected from each core at the beginning of the experiment and at the end of the experiment. Samples were then analyzed for soil bacterial and fungal diversity using metagenomic approach. We used a Roche 454 FLX pyrosequencing technique for microbial diversity analysis. The samples were compared for abundance, diversity, and microbial diversity indices were compared to understand the impact of moisture stress. Our results suggest that prolonged saturation condition caused shift in soil microbial population and abundance. Interestingly, intermittent flooding also changed the abundance and diversity of microbial population in the soils maintained under different land use practices.
Hadley Boehm	hibhr5@mail.missouri.edu	Hadley Boehm, Andy Turner, Craig Paukert	Missouri Cooperative Fish and Wildlife Research Unit	Use of δ15N and δ13C stable isotope analysis to determine diet interactions between Striped Bass and other sport fishes in Bull Shoals Lake.	In 2013, the Missouri Department of Conservation (MDC) began experimental stocking of Striped Bass in Bull Shoals Lake in southern Missouri to create a low density, trophy Striped Bass fishery. Our objective was to determine potential diet overlap between Striped Bass and sport fish species traditionally targeted by anglers. Between 2019-20, we collected muscle samples from fish species, zooplankton, and macroinvertebrates, by season (spring, summer, fall) and end of the lake (east, west) for δ15N and δ13C stable isotope analysis. Results consistently showed black basses and crappies to be approximately one trophic position below Striped Bass. While White Bass, Striped Bass, and Walleye consistently occupied the same trophic position across end of the lake and season, overall mean δ13C (‰) for STB (μ = -29 ± 1) tended to be slightly greater than that of White Bass (μ = -31 ± 1) and Walleye (μ = -31 ± 1). We did not observe consistent patterns in δ13C (‰) overlap for these three species when broken down and compared among length groups. These preliminary findings suggest that while White Bass, Walleye, and Striped Bass occupy similar trophic position, Striped Bass may be using slightly more benthic sources. These findings will be enhanced by an additional year of sampling to enable exploration of diet interactions among years.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Tom Boersig	Thomas.Boersig@mdc.mo.gov	Tom Boersig and Kellie Hanser	Missouri Department of Conservation	Distribution, Trends, and Habitat Associations of Sturgeon Chub (*Macrhybopsis gelida*) and Sicklefin Chub (*M. gelida*) in the Lower Missouri River.	Sturgeon chub (Macrhybopsis gelida) and sicklefin chub (M. meeki) are largely restricted to mainstem rivers of the central United States. Both species exhibit traits including long dispersal distances (>100 km) and flow-dependent spawning cues, increasing vulnerability to river modification. Both have been petitioned under the Endangered Species Act, with their status review requiring data on distribution, abundance, population trends, and habitat associations. From 2005-2021, Missouri Department of Conservation personnel collected both species as part of fish community and pallid sturgeon monitoring on the Missouri River. We used benthic trawling data to examine species distribution, and related catch per unit area (CPUA) to environmental and flow variables. Both species were largely restricted to the mainstem Missouri River, and CPUA was typically highest in downstream samples. Sicklefin chub were more abundant than sturgeon chub in all years sampled. Length-frequency suggests both species reach maturity at approximately 60 mm. Annual abundance was positively associated with intensity and duration of high flow pulses, and low late-season discharge. Mesohabitat variables associated with chub abundance included sand substrates and high bottom velocities. Today, sturgeon and sicklefin chub persist in highly modified large-river environments. However, further manipulation of big river habitat may interfere with important life history functions, including spawning and dispersal. Upstream populations may be most sensitive to additional modification, due to low abundance and limited habitat. Further investigation of these species' population structure, movement, and relationships to flow variables may inform their ability to persist in modified river systems.
Shane Bush	shane.bush@mdc.mo.gov	Shane Bush	Missouri Department of Conservation	Trout management in Lake Taneycomo, Missouri	Lake Taneycomo was built in 1913 and is Missouri's oldest hydroelectric reservoir. The lake is riverine in nature, 22 miles in length and encompasses 2,080 surface acres. Prior to 1958, Lake Taneycomo supported one of Missouri's best warm-water fisheries. This changed in 1958 when Table Rock Dam, located in the headwater of Lake Taneycomo, began discharging cold hypolimnetic water into Lake Taneycomo. The discharge of cold water changed Lake Taneycomo into a cold-water environment, providing optimal conditions for trout. The Missouri Department of Conservation (MDC) began stocking rainbow trout into Lake Taneycomo in 1958 and brown trout in 1980. At present day, 560,000 rainbow trout and 15,000 brown trout are stocked into the lake annually, making Lake Taneycomo Missouri's largest and most popular trout fishery. By the late 1960s, largely through the introduction of Gammarus pseudolimnaeus, rainbow trout were exhibiting growth rates up to 0.7 inch per month. Large rainbow trout were abundant, and the lake quickly earned a national reputation for producing trophy rainbow trout. By 1986, the G. pseudolimnaeus population had declined by approximately 90% and few rainbow trout larger than stocking size were present. This prompted an extensive study conducted by MDC that led to regulation changes in 1997. Since the regulations were implemented in 1997, the rainbow trout population has increased 10-fold. Through intensive management, the lake continues to provide world class trout fishing to this day.

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Sarah J. Clements	sjcnh7@mail.missouri.edu	Sarah J. Clements, Bart M. Ballard, Georgina R. Eccles, Emily A. Sinnott, & Mitch D. Weegman	University of Missouri	Challenges and considerations for the use of tracking technology in avian research	Researchers should consider the costs and benefits of using tracking devices to choose devices that will optimize information gained with minimal effects on study organisms. With numerous technological advancements and devices marketed for avian research, it can be difficult to select an optimal tracking device and sampling design. We present an overview of key decisions and considerations to be made when designing a bird tracking study to best meet different objectives. For example, optimal device size, data type, data retrieval method, attachment type, and duty cycle will vary depending on objectives, budget, and characteristics of focal species. We also summarize the results of a detailed evaluation of six lightweight automated GPS tracking devices of different sizes (1-g, 4-g, 6-g, 10-g, 15-g, 35-g) and varied data collection intervals to quantify (1) fix success rate under different duty cycles, (2) precision of location information, and (3) battery depletion given the effects of duty cycle and reduced light for solar rechargeable units (10-g, 15-g, 35-g). We encourage practitioners to choose devices and sampling designs carefully and evaluate devices prior to deployment on wild birds to maximize data quality relative to their research questions.
Frances M. DiDonato	fmdidonato@mail.missouri.edu	Frances M. DiDonato, Mitch D. Weegman, Theodore C. Nichols, Joshua C. Stiller, James O. Leafloor, Frank Baldwin, Qing Zhao	University of Missouri	Assessing feasibility of a capture-resighting framework to improve precision in Atlantic brant survival estimates	Waterfowl (i.e., duck, goose, and swan) conservation and management in North America is informed by survival estimates based on hunter shot band recoveries, but recovery data may be sparse for some populations with small banding samples or low recovery rates. Joint encounter (JE) models combine live resightings of marked animals with dead recovery data to estimate survival probability. JE models could improve precision in survival estimates relative to those from models with dead recovery data only. However, the extent of improvement may depend on the annual number of marked birds and resighting probability. In 2018, we initiated a capture-resighting program for Atlantic brant (Branta bernicla hrota), an Arctic-nesting goose species, where birds were captured and marked on Arctic breeding areas during summer and Atlantic coast wintering areas, then resighted by trained observers during winter. We developed a two-season, Bayesian multistate JE model to estimate annual survival, resighting, and recovery probabilities for Atlantic brant for the period 2018-2021. Using these results, we created a set of simulated scenarios to model survival for a period of 10 years using combinations of sample sizes (number of marked birds) and resighting probabilities that vary upward or downward by 25% from our current estimates. We compared estimated survival probability among scenarios to understand the extent of improvement in precision of survival estimates using JE models relative to that from dead recovery models. Our results will help wildlife managers understand the feasibility, trade-offs, and utility of a longer-term capture-resighting program for Atlantic brant.

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Dan Drees	Daniel_drees@nps.gov	Dan Drees	National Park Service, Ozark National Scenic Riverways	Highlights from 21 years of fire effects data from Ozark National Scenic Riverways.	After five dormant-season fire applications, the average native herbaceous species richness increased by 112% in 13 glade plots, 119% in 7 dry-mesic woodland plots, and 182% in 12 dry woodland plots. From those same plots, the average native herbaceous abundance increased 92% in glades, 235% in dry- mesic woodlands, and 432% in dry woodlands. The pre-burn versus post-burn photos from these plots provide additional compelling evidence of how prescribed fire is benefitting many pollinators, ground level herbivores, and other wildlife such as prairie warblers. Monitoring of rare plants, pre-burn versus postburn, has also shown strong population increases in burn units at Ozark National Scenic Riverways.
Nicole Farless	nicole.farless@mdc.mo.gov	Nicole Farless and Paul Blanchard	Missouri Department of Conservation	East Fork of the Black River Gravel Augmentation and Movement	The Taum Sauk pump-storage hydropower facility was built in 1963 by Ameren Missouri and their Federal Energy Regulatory Commission license (FERC) was renewed in 2014. A Gravel and Sediment Control Plan was required by FERC, which required Ameren to excavate substrate from the sediment trap upstream of the lower reservoir and evaluate placing some of this substrate in the East Fork of the Black River downstream of the dam to enhance habitat. Upstream of the reservoir, the river is transporting a high bedload as 35,000 yds3 (10 years of accumulation) was excavated from the sediment trap in 2019. Ameren and MDC have worked together since 2017, developing a pilot study to determine the logistics (i.e., location, amount, size) for gravel augmentation. Three augmentations have occurred, adding 25 yds3 in 2017 and 50 yds3 in 2019 and 2020. Augmentations occurred in riffle and dry margin habitat directly downstream of the dam. Substrate movement in relation to discharge was monitored using painted and passive integrated transponder (PIT) tags. Discharge events greater than 2,000 cfs (occur an average of 3.5 times annually) were needed to move rocks out of the augmented location into the downstream pool (200–500ft), whereas 5,000cfs flows (occur an average of 0.7 times annually) were needed to move rocks to the downstream riffle (550–700 ft) habitat. Additional work is being done to determine discharges necessary for further longitudinal movement. The results of this study will guide future gravel augmentations on the East Fork of the Black River.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Matthew Ganden	matthew.j.ganden@usace.army.mil	Matthew Ganden, Brian Stoff, Rob Cosgriff	United States Army Corps of Engineers	Forest Restoration on Mississippi River Islands	The Denmark Island and Drift Island complex in pool 24 of the Mississippi River is a network of ridges and swales, backwater lakes, and small braided side channels. This area has seen an increase in sedimentation in recent years and this problem was exacerbated by recent large scale flood events. Water is currently unable to drain off these sites effectively following a flood, resulting in the degradation of floodplain forests and wetlands, as well as quality aquatic habitat. The proposed project would improve the drainage of water off of these sites by excavating sediment plugs and dredging side channels, and would help to restore critical riparian areas lost in recent years to increased flooding. The project would restore and enhance floodplain forest communities, wetland communities, as well as improve water quality in the area and provide essential side channel and backwater habitat for aquatic species. The proposed dredging would not only improve the backwater habitat within the Drift Island complex, but also the side channel between Drift Island and Denmark Island. This area has also had a large amount of sediment deposition and would benefit by restoring side channel connectivity and aquatic habitat. The project objectives, project implementation, and results of similar projects on river Islands relative to forest restoration will be discussed. Various recommendations for floodplain forest restoration will be given.
Michael E. Goerndt	mgoerndt@missouristate.edu	Michael E. Goerndt, Stewart McCollum, William McClain, Melissa Bledsoe, Toby Dogwiler	Missouri State University	Modeling Growth and Establishement of Plantation and Converted Agroforestry Silvopasture Systems in the Missouri Ozarks Region	The Missouri Ozarks are well known for high production in both timber products and cattle production. Most areas are also not well suited for many other agricultural practices such as row cropping, so forests and grazing lands dominate the landscapes. Such characteristics provide high potential for the agroforestry practice known as silvopasture. This study monitors the establishment of two different types of silvopasture systems, plantation and conversion types. In the plantation silvopasture, two cultivars of black walnut (Juglans nigra) were planted, football and kwikrop. Health and growth were monitored for those cultivars over the first year. The converted silvopasture consisted of a manually thinned upland forest area containing many different oak (Quercus) species as well as a few other hardwood species such as hickory (Carya) and ash (Fraxinus). The converted stand was monitored using an unmanned aerial system (UAS) equipped with a multispectral sensor. The multispectral imaging was used to create canopy height/cover models as well as build models predicting seasonal climate stress variables such as leaf water potential and leaf chlorophyll content of the trees within the converted silvopasture system. The final seasonal climate stress models displayed relatively high prediction potential for important seasonal climate stress variables using remote-sensed data for different forest ecosystems in the Missouri Ozarks region.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
James M. Guldin	jguldin@prodigy.net	James M. Guldin, Lance A. Vickers	US Forest Service	Empirical assessment of growth patterns of white oak stave logs based on ocular inspection of cut stumps	The regeneration dynamics and submerchantable growth patterns of small diameter white oak stems are not clearly understood. One anecdotal observation of the stump cross-sections of a dozen white oak stave logs on Pioneer Forest in 2017 suggested that at least half of the logs showed some degree of suppression for a varying length of time when the trees were small, and that some undocumented harvest or disturbance event led to release of those small stems and subsequent faster rates of radial growth. We decided to broaden this anecdotal examination with a larger, but still empirical, ocular assessment by photographing 100 cut white oak stave log stump cross sections in the woods or on the log deck of a stave log mill, and judging the degree to which logs show evidence of past growth suppression (none, minor, moderate, or major evidence of growth suppression) based on ring width. In logs that show evidence of suppression, the duration of suppression, the date of release, and the size of the tree at stump height will be estimated. These observations may be useful in a subjective description of the range of variation in suppression and release from suppression in white oak trees that develop into stave logs. This may inform the discussion of whether a larger and more scientific study of white oak growth rates, especially in trees smaller than sawlog size, would help managers better predict the ability of white oaks to respond to release and develop into high-quality sawtimber-sized trees.
Joe C. Gunn	jcg5g9@mail.missouri.edu	Joe C. Gunn; Leah K. Berkman; Andrew T. Taylor; Jeffrey B. Koppelman; Shannon Brewer, James M. Long; Taylor N. Volkers; Edward Sterling; Michael Moore; Lori S. Eggert	University of Missouri	Divergence, admixture, and fitness in the Smallmouth Bass (Micropterus dolomieu)	The Neosho Smallmouth Bass (Micropterus dolomieu velox), one of two recognized subspecies, is restricted to the Arkansas River Basin (ARB). To promote angling, the Northern Smallmouth Bass (M. d. dolomieu) has been widely introduced. Consequent intermixing may cause heterosis or, alternatively, reduce diversity and fitness by undermining adaptive genome complexes. We assessed: 1) divergence, 2) local adaptation, 3) admixture history, and 4) fitness consequences of Smallmouth Bass hybridization in the Central Interior Highlands (CIH). We genotyped 50,828 SNPs for Smallmouth Bass distributed across the CIH. We found strong subspecies divergence, identifying four distinct lineages and locally adapted populations within subspecies. In the Northern range, one lineage encompassed Skiatook Lake and two Missouri River tributaries; the other encompassed the White River drainage. In the Neosho range, one lineage encompassed the upper and middle ARB, another the lower ARB. These populations were admixed with White River drainage alleles both historically (likely via transient stream connections) and recently (likely via introductions). Populations in the middle ARB were admixed recently with a Northern hatchery strain. We observed variation in growth for Northern, Neosho, and admixed individuals in Big Sugar Creek and the Elk River within the Neosho range. In the Elk River, admixed fish reached a lower average maximum length than either Neosho or Northern fish. we detected a negative correlation between heterozygosity and body condition, most pronounced in admixed fish, suggesting potential outbreeding depression. We show these subspecies are independent lineages that have hybridized, possibly impacting fitness in admixed populations.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Trystan Harpold	TrystanHarpold@mail.missouri.edu	Trystan Harpold and Benjamin Knapp	University of Missouri	Uneven-aged Management in the Missouri Ozarks: Effects of Stocking and Site Condition on Oak Regeneration	In oak-hickory forests of the Missouri Ozarks, generally dry site conditions increase the viability of uneven-aged silviculture. On better quality sites further east, uneven-aged management is usually not feasible because competition from shade-tolerant non-oaks reduce the development and recruitment of oak advance reproduction. The continuous canopy maintained by uneven-aged management affects oak regeneration by moderating light availability, making it important for periodic harvest entries to create enough light for successful regeneration. Variation in site characteristics creates a mosaic of growing conditions that further contribute to variation in oak regeneration success. While studies have shown the importance of site characteristics and overstory density on the success of oak regeneration, few studies have analyzed the effects of these variables over time. Here, we quantify the effects of stand density and site variables on temporal patterns of reproduction abundance and overstory ingrowth following decades of uneven-aged management. We used data collected from continuous forest monitoring plots at Pioneer Forest, a 147,000-acre property located in the Missouri Ozarks. Over the past two decades, stand stocking has gradually increased from an average of 68.3% to 73.6%, while the average number of saplings has decreased from 72 stems per acre to 32 stems per acre during the same period. Because harvest intensity has varied across individual stands, it is unclear if these declines are the result of current management practices. The results presented here will improve our understanding of oak regeneration under uneven-aged management and will improve silvicultural guidance for forest managers in the region.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Brittany L. Harried	blhf39@missouri.edu	Brittany L. Harried, David J. Hoeinghaus, Edward M. Mager, Lucas J. Driver	Missouri Cooperative Fish and Wildlife Research Unit	Trait-based analysis of spatiotemporal dynamics of intermittent stream fish assemblage structure	Hydrologic drought is increasing in frequency, intensity, and duration in many freshwater ecosystems as a result of interacting anthropogenic stressors (e.g. habitat degradation and climate change). While freshwater fishes native to drought-prone regions are often adapted to survive seasonal drought or recolonize after flow is restored, fish communities can be severely affected by uncommonly long periods of more intense drought. Thus, understanding the mechanisms affecting community structure and dynamics amid intensifying climate and habitat conditions is increasingly important. Inferring these mechanisms can be accomplished using trait-based approaches. This study quantified functional traits related to five niche dimensions (i.e. habitat, trophic ecology, life history, metabolism, defense) that represent commonly used and novel traits for 13 fish species that inhabit intermittent streams in Texas. We used this trait database to 1) identify traits associated with stream fish assemblage structure and dynamics during different flow conditions (i.e. pre-, early-, late-, and post- drought) in two intermittent streams, and 2) to test whether the novel traits contributed to a greater understanding of mechanisms structuring stream fish assemblages. The number and composition of statistically significant traits differed across flow periods and between streams. Many common traits and several novel traits were significant for some flow periods, while only a small number of common traits were significant for all flow periods. Additional studies will be important to test the robustness and generality of the significant common and novel traits identified in this study across different species assemblages and systems.
Topher Hockaday	hockaday.cm@gmail.com	Topher Hockaday and Aaron Geheber	University of Central Missouri	Effects of Stream Gradient on Darter Functional Morphology in the Pomme de Terre River	Darters are a group of small benthic freshwater fishes endemic to North America that often occur in fast moving riffle habitats. Previous research has indicated that stream flow may impact darter morphology, possibly through plastic response and or natural selection processes. The goal of this study was to quantify the effects of stream gradient factors (i.e., related to flow) on functional morphological traits of Etheostoma spectabile (Orangethroat Darter) and Etheostoma caeruleum (Rainbow Darter) within the Pomme de Terre River, Missouri, USA. Using specimens collected from 11 distinct stream sites, we examined darter geometric morphometric data based on 15 homologous lateral landmarks and seven homologous dorsal landmarks. Moreover, we manually measured pectoral fin surface areas, scaled to body length, for all individuals. To explore environmental factors influential on darter morphology, we gathered abiotic stream data from each site including elevation, flow velocity, stream depth, and substrate type. Morphometric data were visualized using Principal Component Analysis to assess body shape differences among individuals. We then used regression to examine relationships between the resultant Principal Component scores and abiotic stream factors. Our analyses suggest that individuals of both species found in higher elevations had larger, broader heads, while individuals from lower elevations had longer and laterally compressed heads. The perceived functional benefits of such morphological alterations in relation to abiotic stream gradient features will be discussed.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Joshua P. Hubbell	jhubbell072786@gmail.com	Joshua P. Hubbell; Joanna Whittier	University of Missouri	Characterizing Long-term Agricultural Impacts On Aquatic Community Health With Implications for Future Monitoring Programs	Agricultural practices impact ecosystems and species, across multiple scales. Historically, conservation managers have used multi-metric approaches such as the index of biological integrity (IBI) to make biological impairment decisions for streams and rivers which are suffering from long-term degradation as a consequence of agricultural impacts. Presently, community ecology studies emphasize the importance of using functional trait diversity indices (FDI) to identify multi-scale ecological stressors due to these indices inherent ability to distinguish how such gradients influence a local assemblage's contribution to ecological function. In this study, we use both IBI and FDI as univariate response metrics of local stream fish assemblage health to investigate the influence of long-term (e.g., decadal) effects of degradations in water quality and streamflow on the greater meta-assemblage. Specifically, we adopted the following objectives, 1) demarcate the current functional trait space within our study watershed and identify important traits driving differentiation in stream fish meta-assemblage structure, 2) highlight the relationships between water quality and streamflow predictors and all biotic endpoints, and 3) discuss the implications of these relationships on the development of future monitoring programs.
Saaruj Khadka	sk4m3@mail.missouri.edu	Saaruj Khadka, Hong S. He, and Sougata Bardhan	University of Missouri	Spatial patterns of white oak mortality in Missouri detected using multicycle Forest Inventory and Analysis data	Recently, there is an extensive dying of white oak trees in the Missouri State. Mostly, mortality in white oak is reported from periodic drought conditions. This study focuses on calculating mortality rate and spatial patterns from annual inventory cycles. We compiled multicycle Forest Inventory and Analysis (FIA) data. Plot and tree-level data are accessed from USDA Forest Service. The plot indicating locations and tree-level data are extracted using geospatial techniques. Both plot and trees are linked together to locate white oak trees across different sites of plots in the State. Diameter at Breast Height (DBH) is used to calculate tree decline based on basal area. All these plots, trees, and basal areas are linked together to calculate the white oak mortality rate. Preliminary results showed greater white oak mortality in the recent cycles than older cycles. Higher mortality plots observed in the southern part than northern part of the State. The white oak mortality showed a clustered spatial pattern across the State. Further research is needed at a broader scale to identify clear mortality patterns in white oak.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Heather M. Krempa	hkrempa@usgs.gov	Heather M. Krempa, Katie Summers	U.S. Geological Survey	Harmful Algae Blooms in the Illinois River Align U.S. Geological Survey Central Midwest Water Science Center Efforts with State and Federal partners	In 2020, the Illinois River Basin was added to the U.S. Geological Survey's (USGS) Next Generation Water Observing System (NGWOS). NGWOS supports innovation and development of emerging monitoring technologies and methodologies to provide high density data and improved prediction tools in affordable and rapid ways. The Illinois River Basin has urban and agricultural runoff, is a drinking water and recreation source, and has had consistent and persistent harmful algal blooms (HABs). The USGS has developed a HABs initiative for the Illinois River Basin that focuses on understanding factors driving the timing, magnitude, and toxicity of HABs occurrences using intensive sample collections and emerging technologies. A bloom in June 2021 was sampled and remotely tracked as it was transported downstream using satellite imagery of chlorophyll concentration probability and phycocyanin fluorescence concentrations. Sample results indicate that all samples had detectable levels of microcystin and taste and odor compounds, including those collected where the bloom was not visible. Samples will continue to be collected to describe conditions prior to, during, and after HABs occurrences to describe bloom characteristics, potential factors driving the occurrence of the bloom, and human health risks. Additional sensors and technologies will be installed including nitrate sensors, floating chlorophyll and phycocyanin sensors, fluorometers, and multispectral camera arrays to provide additional high-density data. Continuous sensor data will be compared with sample data to improve the overall understanding of HABs and toxin production and to increase HAB and toxin prediction potential.
Dacoda Maddox	Dacoda.Maddox@usda.gov	Dacoda Maddox, Ben Knapp, Lauren Pile, John Kabrick, Dan Dey, Chris Newbold	USDA Forest Service and University of Missouri	Seeding Native Woodland Understory Species Over a Gradient of Light in a Recently Thinned Oak Woodland to Restore Native Woodland Understory Composition	The restoration of oak woodlands in the Central Hardwoods has been intensely studied over the last few decades. Much of the work has centered around manipulating the forest structure, removing smaller diameter trees and other woody material to increase the amount of light reaching the forest floor, and the reintroduction of fire. Fewer studies have focused on the ground flora composition and the reintroduction of herbaceous "woodland indicators" to highly degraded sites. This study aims to investigate methods to reestablish herbaceous plants in degraded woodlands. There are several challenges we faced while trying to grow woodland plants in our stands, including light limitations, lack of native woodland seeds in the seed bank and lack of bare mineral soil at the sites due to absent fire. We investigated the light limitation problem by establishing plots across a gradient of light. The next problem was the seed bank. Many of the high-quality woodland indicators were absent from the site and unlikely to be in the seedbank. Our study investigates if seeding is a viable way to reestablish native woodland indicator plants. Following years of no fire, the litter and duff buildup may interfere with seeds reaching bare mineral soil, so we incorporated soil scarification treatments to ensure the seeds can reach bare mineral soil. The results of this study will help managers throughout the central US determine best practices for restoring structure and diversity to restore savannas and woodlands.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Stephen E. McMurray	Stephen.McMurray@mdc.mo.gov	Stephen E. McMurray and Leah K. Berkman	Missouri Department of Conservation	The Naiadgeography of Missouri Revisited: A Preliminary Biogeographical Analysis of Freshwater Mussel Distributions in Missouri	Utterback (1917) coined the term "Naiadgeography" to describe the geographic distribution of mussels in Missouri and developed rudimentary mussel faunal regions – two drainages (Prairie and Ozark) and four "faunas". Presently, Missouri's mussel fauna is included in the Mississippian faunal region, one of four broad geographic regions defined based on mussel faunal similarity (Haag 2009). The Mississippian faunal region is divided into 11 provinces, with 4 of those occurring in Missouri. However, these provinces are too large, and to make conservation and management successful we desired regions that were more tractable. Mussel occurrence data were obtained from published surveys, grey literature, and unpublished records collected by department staff, amateur malacologists, and others. Occurrence data were also obtained from museum collections held at 13 natural history museums. Data were compiled for recognized species at each determinable unique location in the state (n = 2,679), such that repeat visits to locations were combined. Collection records that pre-dated impoundment of major rivers were included, as were some records post-impoundment, but collections from ponds or borrow pits were not, nor were collections from caves or archaeological records. We explored patterns in mussel distribution using nonmetric multidimensional scaling and will present our preliminary results to date.
Luke Miller	Luke.Miller@usda.gov	Luke Miller	USDA Wildlife Services	Use of sUAS to Aid in Eradication of Feral Swine in Missouri	Since 2017 the USDA Wildlife Services has used sUAS as a new technology to support the Missouri Feral Hog Elimination Partnership. Initially, sUAS were used to survey feral swine damage and to estimate their relative abundance. As advancements were made in technology and regulations governing the use of shared airspace with manned aircraft, drones have greatly increased our efficiency in locating individual pigs for removal. High resolution thermal sensors can differentiate feral swine from other wildlife species and survey vast areas quicker than previous methods have allowed. Although most flights occur during the winter when the tree canopy is more open and thermal gradients are larger or at night, sUAS has had success in identifying swine in dense cover during warm summer days, allowing for elimination opportunities year-round, making the sUAS a more diverse tool. Overall, the use of unmanned aircraft has greatly contributed to the efficiency of our monitoring, intelligence, and eradication efforts. We plan to continue utilizing this technology prior to aerial missions to lessen the amount of time the manned aircraft must search at low level to find pigs, which increases the efficiency and safety of our staff and equipment. This technology has also been used to successfully locate and eradicate individual, trap shy pigs by leading ground crews directly to known swine locations. Missouri staff continue to make improvements and will investigate new uses for the benefit of all our stakeholders within the ever-evolving realm of the sUAS and artificial intelligence world.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Austin L. Mueller	alm33480@ucmo.edu	Austin L. Mueller and Aaron D. Geheber	University of Central Missouri	Using Environmental DNA (eDNA) Detection to Determine the Current Distribution of Topeka Shiner (Notropis topeka) in Missouri	The Topeka Shiner (Notropis topeka) is a federally endangered stream fish native to the Midwest United States. In the state of Missouri, the Topeka Shiner has undergone a drastic reduction in distributional range over the last half century, leaving few remaining populations. Although conservation and reintroduction efforts have aided in maintaining a small number of these isolated populations, efficient monitoring is critical for future recovery and stability. Furthermore, effective management decisions require a thorough understanding of the current Topeka Shiner distribution in Missouri. Due to the reduction and rarity of Topeka Shiners within their historic distributional range, traditional monitoring efforts (e.g., seining or electroshocking) may be unreliable (i.e., because of high potential for false negatives). Therefore, the overall aim of this project is to effectively determine the current distribution of Topeka Shiner in select Missouri watersheds using environmental DNA (eDNA) methods, which may allow detection without physical capture. In addition to examining presence or absence of Topeka Shiner within Missouri streams, we also experimentally tested detection ability of eDNA methods using controlled artificial stream units. For the latter, we were interested in the efficacy of eDNA detection across different Topeka Shiner biomass treatments, and at different downstream sampling distances. This project will provide greater understanding of Topeka Shiner occurrence in Missouri, and in turn, will help focus monitoring efforts, aid in future management, and refine species recovery strategies. Current project progress and results will be presented and discussed.
Russell Myers and Iwona Kuczynska	rmyers@marsgeosciences.com, iwona_kuczynska@fws.gov	Russell Myers and Iwona Kuczynska (both presenting)	Cave Research Foundation, US Fish and Wildlife Service	A Microclimate Study of the Largest Hibernaculum for the Endangered Indiana Bat	Lime Kiln Mine, a retired mine protected inside the Sodalis Nature Preserve in Hannibal, Missouri, is the largest Indiana Bat (Myotis sodalis) hibernaculum in the United States. This one mine attracts more than 30% of all known endangered Indiana bats each winter. Indiana bats require cavern temperatures of 3-10oC for optimal torpor, yet these cold temperatures are very rarely found across Missouri's natural caves and mines as well as the other States where the bats occur. The objective of this study is to determine why Lime Kiln Mine is chilled sufficiently to serve as an Indiana Bat hibernaculum and to determine how vulnerable the mine microclimates are to external climatic changes. In this presentation, we will introduce you to our novel method for assessing air-flow dynamics of a hibernaculum, provide initial results which demonstrate why the mine is a suitable winter roost for Indiana bats, and discuss how these findings will be used to make management decisions for the species.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
David Pendergrass	Dpendergrass@SweetwaterResearch.org	David Pendergrass	Sweetwater Research	Contagious Conservation in the Bible Belt: Biblical Literacy and Effective Communication of Conservation Priorities	Empowering engagement in conservation efforts can be challenging in the Bible Belt where stakeholder hesitancy to engage with conservation initiatives is sourced in interpretations of the Holy Scriptures that either diminish the value of the environment or elevate other priorities (e.g., spiritual conversion) to the exclusion of creation stewardship investment. The religious underpinnings of conservation skepticism are usually subconscious on the part of the stakeholder, and they are commonly entangled with political and cultural presuppositions. The purpose of this presentation is to provide biblical information in support of more productive public engagement in regions where American Evangelicalism exerts strong influence. It is for the believer and nonbeliever alike, regardless of biblical literacy. Effective outreach in the Bible Belt does not require subscription to biblical doctrine. Even a basic familiarity with Bible passages that address the relationships of God, man, and the environment can help to mitigate entrenched antagonism and bridge communication gaps during conservation outreach interactions. A brief, high-altitude overview of predominant Christian views on the relative value of creation is presented along with the practical implications of these views for conservation efforts. An introduction to biblical environmental stewardship will also provide outreach and education professionals with syntax that can facilitate more clear communication with Christian stakeholders who are skeptical of the value of conservation initiatives.
Hannah Phelps	hlwhqr@mail.missouri.edu	Hannah Phelps, Laura Conlee, Dr. Michael Byrne	University of Missouri	Assessing occupancy and distribution patterns of plains spotted skunk and prairie gray fox in the Missouri Ozarks	Many knowledge gaps for the plains spotted skunk (Spilogale interrupta) and prairie gray fox (Urocyon cinereoargeneus ocythous) exist; however, there is a perceived decline for both species across their range. Additionally, both species have been petitioned for federal listing under the US Endangered Species Act. In cooperation with the Missouri Department of Conservation, our objective was to determine the occupancy and distribution of both species in the Missouri Ozark region to inform management decisions and potential actions. During September 2020-April 2021 we surveyed 527 sites across 32 counties for the presence of spotted skunks and gray fox using non-invasive camera trapping. Sites were baited with either sardines or predator lure and monitored ≥ 30 days (range: 30 – 70 days). We used single-species occupancy modeling to estimate the proportion of sites occupied throughout the study area and to elucidate habitat associations. We detected spotted skunks at only three sites, which precluded formal occupancy modeling. We detected gray foxes at 88 sites, and preliminary analyses suggest a positive relationship between occupancy probability and ground slope (β=0.0384, 95% CI: 0.001-0.076), and an overall occupancy rate (proportion of sites occupied) of 0.178 (SE = 0.018). Further analyses for gray fox data are ongoing. Although gray fox appears reasonably well distributed, the low detection of spotted skunks raises additional questions. Further field sampling is required to determine if spotted skunks are as rare as our results suggest, or if our survey methodology was insufficient to reliably detect skunks.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Nathan M. Roberts	nroberts@cofo.edu	Nathan M. Roberts, Shawn M. Crimmins, Matthew Lovallo, and Caleb Skinner	College of the Ozarks	Seeing spots after 40 years: Bobcat (Lynx rufus) population status, monitoring, and management in the United States	We surveyed state wildlife agencies in the contiguous United States during the spring and summer of 2020. These surveys regarding bobcat population status, management, monitoring, and regulatory enforcement. These results were compared to similar data collected in 2008. We found that, of the 48 states surveyed, none reported that populations had declined in the previous decade. As of 2020, 37 states allowed for some regulated take of bobcat via hunting or trapping. Regulations were reviewed regularly by almost all states and 42 states used more than one method to monitor populations. Bobcats continue to thrive throughout their range and are an example of a modern conservation success story.
Sherri Russell		Sherri Russell	Missouri Department of Conservation	One Health and Natural Resources: What is the connection? What is the impact?	One Health is a collaborative, multisectoral, and trans-disciplinary approach – working at local, regional, national, and global levels – to achieve optimal health and well-being outcomes recognizing the interconnections between people, animals, plants and their shared environment. This paradigm usefully examines connection from the molecular level to the global. The perplexing question of how to acknowledge connection at multiple levels without reductionism or fear has been incompletely explored. Historically, One Health has been used as a model to explain adverse impacts from nature on humans and domestic animals. This presentation will argue that in fact the more important impact is the reverse. Spending time in nature is healthy and healthy nature results in health people both at the individual and population level. Further, natural resource personel struggle to both understand and integrate this thought model in their daily experience. This presentation of a paper in process will explore specifically the matrix model of One Health as it relates to daily natural resource protection with a focus on beneficial health affects on humans by spending time outdoors.
Kylie Sterling	Kylie6@live.missouristate.edu	Kylie Sterling, Edward Sterling, Quinton Phelps, and Hae Kim	Missouri State University	Population Demographics of Largemouth Bass in the Upper Mississippi River: An evaluation of management strategies and understanding potential factors governing dynamic rate functions	The Upper Mississippi River (UMR) supports an ecologically and economically important commercial and recreational fisheries. One such recreational fishery in the UMR is the Largemouth Bass. Little is known about Largemouth Bass population dynamics in large river ecosystems. Therefore, the objectives of this study are to evaluate recruitment, growth, and mortality of three Largemouth Bass populations in the UMR, specifically pools 4, 8, and 13, and to use those dynamic rate estimates to inform exploitation models to evaluate best management practices for each study pool. To inform these dynamic rate estimates we used sagittal otoliths for ageing purposes and took length and weight from each individual. Analyses showed that recruitment in pool 4 (RVI = 0.50986) was more variable than that of pool 8 (RVI = 0.809094) and pool 13 (0.733371). However, growth and mortality estimates were similar among the three study pools. Yield-per-recruit models suggest that a more liberal length limit of 279 mm would maximize yield in each pool. Number of preferred-size fish models suggest that the current 356 mm minimum length limit creates a considerably increased number of preferred-size fish in each pool under reasonable exploitation rates of 20-40%. This information could benefit managers' decision-making by providing them with informed data on the Largemouth Bass populations in these recreational fishing areas of interest.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Emily Tracy-Smith	tracysmithe@missouri.edu	Emily Tracy-Smith, Craig Paukert, Paul Blanchard, and Jason Persinger	University of Missouri	Development of a flow-based aquatic community classification to define the natural fish community across Missouri's stream sizes	Given the constraints on water resources and potential diversion of Missouri's freshwater resources there is a need for ecological approaches to water resource management. To mitigate the impacts of human activities, such as flow alteration, we must take into account the critical role flow regime plays in sustaining biodiversity and productivity in rivers. Our research focuses on understanding the relationships between flow regime, types and degrees of flow alteration and ecological response. Our main objective is to contribute scientific information necessary to define environmental flows and guide development of flow recommendations that balances ecological flow needs with other water management needs. We used fish assemblage data from the MDC Resources Assessment and Monitoring program to develop a flow-based aquatic community classification. Multivariate regression tree analysis was used to categorize Missouri's stream segments into habitat types based on how predicted flow metrics, drainage area, and stream temperature correlate with measured fish species abundances for wadeable streams. With a lack of stream gage data available across the landscape, a method was developed by MDC using available USGS gage data and reference flow duration curve percentiles for ungaged stream segments. This flow prediction method accounted for hydrologic and thermal influences of springs and losing streams and is the foundation of our flow-based classification. Classification results will be used to identify stream habitat categories based on hydrology, stream temperature and size classes and help quantitatively establish species that represent the natural biological community according to Missouri water quality standards (i.e., warm, cool, cold-water habitat).
Indigo T. Tran	tran0897@live.missouristate.edu	Indigo T. Tran, Leslie M. Hatch, Debra S. Finn, and La Toya Kissoon	Missouri State University	Decomposing sycamore leaves leached lead and zinc in a mine-contaminated river	Big River sediment is contaminated with metals from 200 years of lead mining. Elevated metal concentrations have been reported in birds, mussels, and fishes in this watershed. Sycamore trees growing on gravel bars in Big River also accumulated high concentrations of lead, zinc, and cadmium in their leaves. Sycamore leaves can release metals back into the ecosystem after they shed and decompose. High metal content of leaves can inhibit colonization of microbes and macroinvertebrates, and subsequently decrease decomposition rates. We carried out a leaf pack experiment using autumnal sycamore leaves to measure metal leaching during leaf decomposition in Big River. We collected leaves from trees on contaminated and non-contaminated gravel bars in Big River and placed them in mesh bags (7mm or <1mm hole size) in riffles up and downstream of mining contamination. On six dates, we collected leaf packs, then dried and weighed them to measure biomass loss. We also analyzed for metal concentrations of these leaves using ICP-MS. Our initial findings showed that contaminated leaves decomposed at a faster rate than non-contaminated ones, independent of river placement and mesh sizes. We hypothesize that metal leaching will increase over time as sycamore leaves decompose in Big River.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Elizabeth Vasko	lavhbn@umsystem.edu	Elizabeth Vasko, Dr. Liz Hasenmueller, Dr. John Sloan	University of Missouri	How does river flooding impact nutrient cycling in floodplain features?	Rivers can transport excess inputs of normally limiting nutrients (like nitrogen and phosphorus) from agricultural landscapes to the global ocean, impacting human health and causing ecosystem degradation. To manage agricultural pollution, we must understand how river systems release, sequester, or transform nutrients in their floodplain features. Thus, we examined the effects of flooding on nutrient dynamics for a backwater area along the Mississippi River (Alton Slough, Missouri). Alton Slough is usually poorly connected to the main channel and features little to no current. However, the site is regularly impacted by floods along the river, which can dramatically alter processes across the sediment-water interface as the feature is scoured. We collected and homogenized sediments from the backwater site, then placed them in tubes where they were split into three different treatment groups. Sediments in the "characterization" treatment were immediately analyzed for nutrients. Water columns were added to sediments for treatments of "advection" (shaken to represent flood scour) and "diffusion" (motionless to represent periods of quiescence) that were sampled daily for 2 weeks. Our preliminary findings show that water column nitrate and phosphate increased for both treatments, but releases were higher under advection. Both treatments experienced an initial increase and subsequent decline of ammonium of similar magnitude, but the response was slower in the diffusion treatment. Dissolved oxygen was consistently ~85% under advective conditions, but fell to 43% in a diffusive setting. Our data show that flooding increases nutrient release from sediments, potentially raising concentrations in the water column beyond safe limits.
Ian Vaughan	imv3bv@missouri.edu	Ian Vaughan, Benjamin Knapp, Emile Gardiner, Morgan Davis, and John Kabrick	University of Missouri	Determining the Effects of Dormant Season Flooding on Pin Oak Root Development	Changes in land use have altered the hydrologic regime of many bottomland forests along the Mississippi River. Human induced flooding in managed green tree reservoirs provides valuable waterfowl habitat, with oak species such as pin oak (Quercus palustris) producing hard mast. However, flood timing and duration has the potential for stressing vulnerable oaks seedlings. Previous studies have shown growing season floods can inhibit root growth, but the impacts of dormant season flooding are not as well studied. We examined the effects of soil temperature and dormant season flooding on Q. palustris seedlings using insulated water baths of 5, 10, and 15°C. Half of the seedlings received soil flooding 60 days from January to March, after which floodwater was drained for the remainder of the study. Seedlings were harvested before, during, and after flooding. Root length was determined using scanned images and WinRHIZO from Regent Instruments Inc, after which samples were oven-dried to determine mass. During soil flooding, flooded seedlings produced less root mass than those that were not flooded. However, by the end of the experiment, seedlings that received flooding exhibited greater lateral root mass and length than those that did not. Flooding did not significantly impact aboveground seedling biomass. These findings suggest that Q. palustris may experience temporary stress during dormant season flooding but can recover without lasting effects.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Bram H.F. Verheijen	bhv523@missouri.edu	Bram H.F. Verheijen, Lisa B. Webb, Heath M. Hagy, and Michael G. Brasher	Missouri Cooperative Fish and Wildlife Research Unit	Dynamics of waterfowl harvest distributions in the Central and Mississippi flyways from 1980–2019	The geographical distribution of non-breeding waterfowl can vary considerably from year to year in response to spatiotemporal variation in weather conditions and habitat availability. However, continuing changes in climate, habitat availability, and anthropogenic pressures could lead to more persistent shifts of waterfowl distributions, which could cause a mismatch with local habitat and harvest management decisions informed by historic distributions. We used band recovery data from 1980–2019 to assess if and how autumn and winter distributions of nine duck species in the Mississippi and Central flyways have changed within and across years. For each species and year, we used kernel density estimators to determine the centroid location, size, and latitudinal extent of month- and age class-specific distributions. Preliminary results for Mallards show that centroids of band recovery distributions have shifted northwards by ~1 degree (~110 km) since 1980—a trend mainly caused by a ~2-degree northwards shift during December and January. Banding location explained ~30% of variation in longitude but only ~0.5% of variation in latitude of recovery location. Core area size (50% isopleth) showed large annual variation, which was independent of centroid latitude. Last, the southern extent of the core area retracted northwards from 1980–2019, while the northern extent expanded at a slower rate. Next steps will link observed distributional shifts to spatiotemporal patterns in banding effort, hunting effort and regulations, climate, and land use variables. Understanding drivers of historical changes in non-breeding waterfowl distributions will help managers anticipate future changes and enable more informed conservation and management.
Lance A. Vickers	vickersl@missouri.edu	Lance A. Vickers, Benjamin O. Knapp, and Daniel C. Dey	University of Missouri	Do forest health issues in oak forests accelerate compositional shifts to non-oaks?	Oak dominated forest types occupy nearly half of the eastern US forestland. Despite their ubiquity, a long-standing concern has been compositional shifts away from oaks, in part due to challenges with establishing abundant, large advanced oak reproduction within mature forests prior to release events. Understory demographics are often indicative of future forest composition, especially for species such as oak that rely on advance reproduction, making it plausible that canopy health issues stimulate understories and hasten compositional shifts. Further, recruiting established understory oaks into canopies is tedious in most cases and forest health issues may exacerbate management difficulties and uncertainty. We use FIA data to examine the influence of forest health disturbances on oak understories and their common competitors to evaluate if oak understory demographics differ among plots with and without health issues. Our results help identify cases with potentially generation-spanning negative effects that might be alleviated or reduced with proactive understory management to create more resilient forest ecosystems.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Hannah Whaley	hlw97@live.missouristate.edu	Hannah Whaley, La Toya Kissoon	Missouri State University	How does land use impact plant communities in spring-fed ponds?	Ponds are important habitat for aquatic and terrestrial life and serve many ecosystem functions. They act as breeding, nesting, and feeding grounds for birds, fishes, amphibians and macroinvertebrates. They are also effective at filtering runoff and preventing erosion. In the Ozarks, springs are often the water source for both rural and urban ponds. Weathered limestone in the Ozarks increases the susceptibility of springs to contamination from land use activities. To understand how contaminants are affecting the spring-fed ponds in the Ozarks, I conducted vegetation surveys at 18 ponds to compare their plant communities with land use in their watersheds. I also collected water and sediment samples to analyze for multiple elements. We expect that land use will have the greatest impact on plant communities, following a trend of more urban development having lower plant diversity.
Deborah J.M. Wheeler	djwheeler@ucmo.edu	Deborah J.M. Wheeler	University of Central Missouri	The effects of cattle introgression on American bison behavior and dominance structure	The American bison (Bison bison) once roamed across North America, with an estimated 60 million in the 1700s. The population drastically declined to 541 individuals in the U.S. by 1889 due to overhunting, and transferal of disease from cattle. During the 1880s, ranchers began crossbreeding bison with cattle to introduce favorable characteristics in the cattle population (e.g., hardiness). Introgression of cattle DNA into a declining bison population has led to fewer than 5% of American bison now considered genetically pure (i.e., no cattle genes present). Even though bison and cattle are related, they do have perceivable differences (e.g., morphology and behavior). While much of the research on cattle introgression has focused on morphologic variation, less is known about the impacts of cattle introgression on social structure. Changes in social structure could potentially influence many aspects of this species (e.g., foraging, social hierarchy, etc.). The current study seeks to address the impact of cattle introgression on bison behavior. Genetic testing (i.e., mtDNA and Nuclear DNA) was performed on a bison herd in Kingsville, Missouri. In situ observations were conducted using an unmanned aerial vehicle and on foot. Behavioral variables (e.g, foraging, movement, passive/aggressive interactions) were collected and assessed in relation to the type of introgression present within individual bison (pure, mtDNA, Nuclear DNA, or both mtDNA and Nuclear DNA). A greater understanding of how cattle introgression influences social structure within bison will be beneficial for the conservation and preservation of our national mammal.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Katie Wiesehan	katie@landlearning.org	Katie Wiesehan	Southern Illinois University Edwardsville and Land Learning Foundation	Population Analysis and Distribution of the State-Threatened Illinois Chorus Frog (Pseudacris illinoensis) in Southwestern Illinois.	The Illinois Chorus Frog (Pseudacris illinoensis; ICF) is state-threatened in Illinois. Populations have been extirpated throughout their range in Arkansas, Missouri, and Illinois due to human impacts. A single population remains in Madison County, Illinois near SIUE. Their range has shrunk by 50% since the 1990s, and they are facing habitat loss from warehouse development, road mortality, and predation. ICF are fossorial and found exclusively in sand prairies where they rely on forelimbs for burrowing and eat agricultural pests underground. The Madison County population is found in restored sand prairies and breeds in ephemeral ponds. The goal of this research was to assess the conservation status of the population using mark-recapture to estimate population size. We identified the location of breeding and non-breeding habitat, migratory routes, road mortality, and demographic features of the population. The study was conducted from March-June of 2019, 2020, and 2021 and involved surveys along roads and ponds. Frogs were sexed, weighed, snout-vent length measured, and coordinates, movement direction, and weather conditions were recorded. Individuals were uniquely identified by inserting a Passive Integrated Transponder (PIT) tag. Program Mark was used to estimate population size which was 854 for 2019, 2,011 for 2020, and 211 for 2021. The Schnabel method estimated population size at 617 in 2019, 1,367 in 2020, and 104 in 2021. Most dead frogs were found on roads near breeding sites. Female ICF were significantly longer and heavier than males. These data will inform future management decisions regarding the conservation of Illinois chorus frogs.

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Sean J. Zeiger	zeigers@lincolnu.edu	Sean J. Zeiger	Lincoln University of Missouri	Simulating pre-development nonpoint source loading in Moreau River Basin: A SWAT modeling application	Land use has caused excessive nonpoint source pollution loading resulting in widespread water resource degradation in Missouri other regions of Mississippi River Basin. Regional management efforts are needed to develop watershed plans that, at least in part, consider baseline nonpoint source pollutant loading during reference conditions. However, historical data required to quantify baseline nonpoint source pollutant loads are usually not available. The objective of this study was to quantify baseline nonpoint source pollutant loads using The Soil and Water Assessment Tool (SWAT) in Moreau River Basin located in central Missouri. Native land cover based on soil characteristics was used to simulate pre-development nonpoint source loading regimes during reference conditions. Reference conditions simulated using SWAT were compared to recent nonpoint source loading estimates from US Geological Survey SPAtially Referenced Regression On Watershed attributes (SPARROW). Results from native land cover analysis showed nearly 50% of native forest and prairie land cover was cleared for agricultural land use in the study basin. Results from SPARROW indicated recent average sediment, total nitrogen (TN), and total phosphorus (TP) yields (loads per unity area) were within a range of 123 to 200 Mg km-2, 580 to 1,070 kg km-2, and 77.8 to 138 kg km-2. Significant differences ($p<0.05$) were observed between SWAT simulated pre-development nonpoint source pollutant loads compared to results from SPARROW. The SWAT simulated pre-development and contemporary loading regimes from this study point to a need for practical loading targets that support contemporary management and integrated flow and pollutant loading regimes.