

1) *Geospatial analysis of stream bank stability of small, agricultural streams for conservation planning, Lamar Lake watershed, MO.* Hannah Adams, Robert Pavlowsky **ABSTRACT:** Excess nutrients and sediment inputs produce large algal blooms and cause chronic taste and odor problems in water supplies from Lamar Lake, located in SW Missouri. In 1998, Lamar Lake was listed under section 303(d) of the federal Clean Water Act for algae pollutants caused by excess phosphorus. However, little is known about the role of bank erosion in the watershed as a nonpoint pollution source. Today, high-resolution DEMs are used to successfully detect stream bank erosion as a non-point pollution source. However, understanding the limitations of high-resolution data to analyze stream bank erosion of small, agricultural streams is lacking. The purpose of this research is to develop a method that utilizes readily available aerial photos and LiDAR DEMs to assess the spatial distribution of channel stability and bank erosion risk in small agricultural watersheds. Historical aerial photos were used to digitize streams to analyze changes in channels for the following years: 1953, 1966, 1997, 2008, and 2016. Disturbances were classified using the 1966 and 2008 aerial images. Riparian corridor conditions were classified using the 2016 aerial imagery. A 1m resolution LiDAR-derived DEM was used to measure channel geometry and longitudinal profiles were extracted to assess stream power trends. A modified Rapid Visual Stream Assessment was conducted to rank stream bank condition and verify photograph and modelled trends. Channel change and riparian classifications will be used to identify potential nonpoint sediment sources to the lake and determine the percent contribution of total sediment and phosphorus load from bank erosion sources.

2) *Professional Internship at Big Muddy National Fish and Wildlife Refuge: An Applied Learning Partnership between a Natural Resource Agency and a University.* Kaitlyn Atkins **ABSTRACT:** This summer I worked for the US Fish and Wildlife Service at Big Muddy National Fish and Wildlife Refuge. Where I served on the invasive species plant crew. We worked together to control the invasive species. We went around to the different units and sprayed the invasive plants. Our prime target invasive that was hard to control was Johnson grass. There were also times that we got a break from the side by side Kubotas and got to go out on the Missouri River and check out the channelization of the units. This was to make sure they were doing the expected. We also got to explore new places and some outreach and education opportunities as well. The departments we went to were the USDA, Ecological Services and the USGS office in Columbia, Missouri. I learned many things about the control of invasive and which plants they are. Along with that I learned how to correctly operate and maintain an ATV. This summer internship has been filled with many learning opportunities, adventures and ways to control invasive plants and fish.

3) *Phytohormone treatment with gibberellic acid alleviates the negative allelopathic effects of Amur honeysuckle (*Lonicera maackii*) leaf extracts on seed germination and growth.* Csengele E. Barta, Brian C. Jenkins, Mary L. Moore, Kerry D. Moore, Devon S. Lindstrom, Chayata F. Thammarat and Stan R. Svojanovsky **ABSTRACT:** Invasive species are a threat to biodiversity and a relevant concern for species conservation and restoration. These species may employ a large array of strategies, through which they negatively impact the germination, growth, survival or reproduction of native species. One such strategy is the synthesis and release of a variety of allelopathic chemicals into the environment, which directly or indirectly affect native species. Decomposing leaves of Amur honeysuckle (*Lonicera maackii*), a shrub rapidly invading the Midwestern US have been shown to leach a variety of phenolic molecules into the soil, with devastating inhibitory effects on native species in the region. Nevertheless, the action mechanism of inhibition has not been studied to date. In this work we explored the mechanism of inhibition by honeysuckle leaf extracts in germinating field mustard in a bioassay. The extracts significantly decreased the germination of mustard seeds. While the inhibitory effect was dose-dependent, stronger with increasing extract concentrations, we found that high endogenous or exogenous gibberellic acid (GA) phytohormone treatment can relieve the inhibition. We hypothesize, that the allelochemicals in the honeysuckle leaf extract alter the hormonal balance in germinating seeds, effect which however, can be alleviated by elevated GA concentrations. Ultimately, a better understanding of the inhibition mechanism by allelopathic chemicals is expected to contribute to developing effective invasive species management approaches in the future.

4) *Influence of channel geomorphic processes and sediment metal concentrations on macroinvertebrate communities in urban streams, Springfield, Missouri.* Madalyn Behlke-Entwisle, Ethan Pelke, Micah Seago, Robert Pavlowsky **ABSTRACT:** Physical habitat assessments are often used to characterize macroinvertebrate sampling sites for stream impairment assessments. This study examines the relationship between benthic macroinvertebrate community indices (EPT & Taxa Richness) in urban streams in Springfield, Missouri, and geomorphic indicator scores. In addition, potential effects of sediment metal toxicity will be evaluated. Six long-term monitoring reaches approximately six channel widths long were surveyed for this study across a range of index scores. A modified rapid geomorphic assessment procedure that evaluated channel processes such as incision, aggradation, widening, and planform adjustment was used to identify the degree and cause of channel instability and degraded habitat. Active stream sediment was sampled at three sites within the sampling reach, and the <250 um fraction was analyzed for metals in the laboratory using X-Ray Fluorescence (XRF). Relationships among biotic indices and channel and sediment variables will be evaluated.

5) *Summer resting site selection by female raccoons (Procyon lotor) in an urban habitat in Northwest Missouri.*

Kaitlyn Campbell, Jack Deshon, Cary D. Chevalier, Jason Kusilek, Jeremy Reynolds, James Swofford, Morgan

Wells **ABSTRACT:** Raccoons are an important member of the mammalian fauna of Missouri. However, we know little about their modes of resource selection in urban areas of NW Missouri or the characteristics of their resting site choices. The purposes of this study were to: 1) determine if female raccoons choose one resting site over any possible alternative site and 2) determine the spatial distribution and use of summer resting sites by female raccoons. Female raccoons were captured with live traps, fitted with radio transmitters (Telonics, Mesa, AZ) and subsequently located in their diurnal resting sites. Measurements were taken at 27 resting sites during summer 2018 and combined with female resting sites from summers of 2010, 2011, and 2012, for a total of 69 female resting sites. Twenty-two variables were measured at each resting site and its two randomly associated satellite sites. Of these variables, statistical differences (Wilks' Lambda; F-Test; $P < 0.05$) between mean values for raccoon resting sites and alternate satellite sites occurred for 4 variables. Four models were constructed using stepwise discriminate function analysis and evaluated for efficiency in identifying female raccoon resting sites, as well as identifying the most important variables keyed on by female raccoons in selecting resting sites during the summer season. All models were significantly effective at differentiating between real raccoon resting sites and randomly-selected sites in the environment ($P < 0.05$). Model efficiencies equaled or exceeded 67%. Models such as these can be useful in predicting habitat "richness" for resources such as resting sites.

6) *Pollinator networks in established urban prairie gardens compared to rural remnant prairie conservation areas.*

Amanda L. Coleman and D. Alexander Wait **ABSTRACT:** Prairies support over 800 species of plants, insects, birds, fish, and mammals, even though only 1% of remnant prairies remain in the United States. Importantly, prairie "gardens/plots" are gaining popularity for their ecological services. However, it is not known to what extent these small urban prairie areas can sustain pollinator networks. The goal of our research was to examine pollinator networks in three rural remnant prairie units and three urban prairie units in southwest Missouri. We tested the hypothesis that rural remnant prairies have stronger plant/pollinator networks than urban prairie units. Rural units were: Woods Prairie, Providence Prairie, and La Petite Gemme Prairie. Urban units were all in Springfield, MO: Valley Water Mill Park, Kickapoo Edge Prairie at Nathaniel Green Park, and the Springfield Conservation Nature Center. From May through August 2018, we sampled the five most abundant forbs in bloom, the number of pollinator visits, and fidelity from dawn to dusk in all six units. We found that the number of insect visits and fidelity of insect guilds was not different between rural and urban units. However, the five most abundant plant species common to rural units were not the same as those in urban units and the distribution of these species (random, clumped, even) was not similar (33% similarity). Our data reveal that, surprisingly, our hypothesis was not accurate. These results suggest that current management of urban prairie units may be sufficient to sustain the same level of pollinator services as in rural prairies.

7) *Distribution records of horsehair worms (Nematomorpha: Gordiidae, Chordodidae) and habitat characteristics for three species from wadeable streams in Missouri.*

Matthew D. Combes, William R. Mabee, Ben Hanelt **ABSTRACT:** We present Missouri distribution records for four species of Nematomorpha (horsehair worms) based on records from the literature and our locality records for reference specimens identified from macroinvertebrate community samples collected from reaches of wadeable streams sampled and surveyed throughout the state from years 2000 through 2015. The species found to occur in Missouri are: *Gordionus violaceus*, *Gordius robustus*, *Chordodes morgani*, and *Paragordius varius*. Select habitat characteristics we found associated with occurrence of *G. robustus*, *C. morgani*, and *P. varius* at sites where reference specimens of these species were collected are also provided.

8) *Nonpoint pollution source modeling in Mineral Fork and Mill Creek watersheds, Washington County, Missouri: assessment of channel erosion inputs using LiDAR and historical aerial photography.*

Kayla Coonen, Marc Owen, and Robert Pavlowsky **ABSTRACT:** Non-point source (NPS) pollution is the leading source of water-quality impacts to surface water in the United States. The Clean Water Act (Section 303d) specifies that watershed models should be used to develop Total Maximum Daily Loads (TMDLs) to determine pollutant load limits and evaluate plans and effectiveness for best management practices. This study aims to develop a nonpoint source model for sediment and nutrients using STEP-L for Mineral Fork and Mill Creek watersheds in Washington County, Missouri. These watersheds offer a challenge in that the drainage network and sediment transport has been disturbed by large-scale barite mining with pits, ponds, and tailings dams. In addition, modeled sediment loads will be used to estimate the lead loads into Big River to evaluate the relative contributions of mining-related lead from St. Francois and Washington counties. This poster reports preliminary results on the sampling and spatial analysis of bank erosion rates in the watersheds to provide input data to support NPS modeling. Historical aerial photography and LiDAR are used to estimate bank erosion inputs for different locations along the channel network. Ultimately, this study will contribute to a better understanding of nonpoint sources in southeastern Missouri and aid in evaluating the influence of historical mining in Washington County on lead contamination in Big River.

9) *Hornyhead Chub Spawning Associates in the East Fork of the Black River.* Eric Cox, John Brant **ABSTRACT:**

Lithophilic spawning fish require silt free substrate for successful spawning. Male Hornyhead Chubs use available substrate of sizes ranging from 5.6 mm to 22.4 mm to build spawning mounds. Affiliated lithophilic spawning fish use these mounds for reproduction and aide in protection during mound construction. On the East Fork of the Black River, species that utilize these mounds are Bleeding Shiners, Ozark Minnows, Carmine Shines, and Striped Shiners. The East Fork of the Black River is a substrate deprived system due to the presence of an upstream dam which has inhibited bed movement. Our objectives were to determine how lithophilic spawning communities are influenced by the presence of Hornyhead Chub mounds and to assess these communities in relationship to the distance from the Lower Taum Sauk Dam. This research was performed in 6.3 km of the East Fork of the Black River immediately downstream of Lower Taum Sauk Dam. We sampled fish communities in riffles and runs during fall of 2017 and 2018 using backpack electrofishing, grid electrofishing, and seining. Thirty Hornyhead Chub spawning mounds were located between 2.0 km and 2.6 km downstream of the dam but were absent from the rest of the study reach in 2017 and 2018. The purpose of this research is to provide suggestions for gravel augmentation in the East Fork of the Black River to benefit fish communities.

10) *Climatic effects and habitat conditions explain variation in the demography of long-distance migrant birds.*

Stephanie Cunningham, Mitch D. Weegman, Qing Zhao **ABSTRACT:** Populations of North American Arctic-nesting geese, such as greater white-fronted geese (*A. albifrons*) have increased in previous decades. These geese utilize agricultural landscapes, including rice-dominated agriculture in the Mississippi Alluvial Valley in Arkansas and Mississippi, and Sacramento Valley in California. We examined the relationship between adult and juvenile survival, productivity, and population growth rates in the Pacific population of greater white-fronted geese and environmental conditions between 1965 and 2016, utilizing a two-stage matrix model. We obtained banding records from 5913 birds, including 852 dead recoveries. Our data set included only bandings from breeding areas in southwest Alaska. We estimated time-dependent adult survival (mean 0.80 ± 0.06) and decadal time-constant juvenile survival (mean 0.50 ± 0.14) with Bayesian mark-recovery models. We utilized age ratios from the Parts Collection Survey and bandings to estimate productivity (0.77 ± 0.30 offspring per female). Over our time series, the mean population growth rate (1.04 ± 0.24) suggests an increasing population but with large annual variability. We developed regressions to explain variation in population growth rate, and included hypothesized landscape features (i.e., rice acreage in Sacramento Valley during winter and grass in Klamath Basin during spring) and weather effects (i.e., Pacific Decadal Oscillation during summer). We found a significant relationship between rice acreage and productivity ($P = 0.024$), as well as between date of last snow cover and juvenile survival ($P = 0.032$). These results provide an initial understanding of Pacific white-fronted goose demography and drivers, which will be useful for more informed conservation practices and management actions of this and related species.

11) *Herb-Chronology: Past regional work and future applications in Missouri landscapes.* Justin Dee, Michael

Stambaugh **ABSTRACT:** Herb-chronology is the study of annual growth rings in roots of perennial forbs. Though annual growth rings in trees has established potential for better understanding how trees respond to the environment so informed policy and management may take place, the occurrence of growth and the utility of rings in forbs has only recently been considered. In the last several years a few regional studies have occurred in the tallgrass prairie in which several species have been identified to have distinct annual rings. In general, and similar to tree-rings, two main lines of data may be acquired by studying annual rings to understand how forb species respond to environment. First, by counting the absolute number of rings in individuals, population age structures may be inferred which can answer key questions regarding the implications of management. In this poster we will present one study on local Milkweed species in which we used population age structures amongst different management regimes to better understand how to manage resources for the Monarch butterfly. The other major utility of annual ring analysis is measuring incremental growth and correlating ring chronologies of populations with annual climate or site conditions. Further work outlined here with local milkweed species and various legumes has found a significant decrease in growth during excessively hot and dry summers, as well as a decline in growth with fire suppression. To close, we consider further applications of herb-chronology, particularly for better understanding growth response of perennial forb populations locally in different Missouri habitats.

12) *Fish community and Topeka Shiner monitoring at Tallgrass Prairie National Preserve, Kansas.* Hope R. Dodd

ABSTRACT: Tallgrass Prairie National Preserve (TAPR), located in the Flint Hills region of Kansas, was established to protect and preserve the tallgrass prairie ecosystem. An integral part of tallgrass systems is water quality/quantity and biotic integrity of prairie streams. The federally endangered Topeka Shiner is located within the streams of TAPR, but has shown a decline within the streams of this national park. Thirteen stream reaches were sampled from 2001- 2009, and 2015 to assess fish communities and Topeka Shiner population status. Additional sampling occurred in 2010, 2013 and 2014 at stream reaches where the Topeka Shiner had previously been recorded. Community richness and diversity, species composition and abundance, and the index of biotic integrity were calculated for the 13 reaches sampled to examine relationships between fish communities, habitat and water quality parameters. A non-metric multidimensional scaling analysis was used to determine sites with similar community composition and to determine habitat variables important to fish communities and the Topeka Shiner. These results will be used by NPS and USFWS to re-establish Topeka Shiner populations within watersheds in the park where the species previously occurred and to introduce this species into watersheds where suitable habitat is available.

13) *Comparing Substrate Sampling Methods in the East Fork Black River.* Leann Drury, John Brant

ABSTRACT: The composition of stream substrates is important to both physical and biological stream functions, influencing channel form and hydraulics. Substrate size serves as important criteria to determine potential spawning habitat for substrate spawning fish. Our objective was to compare the Wolman pebble count method using transects and the use of random points generated from ArcMap to collect substrate samples. We conducted our substrate sampling at two riffle-run complexes in the East Fork Black River (EFBR) downstream of the lower Taum Sauk Dam. The Wolman pebble count procedure is used to evaluate sediment processes by measuring substrate size classes and distributions throughout the channel. Sampling random points were generated within the area of interest and between 100 and 600 substrate measurements were taken in relation to the size of the riffle-run complex. To compare the sampling methods, two reaches in the (EFBR) were measured using both the Wolman pebble count and random points to determine if the two methods give similar results in size distribution, skewness, and sorting by calculating d50, d84, and d16. These calculations will show where 50%, 84%, and 16% of the collected samples are finer substrate. By being able to better understand the substrate distribution in the EFBR, future gravel augmentation ideas may be considered.

14) *Late season pollinators: Influences of plant composition and trap height.* Emily Dunlap, Daniel A. Marschalek

ABSTRACT: Insect pollinators are responsible for pollinating most of the world's flowering plants. Due to declining pollinator populations, knowledge about native pollinators is more crucial than ever. We compared species richness and abundance of flower visitors for fall flowering plants. Capture rates related to trap location were also investigated, as potential pollinators have different behaviors. The study site was located in Gasconade County, Missouri, and is regularly planted with native wildflowers for seed harvest. Traps (colored cups with soapy water) were placed in two separate fields: a near monoculture of showy goldenrod (*Solidago speciosa*), and a second field with a mix of New England aster (*Symphotrichum novae-angliae*), showy goldenrod, rigid goldenrod (*Solidago rigida*), and white heath aster (*Symphotrichum ericoides*). Both fields had traps at 0.8 meters above the ground, roughly the height of the plants. In the mixed field, traps were placed at 0.8 meters high along the edges and in the middle of the field, and also at ground level in the middle of the field. The potential pollinator composition differed between fields suggesting insects prefer certain types of flowers. Samples also differed between trap height in the same field, suggesting that behavior of insects will influence capture rates. We also found that the first frost resulted in a drastic shift in flower visitors, with primarily European honey bees and few native species late in the year.

15) *Curly-leaf Pondweed Influence on Various Sized Lakes.* Jessica Filla, Mike Anderson, and Brian Todd

ABSTRACT: Curly-leaf pondweed (*Potamogeton crispus*), an uncommon, non-native aquatic plant in Northeast Missouri, has the potential to degrade water quality. We observed a small (1.7-acre), medium (23.8-acre), and large (573-acre) lake to see how much impact this plant could have on water quality. We estimated the percent coverage of curly-pondweed in each water body and measured weekly dissolved oxygen, temperature, and Secchi transparency readings. In early summer, curly-leaf pondweed is fully developed and turions, or buds that can grow into a complete plant, are released. In mid-June, as the plant begins to senesce, added biological oxygen demand from the microbial decomposition contributed to the dramatic drop of dissolved oxygen concentrations in the 23-acre lake. According to literature, fish begin to stress when dissolved oxygen concentration drops to three parts per million (ppm) and concentrations become lethal below two ppm. A portion of this lake had dissolved oxygen concentrations below two ppm, while the other two water bodies were not impacted significantly. After analyzing the data, the 23-acre lake was impacted the most. Curly-leaf pondweed covered approximately 61 percent of the surface area, and consequently, turion densities were the highest at this location. With the deficiency of dissolved oxygen and extreme heat of summer 2018, a fish-kill could have occurred. Moving forward, it is important to suppress the spread of curly-leaf pondweed early in its lifecycle to prevent broad colonization and a possible fish kill.

16) *Validating the taxonomic and distributional status of the Neosho Smallmouth Bass (Micropterus dolomieu velox)*. Joe C. Gunn, Leah K. Berkman, Lori S. Eggert **ABSTRACT:** Smallmouth Bass (*Micropterus dolomieu*) are economically important as a sportfish, accounting for a multi-billion-dollar angling industry in the United States alone. Thus, stocking has become increasingly common. The taxonomic status of *M. dolomieu* is controversial. Two subspecies are currently recognized: the Northern Smallmouth Bass (*M. d. dolomieu*), whose native range extends north and east of the Mississippi River, and the Neosho Smallmouth Bass (*M. d. velox*), which is restricted to the Arkansas River Basin. Although they are allopatric, their distinction is based primarily on a few morphological traits, such as the number of soft dorsal fin rays, predorsal contour, and body size. The taxonomic relationship between these subspecies has not been adequately resolved on a molecular level. Because mixing of genetically unique populations can lead to hybridization or, in extreme cases, loss of species-wide diversity, it is vital to consider genetic distinctions within *M. dolomieu* when restocking fisheries. To investigate the taxonomic and distributional status of *M. d. velox* in Missouri, Arkansas, and Oklahoma, we measured levels of genetic differentiation at 14 microsatellite loci among samples collected from the putative native ranges of both subspecies. With these results as a guide, we identified 95 samples representing relatively high genetic divergence and evaluated genome-wide differentiation between subspecies using double-digest RAD sequencing (ddRAD-seq). Our genomic analysis lays the groundwork for an assessment of population structure at thousands of single nucleotide polymorphisms (SNPs), which will allow us to evaluate the taxonomic and distributional statuses of the *M. dolomieu* subspecies.

17) *Chemical Fingerprint Analysis of Sycamore Trees in Big River, MO*. Jordan Heiman, Trang Tran, La Toya Kisson-Charles **ABSTRACT:** The Big River located south of St. Louis, MO contains contaminated sediments from many years of lead mining. Within the river are vegetated gravel bars. Sycamore trees are one of the most abundant types of vegetation on these gravel bars. Previous work focused on lead concentrations in sediment and in organisms such as birds, but few have studied metal concentrations in the vegetation of this mining-contaminated river ecosystem. To determine metal concentrations and contamination of gravel bar vegetation, we measured several chemical elements, including lead. From these elements we were able to create a chemical fingerprint of each part of the sycamore trees on both a contaminated gravel bar and a non-contaminated gravel bar. Chemical fingerprint analysis allowed us to create chemical profiles using analytical techniques, which we used to compare test samples from different parts of trees in our study. We sampled leaves, bark, branches, and stems of sycamore trees on a gravel bar upstream and a gravel bar downstream of the mining contamination. The samples were dried, weighed, crushed, and analyzed for element concentrations. We found that the contaminated gravel bar had elevated levels of most elements, such as lead, cadmium, and zinc in most tree parts, but especially bark.

18) *Spatial Distribution of Riparian Tree Mortality by a 500 year Flood in the North Fork River Watershed, Southern Missouri*. Joshua Hess and Robert T. Pavlowsky **ABSTRACT:** Climate change has increased the frequency of large floods in rivers draining in the Ozark Highlands resulting in higher rates of channel sedimentation, bank erosion, and damage to infrastructure. This study assesses the effects of a large flood (>500 year recurrence interval) during April-May 2017 on riparian forests along six tributary streams on the North Fork of the White River, Missouri. High-resolution drone imagery taken after the flood is used to identify riparian forest flood damage and generate several map series showing riparian forest flood damage density and channel planform changes. Channel planform changes are identified by comparing 2007-2008 leaf-off aerial imagery with the 2017 drone imagery. Additionally, confinement, stream power, sinuosity, and substrate are used to explain the spatial distribution of riparian forest flood damage. The highest densities of riparian forest flood damage correlate with areas where the stream flow is directed into a vegetated area (bends in the stream and chutes), where the channel is confined by a valley wall and in sample reaches of intermediate drainage areas. Patterns of tree effects will be assessed and compared to wood debris volume measurements. This information can be used to understand ecological disturbance by floods and to improve management practices in Mark Twain National Forest.

19) *Evaluation of differences between movements and winter habitat selection of diploid and triploid grass carp in a large lake*. Tyler Hessler **ABSTRACT:** Grass Carp, *Ctenopharyngodon idella*, were first introduced into the United States in 1963 to aid in the control of aquatic vegetation in aquaculture lakes and ponds. They have since escaped and made their way into numerous waterways, posing a great risk to native aquatic vegetation assemblages if a significant number are present. Currently Grass Carp pose a threat to the Great Lakes if they are able to establish themselves there, limiting food and habitat for a variety of native aquatic organisms. The magnitude of the threat is not yet known, as more research is needed on how grass carp behave in lake systems. In our study, we are tracking Grass Carp implanted with acoustic transmitters on Truman Reservoir, MO in order to learn more on their spawning behaviors and habitat selections. In particular, we look to characterize spawn migration behaviors into tributaries and how diploid (fertile) and triploid (sterile) fish may differ during this stage of life. We also aim to determine winter habitat selection in the lake and whether grass carp form winter aggregations which may be vulnerable to harvest. Preliminary results have shown Grass Carp select habitat close to shore in shallow water and only diploid Grass Carp have attempted spawning migrations.

20) *The effects of rehabilitative captivity on neophobia in Strix varia (Barred Owl)*. Juliana M. Hitchcock, Aaron Geheber, Kurtis Dean, Scott Lankford **ABSTRACT:** Rehabilitation facilities offer short-term treatment for sick or injured animals with release as the end goal. In Missouri, rehabilitation treatment involves keeping patients within enclosures which limits outside factors such as weather changes and interactions with other animals, but allows rehabilitation personnel easy access to patients for medical treatment and maintenance. Such an enclosed cage creates a static environment, potentially obscuring the relationship between predator and prey. Also, enclosures have the potential to induce neophobia, a behavior needed for adaptation and survival in the wild, but detrimental when out of proportion with lifestyle. To address this issue, *Strix varia*, common name Barred Owl, a species of owl frequently found in Missouri rehabilitation facilities, were assessed for neophobia levels at the beginning and end of captivity. *Strix varia* in captivity were offered a diet of frozen mice and/or chicks (commonly available in rehabilitation facilities) with sound stimulus to determine if *S. varia* primarily use auditory or visual cues during hunting, and to secondarily determine if sound stimulus will alter the development of neophobia in captivity. All subjects were exposed to a live hunting test to determine if sound stimulus is beneficial during captivity. Preliminary data and anecdotal observations suggest *S. varia* primarily utilize visual cues during nocturnal hunting, but use auditory cues to orient themselves towards prey. However, auditory cues seem to play a role in determining neophobic reactions towards novelty. Results from this study are expected to assist rehabilitation specialists in developing more stringent protocols for patient enrichment during captivity.

21) *The Green Plague: Algal Toxins and Fish Health in an Agricultural Reservoir*. Joshua Horne, Rebecca L. North, Morgann Clinton, Jacob Gaskill, Katrina Knott, Rebecca O’Hearn, Larry Lawson, Alba Argerich **ABSTRACT:** Agricultural reservoirs often contain high nutrient concentrations that can result in the excessive growth of cyanobacterial harmful algal blooms (cyanoHABs). CyanoHABs can produce toxins such as microcystin and cylindrospermopsin; hepatotoxins that are known to cause liver damage. The objective of this research is to examine the relationship between algal toxin concentrations in the water and in fish tissues. As occurrences of cyanoHABs increase with anthropogenic pressures, understanding how varying concentrations of algal toxins affect fish health can help us better understand lake ecosystems and prevent human health consequences due to ingestion such as acute abdominal pain and muscle tremors. Our study system is Dairy Farm Lake, an agricultural reservoir surrounded by farmland that frequently experiences cyanoHABs. We collected biweekly water samples beginning in 2017 and fish tissue samples twice per season beginning in 2018. We tested water samples for microcystin and cylindrospermopsin concentrations. Currently, Missouri Department of Natural Resources recommends that fish should not be consumed within two weeks of visible algal bloom dissipation due to unknown risks. The results of this research may be used to inform future fish consumption guidelines and management practices.

22) *Butler Hollow Cave Project*. Scott House, James Cooley **ABSTRACT:** The Butler Hollow Project is a five-year project to gate unsafe cave entrances that were part of mining/ore-prospecting projects some decades ago. Bat-friendly gates have been built on twelve cave entrances. Cultural assessment, cave mapping, and biological inventory have been done on all project caves. Additional caves on the Cassville subdistrict, Mark Twain National Forest have also been investigated, mapped, and inventoried as part of a search for more disturbed caves.

23) *Cave and Bat Management on Ozark National Scenic Riverways*. Scott House, Kim Houf **ABSTRACT:** The Ozark National Scenic Riverways (National Park Service) has over 400 caves within its authorized boundaries. Most of those are on fee-simple land (NPS owned). Active management of the caves involves constant monitoring, bat censuses, biological inventories, mapping, and cave gate building and maintenance. To accomplish this, the Cave Research Foundation partners with the National Park Service; NPS provides funding while CRF provides qualified volunteers and part-time professional labor.

24) *The Missouri Cave Database*. Scott House, Ken Grush **ABSTRACT:** The Missouri Cave Database is an outgrowth of 50-year effort by the Missouri Speleological Survey to document cave and karst information in the state. The present database was initiated as a small effort in the late 1980’s and eventually incorporated thousands of records from the old Cave Catalog, a joint effort between the MSS and Missouri Geologic Survey. Today the database has expanded into a relational database with more than 7500 main table records: additional descriptions, trip reports and other materials comprise yet another 17,000+ records. Map records include over 5500 records while biological occurrences in caves includes more than 33,000 records.

25) *Environmental history as interpreted through floodplain core analysis along the lower Big River below Byrnesville, Jefferson County, Missouri.* Miranda Jordan, Robert T. Pavlowsky, Marc Owen **ABSTRACT:** Floodplains usually contain long-term records of sedimentation. Therefore, core profile analysis can be used to evaluate the history of environmental disturbance and human influence on flood frequency and sediment loads in a watershed. This study evaluates sedimentary and geochemical characteristics of legacy floodplain deposits which accumulated over the past 170 years along Big River (2,500 km²) in southeast Missouri. Previous studies suggest soil erosion rates peaked during agricultural settlement period between 1850 and 1910. In addition, Big River received large volumes of mine tailings released from the Old Lead Belt District. Mining-contaminated legacy deposits from 1 to 4 meters thick are known to occur on floodplains along Big River. This study will be first to link floodplain stratigraphy and deposition rates to watershed disturbance events including settlement, mining, and large floods. Fifteen cores were collected by a Giddings push tube rig along a transect located below the USGS gage at Byrnesville, Missouri. High resolution analyses of a 4 meter core were used to assess vertical trends in sediment properties, metals, Cesium-137, organic content, and magnetic susceptibility. Results include: (i) review of watershed settlement, mining, and flood history; (ii) correlation of sediment and geochemical trends to watershed disturbance events; and (iii) reconstruction of floodplain sedimentation trends. Preliminary core results indicate that percent sand can be utilized to indicate historical flood events, Pb profiles tend to correlate with production history of the Old Lead Belt, and overbank deposition rates have averaged 2 cm/yr over the past 150 years.

26) *Reservoir Observer Student Scientists (ROSS): Engaging youth in harmful algal bloom monitoring.* E. Kinzinger, E. Downing, A. Thorpe, G. Kirchofer, R.L. North **ABSTRACT:** Observations of high winter algal biomass are becoming more common, so understanding algal dynamics in the typically understudied shoulder and winter seasons is necessary to protect public health and inform water quality management decisions. We are interested in determining if cyanobacterial harmful algal blooms (CyanoHABs) are occurring in the shoulder and winter seasons and whether or not they are producing toxins during these times. Through a partnership between high school students, extension representatives, and the Limnology Lab at the University of Missouri, the Reservoir Observer Student Scientists (ROSS) program is engaging youth to assess the year-round presence and severity of CyanoHABs. Students are trained using standard limnological sampling methods and commit to weekly collection, filtration, and preservation of samples. Samples are then analyzed for chlorophyll a concentrations, cyanotoxins, nutrients, and total suspended solids by the Limnology Laboratory. Preliminary results from samples collected by Rock Bridge High School students in Columbia, Missouri indicate that the cyanotoxin microcystin was present year-round. While concentrations of microcystin were low, they were not zero, indicating that cyanotoxins were present throughout the winter months. Additionally, side by side sampling between the students and lab technicians indicated that the students collected high quality data. As the ROSS program grows, study lakes will represent a range in snow and ice cover throughout five additional states. This partnership not only provides valuable insights into shoulder and winter season limnology, but allows for the education and empowerment of students to be knowledgeable about their local water resources.

27) *Variability in Streamwater Chemistry Across a Multi-land-use Watershed.* Phillip Klenke, Alba Argerich **ABSTRACT:** Hinkson Creek, an urban stream that is located in Boone County, MO and flows through the city of Columbia and University of Missouri property, has been listed as impaired to sustain aquatic life by the Missouri Department of Natural Resources and EPA. This stream's watershed is comprised of a multi-land-use watershed, receiving storm-water runoff from agricultural, forested, and urban environments. As each of these environments contribute their own forms of pollutants to the watershed, it is difficult to determine which source(s) has led to the Hinkson's impairment. Performing sampling events across space and time along the Hinkson Creek will help to inform us on management decisions for the stream's watershed.

28) *Missouri maple syrup: production methods and lessons learned from the School of Natural Resources sugar shack.* Benjamin Knapp, David Kerley, Bennett Wickenhauser **ABSTRACT:** Far from the heart of the maple syrup industry, the sap still flows from sugar maples in the early springtime of mid-Missouri. In our state, maple syrup production is generally limited to families and hobbyists with interest in the process and the product. At the University of Missouri's Baskett Wildlife Research and Education Center, students, faculty, and staff work together each year to produce local maple syrup from approximately 200 sugar maple trees across the property. In 2018, we monitored sap production (weight) and sugar content (percent) from 41 trees throughout the maple syrup season. We found high variability in sap production among the trees, with 50% of the total sap production during the season coming from nine trees (22% of the sample trees) and 90% of the total sap production coming from 28 trees (68% of the sample trees). There were six sap collections during the season, and individual trees were consistent in their relative level of sap production at each collection throughout the season. Although several trees were poor producers regardless of their size, we found a positive relationship between tree diameter and the top 90% of sap producing trees. These results can help to increase efficiency by identifying good sap producers, thereby providing opportunity for release through thinning and prioritization of collecting efforts to good producers. Overall, this student-led project provides great opportunity to learn about sap and syrup production, build community through connection with nature, and enjoy a springtime tradition.

29) *Does growth efficiency influence mercury bioaccumulation in Largemouth Bass from Missouri reservoirs?*

K.K. Knott, R. O'Hearn, D. Niswonger, L. Lawson, J. Wenzel, M. McKee **ABSTRACT:** The Missouri Department of Health and Senior Services recommends that women of child-bearing age and children under 13 consume no more than one meal per month of large predatory fish due to elevated mercury (Hg). However, Hg concentrations in fish of the same size and species can differ depending on the reservoirs from which they were taken. We currently lack an understanding of the key factors contributing to variable Hg bioaccumulation. This has led to confusion regarding the safe consumption of fish. Previous monitoring efforts by the Missouri Department of Conservation reported that Hg concentrations in Largemouth Bass (*Micropterus salmoides*; LMB) were positively correlated with fish length and negatively correlated with reservoir surface area. Elevated Hg concentrations may also relate to body condition of fish and habitat quality, but these interactions have yet to be examined for LMB in Missouri. Muscle Hg concentrations of LMB (n=12/lake category) from 6 small (<51 acres), 6 medium (280-1600 acres), and 7 large (2600 – 59500 acres) lakes were compared to relative weight (Wr) of individual fish and length-frequency histograms of each lake population. Lakes with a more balanced distribution of fish lengths (proportional size distributions (PSD) of fish >12 inches, PSD12 57-68) featured LMB that were in relatively good condition (Mean \pm SD, 111 \pm 40) and had the lowest concentrations of Hg (236 + 168 ppb; $p < 0.001$). Hg concentrations were highest (445 \pm 247 ppb) and Wr lowest (96 \pm 34) for LMB in lakes that had a PSD12 <40 indicating a stunted population. LMB from lakes with proportionately greater number of large fish (PSD12>70) had Hg concentrations and Wr at intermediate levels (267 \pm 150 and 97 \pm 14, respectively). A more balanced population suggests that prey abundance and water quality conditions are favorable, and that fish may be limiting Hg bioaccumulation through growth dilution. Greater bioaccumulation of Hg may result from relatively slower growth and greater metabolic demands of LMB in stunted populations. These data will assist in decisions as to whether site-specific fish consumption advisories due to Hg are warranted, and whether fisheries management strategies could mitigate Hg bioavailability. This information will aid in the protection of fish consumers, and preserve the economic and recreational value of Missouri's aquatic resources.

30) *White River Crayfish (Decapoda; Cambaridae) invasion of a headwater stream in the Osage Plains of*

Missouri. Seth W. Lanning, William R. Mabee, Matthew D. Combes **ABSTRACT:** An adult Form I male specimen of the crayfish *Procambarus acutus* (White River Crayfish) was found in an unnamed headwater tributary in North Fork of the Spring River drainage within the Osage Plains of southwestern Missouri during 2016. Sampling techniques and taxonomy used in collection and identification of the specimen are provided, and habitat characteristics of the reach where *P. acutus* was found to occur are presented. *Procambarus acutus* is regarded as an invasive species within drainages of most ecological sections of Missouri, and extensive sampling efforts combined with detailed studies of biotic communities, physical habitat, and water quality of sites invaded by *P. acutus* are warranted to assess status of this species with regard to affects to freshwater organisms and systems where it is invasive.

31) *Sediment quality survey to identify nonpoint and point sources of pollution in an urbanized watershed,*

Springfield, Missouri. Sarah LeTarte, Madalyn Behlke-Entwisle, Indigo Tran, Robert Pavlowsky **ABSTRACT:** Sediment quality surveys can be used to supplement water quality monitoring programs to aid in pollution sources identification in watersheds. Fine-grained sediments are relatively inexpensive to collect, bind and concentrate metals and phosphorus to easily detectable levels, and integrate source inputs from both local and watershed sources. The purpose of this study is to use a geochemical survey of active stream sediment for MS4 screening to identify pollution sources in an urban watershed. Jordan Creek (40 km²) drains 95% urban land in Springfield, Missouri including historical industrial center and redeveloped downtown areas. A total of 111 samples including duplicates were collected from forty-six sites within the watershed and two sites from a nearby residential watershed. Samples were dried at 60 °C, sieved to the <250 um fraction, extracted by aqua regia (hot concentrated nitric and hydrochloric acids), and analyzed by ICP-AES for 35 elements including trace metals and phosphorous. Preliminary results indicate potentially toxic levels of some metals such as lead, zinc, and cadmium in the main channel below the downtown area and in other local hotspots in both north and south branches. Phosphorus concentrations appear to be highest in the upper segment of the north branch above the downtown area. Sediment normalization procedures using organic matter, iron, manganese, and aluminum will be used to enhance pollution anomalies and map out stream segments with both low and high risk of pollution. Potential point source effects will also be evaluated based on pollution discharge permits and field investigations.

32) *Bird Diversity in North City St. Louis Vacant Lots*. Sebastian Moreno, Charles Nilon, Robert Pierce **ABSTRACT:** St. Louis has experienced a gradual population loss since its peak in the 1950's, resulting in a prevalence of vacant land. The neighborhoods of Baden and Wells-Goodfellow have the largest concentration of vacant lots in the city. The goal of this research is to learn how birds use the range of vacant lots in these neighborhoods. Since the city is responsible for most of the vacant lots, many of them have unmaintained vegetation. This mix of managed and unmanaged vacant land creates various habitats for a diverse bird community. Our research addresses three questions: 1) what are the current vegetation classes found within vacant lots in these neighborhoods? 2) what bird species are found within these areas? and 3) does the concentration of vacant lots in a neighborhood affect bird diversity? We classified and mapped the land cover types for 847 vacant lots in the two neighborhoods. Baden has a total of 11.7% vacancy while Wells-Goodfellow has a 28.1% vacancy. Baden has 51% of its vacant lots classified as mowed lawn, 8% closed forest, 13% woodland, and 19% scarcely vegetated artificial surface. Wells-Goodfellow has 59% of its vacant lots classified as mowed lawn, 9% closed forest, 20% woodland, and 8% scarcely vegetated artificial surface. Three rounds of bird counts were conducted on 50 X 1 ha plots within each neighborhood. From the 100 total sites the following species were seen in over 25% of them: European starlings, American, northern cardinal, mourning dove, house sparrow, and chimney swift.

33) *How Does Seeding Rate Influence Plant Expression? Observation of Three Third-year Native Plantings*. Casey Bergthold, Ryan Diener, Lora Dirnberger, Scott James, and Courtney Nicks **ABSTRACT:** Recommended seeding rates for native plantings must be sufficient to produce stands that ensure benefits to soil, water and wildlife resources. However, rates above this threshold can result in unnecessary expenses for landowners and poor-quality wildlife habitat when monoculture plant communities develop. Recommendations for seeding rates are commonly developed based on the number of Pure Live Seeds (PLS) needed to establish monoculture stands at densities of 0.5-5 plants/ft². Little research has been done to determine if these rates are appropriate for high diversity seedings. Several Midwestern states currently use rates below what are recommended in Missouri. If seeding rates could be reduced, while still protecting soil and water resources, substantial financial and ecological benefits could be accrued. To inform this discussion, we evaluated species expression resulting from seeding a CP33 seed mix (63 PLS Seeds/ft²) and a reduced rate mix (21 PLS Seeds/ft²) of the same species set. By the third growing season, four of the twelve seeded forbs were regularly observed in Shelby, Montgomery and Stoddard counties on control and treatment plots. Conversely, we observed stem counts and diversity highest in treatment plots within all three sites. Treatment plots sampled in May and July averaged 20.3% and 80.6% more stems and 15.5% and 37.7% more species per sampling effort than found within all three control plots. In conclusion, we observed that low rate seeding provided more stem density and diversity by encouraging both seeded and volunteer grasses and forbs.

34) *Movement patterns and habitat use of the black blister beetle in restored tallgrass prairie and degraded grassland*. Hannah Ogden, Daniel M. Wolcott, Daniel A. Marschalek **ABSTRACT:** The black blister beetle (*Epicauta pennsylvanica*) is a common fall species, feeding on goldenrod (*Solidago* sp.) flowers. In 2018, we conducted a study to quantify the movement patterns of this beetle, and its habitat use in a restored tallgrass prairie and adjacent degraded grassland. This prairie and grassland are located on the west side of Warrensburg in Johnson County, Missouri. Mark-recapture techniques provided movement, population size, and survival rate data. We uniquely marked 914 individuals and recaptured 22.2% over 16 surveys (16 August to 11 October). This includes three individuals that were each captured during five different surveys and one individual that remained in the area for at least 20 days. Several individuals were detected moving from the restored grassland to the degraded grassland, as well as in the opposite direction. Although not appearing to be active fliers, their dispersal ability allows them to travel several hundred meters easily. Feeding activity and movement of the black blister beetle likely contribute significantly to goldenrod pollination.

35) *Historical land use influence on legacy floodplain deposits in forested watersheds in the Ozark highlands*. Katy N. Reming, Robert T. Pavlowsky, and Marc Owen **ABSTRACT:** Hydrologic disturbances due to land use and climate effects can disrupt river form and increase sediment transport. Stream channels in the Ozark Highlands have been affected by accelerated sediment delivery and gravel bar deposition since early European settlement in the mid 1800's. The purpose of this study is to investigate the alluvial storage of fine-grained sediment released by historical soil and channel erosion and the spatial distribution of legacy floodplain deposits in an Ozark watershed. Big Barren Creek watershed (191 km²) drains the Salem Plateau in Mark Twain National Forest of southeastern Missouri. It is hypothesized that episodes of legacy deposition occurred during two different disturbance periods: widespread logging of pine forests (1880-1920) and stream channelization for flood control along some bottomland segments since 1960. Stratigraphic analysis was used to evaluate the origin and age of floodplain deposits. Floodplain cores collected at 24 locations along the length of Big Barren Creek were analyzed at 3-10 cm intervals for sediment texture, organic matter, Cs-137, magnetic susceptibility and buried soil and root crown elevations. Cs-137 profiles indicate recent (post-1963) sedimentation rates averaging 0.28 cm/yr in upper segments (15.5 km²) and 0.5 cm/yr in middle segments (20-50 km²). Post-settlement (1890-1963) sedimentation rates based on buried soils assumed to represent the pre-settlement surface ranged from 0.31 cm/yr in upper segments and 0.5 to 1.0 cm/yr in middle segments. These forest floodplain sedimentation rates are similar to those reported for legacy deposits in other watersheds affected by row-cropping in the Midwest and Eastern USA.

36) *Step-pool channel form, distribution, and forcing in the Salem Plateau, Carter County, Missouri.* Triston Rice and Dr. Robert Pavlowsky **ABSTRACT:** Step-pool channel form is generally controlled by gradient, substrate characteristics, and sediment supply. In addition, localized geomorphic forcing can play a role in controlling channel geometry due to the effects of geologic factors such as material size and erosion resistance of bedrock and biologic factors mainly by inputs of large woody debris (LWD) and occurrence of living trees in the channel. How and where these geomorphic variables effect step-pool channel characteristics is poorly understood in the Ozark Highlands. This study reports a geomorphic assessment of step-pool and other channel types in Deer Camp Hollow (DCH) located in a head-water stream in which drains the Salem Plateau in Mark Twain National Forest in Carter County, Missouri. DCH has a drainage area of 0.2 km², basin slope of 8.5%, and main channel length of 865m. Topographic surveys, bed sediment counts, and LWD inventories are used to assess channel form and forcing effects within all links in the second order channel network. Preliminary results indicate that step-pool forms occur along >80% of the channel length and step-spacing distance varies as a function of active channel width and decreases with frequency of forcing structures. Drainage from forest roads appears to be extending channel length head ward by shallow incision into colluvium and organization of bed material into immature steps.

37) *Evaluation of herding techniques for the concentration and mass harvest of bigheaded carps.* Josey Ridgway, Katelyn Lawson, Robin Calfee **ABSTRACT:** Removing mass quantities of Silver Carp *Hypophthalmichthys molitrix* and Bighead Carp *H. nobilis*, hereafter referred to as bigheaded carps, is a primary management action to contain the population growth and reduce upstream dispersal. Given their evasive behavior and gear avoidance, catching bigheaded carps efficiently has been challenging. However, the robust behavioral response of bigheaded carps when exposed to stimuli (visual, acoustic, and/or electrical) may facilitate resource management agencies' ability to drive, corral, trap, and remove large numbers of individuals. Herding trials were conducted on Perche Creek, a tributary to the Missouri River located in Columbia, Missouri with high densities of bigheaded carps. A 500m reach was contained using block nets, and fish were motivated through a 5-6m opening using one of five herding treatments administered off one boat traversing downstream from bank to bank at 2mph. Stimuli included: (1) Broad-frequency sound (emitted with underwater speakers), (2) electricity, (3) sound & electricity, (4) commercial fishing technique (trimming up outboard motor to throw water while banging on the boat hull with a wooden club), and (5) driving boat with no added stimulus. A combination of side-scan sonar imaging (Humminbird MEGA Imaging) and high-resolution ARIS sonar enabled us to quantify proportion of fish moved. Preliminary results revealed herding treatments moved large numbers of fish downriver. Statistical analysis will test which stimuli are more effective for future application. This study aims to provide first steps for concentrating bigheaded carps for more efficient harvest.

38) *Geomorphic and land use controls on headwater channel morphology in Mark Twain National Forest.* Grace Roman and Robert Pavlowsky **ABSTRACT:** Prescribed burning has been used over the past decade to manage forests and to restore shortleaf pine-oak woodlands in Mark Twain National Forest. A monitoring program was initiated by Missouri State University and the Forest Service in 2015 to evaluate the hydrological effects of burning on soil erosion, stream instability, and flooding in Big Barren Creek watershed (190 km²). This study focuses on understanding the relationship between frequency of forest burning and channel morphology (size, shape, and substrate) of headwater streams (<1 km²). A combination of field measurements, geo-processing methods, and hydraulic modeling will be used to analyze (i) channel form; (ii) channel substrate properties; and (iii) tree/down wood composition in active headwater stream channels. Thirty-eight channel sites were assessed with drainage areas ranging from 0.003-0.2 km² and slopes ranging from 3-20 %. Catchment burn frequency over the past 16 years ranged among sites as follows: 50% not burned; 26% burned 1 to 3 times; and 24% burned >3 times. Preliminary results show that geomorphic conditions and soil depth generally control channel form. Burn frequency does not seem to exert an influence on channel form, however, management practices probably affect inputs of large woody debris which may affect localized channel behavior and sediment erosion.

39) *Metal contamination in roadside soils and street dusts in residential neighborhoods in Springfield, Missouri.* Kelly Rose, Dr. Robert T. Pavlowsky, Marc Owen **ABSTRACT:** Urban areas are exposed to metal pollution from vehicular wear and emissions, construction materials, industrial sources, and past chemical use. Roadside soils can accumulate toxic metals and pose a health risk for local residents. For example, soils are considered unsafe if they contain >1,200 ppm lead (Pb) in residential areas and >400 ppm Pb within children's play areas. This study assesses Pb, zinc, and copper concentrations in roadside soils and road sediments from residential areas in Springfield, Missouri. Paired roadside soil and street dust samples were collected at 54 sites from six neighborhoods of different settlement ages and along roads with varying levels of traffic use. An XRF analyzer was used to measure heavy metal concentrations in the <250 um size soil fraction. The highest Pb concentrations were found in older neighborhoods and along primary arterial roads. Maximum Pb concentrations in older areas exceeded 800 ppm for soil and 200 ppm for sediment. In comparison, maximum Pb concentrations in younger neighborhoods ranged between 100-130 ppm for both soil and sediment. The highest concentration detected during this study was 1,677 ppm Pb in a soil along a commercial strip mall, near an older neighborhood, and along a major road. Only two soil samples and two sediment samples from an early-20th century neighborhood and one soil sample from the mid-20th century neighborhood exceeded the 400 ppm Pb limit which suggests a low health risk among sites evaluated.

40) *Evaluation of milkweed survival and monarch use in a restored prairie.* Nason Saltsgaver, Wesley A. Hanks, Eric W. Kurzejeski, and Larry D. Vangilder **ABSTRACT:** The monarch butterfly (*Danaus plexippus*) is one of the most iconic Lepidoptera species in the Americas. Monarchs rely on milkweed (*Asclepia* spp.) to complete a complex multi-generational cycle during summer. The Missouri Department of Conservation plan states the establishment of milkweed as the greatest limiting factors to monarch abundance. In Spring of 2017, we planted 6,400 milkweed plants into restored prairie on 32 one-acre plots at Prairie Fork Conservation Area near Williamsburg, Missouri. All plots were mowed and treated with grass herbicide and 16 plots were disked prior to planting. Plots were planted with either bare-root stock milkweed or nursery grown milkweed plugs. We measured survival of bare-root and nursery grown plugs two years after planting. The mean survival in plug plots was 9% while bare-root stock survival was significantly higher at 32%. Plugs in disked plots had higher survival (12%) compared to plots that were only mowed and treated with grass herbicide (6%). Bare-root stock survival in disked plots (38%) was not significantly higher than mowed plots (26%). We also monitored timing and density of monarch egg deposition from June 1 to September 30. Data were collected from 20 randomly selected plants in 16 plots. The number of eggs, instar, and the height and species of milkweed were monitored in two-week intervals each month. We found 7.6% of plants showed evidence of use by monarchs, compared to 12% in the summer of 2017. The greatest proportion of use was found during the month of August.

41) *Estimating behavioral transition probabilities of Greater White-fronted Geese using Non-homogenous Markov Models.* Toryn Schafer, Christopher K. Wikle, Mitch D. Weegman **ABSTRACT:** The North American mid-continent Greater White-fronted goose (*Anser albifrons*) annually migrates long distances from breeding grounds in the Arctic circle to various staging grounds including Canadian prairies and wintering grounds in Southern United States. Novel wildlife devices allow for remote collection of behavioral and spatial data throughout the year. We equipped geese with accelerometers that recorded movement every 6 minutes. Acceleration values were classified into discrete behaviors such as flying, grazing, stationary and walking, for comparisons of strategies among individuals with implications for understanding mechanisms for population dynamics. We used non-homogeneous Markov transition models to estimate transition probabilities between behavior categories during spring migration. We implemented models in a Bayesian hierarchical framework that allowed for covariates to inform individual transitions. We explored a suite of covariates including habitat and weather.

42) *Presence and Habitat Use of the Blanding's Turtle (*Emydoidea blandingii*) on the Loess Bluffs National Wildlife Refuge, Missouri.* Valerie Schneider and Dr. Kurtis Dean **ABSTRACT:** The Blanding's turtle (*Emydoidea blandingii*) is a medium-sized, semiaquatic turtle that ranges from Nebraska (United States) to Nova Scotia (Canada) (Ruane et al. 2008). It is classified as an endangered species in Missouri, and will be reviewed by the U.S. Fish and Wildlife Service for federal listing in 2023 (Johnson 2000; Dalaba 2017). This study assessed the current population of Blanding's turtles and the habitats they utilize on the Loess Bluffs National Wildlife Refuge (NWR) in Mound City, Missouri. Movement data was used to calculate and map 90% minimum convex polygons to define home range size. Vegetation percent cover and height of vegetation above water was summarized to determine Blanding's turtle preference in available habitat.

43) *Relationship between macroinvertebrate indices and channel enlargement and substrate in urban streams, Springfield, Missouri.* Micah Seago, Ethan Pelke, Madalyn Behlke-Enwisle, Robert Pavlowsky **ABSTRACT:** Physical habitat assessments are often used to characterize macroinvertebrate sampling sites for stream impairment assessments. This study examines the relationship between benthic macroinvertebrate community indices (EPT & Taxa Richness) in urban streams in Springfield, Missouri and the amount of channel enlargement relative to rural reference streams. In addition, the relationship of sediment size and embeddedness to macroinvertebrate scores was evaluated. Six long-term monitoring reaches about six channel widths long were surveyed for this study across a range index scores. Channel cross-section area and discharge capacity were compared to regional drainage area and slope developed by the US Geological Survey. A modified Wolman pebble count procedure was used to collect 30 samples each from glide and riffle channel units. Fine-sediment area or embeddedness was also sampled for each channel unit. Relationships among biotic indexes and channel and sediment variables will be evaluated.

44) *Investigating the Role of Stream Flow in the Structuring of Headwater Stream Fish Communities.* Nicholas Sievert, Craig Paukert **ABSTRACT:** Alterations to stream flow can have substantial impacts on the suitability of habitat for stream fish. High flow events shape stream channel morphology and bring large amounts of woody debris into headwater streams. Stream drying can result in the loss of connectivity between stream habitat units and temporal loss of stream habitat types such as riffles and glides. 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. 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. 2018 data is still being collected and processed, however 2017 data showed patterns in flow and fish community structure. 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 11 to 19. 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. 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.

45) *Habitat-specific survival of northern bobwhite juveniles on traditionally managed conservation areas and native grasslands.* Emily Sinnott, Frank Thompson, Mitch Weegman, Tom Thompson **ABSTRACT:** Northern bobwhite abundance in Missouri has declined 74% over the past 50 years according to Breeding Bird Survey data. These trends are likely a result of some combination of reduced survival, productivity, and carrying capacity in marginal habitats and altered landscapes. For species with low annual survival, like bobwhite, productivity and juvenile survival are important demographic rates for population growth. Our aim was to estimate habitat-specific juvenile survival on traditionally managed conservation areas and native prairies. We tracked broods and radio-tagged young from 2016 through 2018 on native grasslands, agricultural fields, private pastures, and in woodlands to monitor habitat use and survival. We evaluated juvenile survival using logistic regression known-fate models. Preliminary results suggest higher survival rates on native grasslands compared to other mixed cover types. We will be evaluating reproductive success and juvenile and adult survival in an integrated population model to determine their importance to population growth and differences among management and vegetation types.

46) *Say #byetobags: A Reusable Bag Program at the Saint Louis Zoo.* Kirinne Slaughter, Zoo ALIVE Teen Volunteers **ABSTRACT:** This poster will be presented by Zoo ALIVE Teen volunteers from the Saint Louis Zoo, and will highlight the Saint Louis Zoo's #byetobags program, a donor funded conservation action initiative at the Saint Louis Zoo. Our aim is to educate Zoo visitors about the harmful effects that single-use plastic bags have on our local Mississippi watershed and the oceans while also encouraging the use of reusable bags as a replacement. We ask Zoo visitors to make a pledge to switch to reusable bags and provide each participant with a free reusable bag as an incentive. Every facet of the #byetobags program has been created and planned by Illinois and Missouri high school students (15-18 years old) through the Zoo ALIVE ("Active Leaders in Volunteer Education") Teen Volunteer program. A part-time program coordinator oversees and facilitates the activities of the teen volunteers. The teens work #byetobags-related events, providing experience in communicating with Zoo professionals and visitors, and practice with decision making skills and collaboration. A primary objective of the program continues to be teen leadership development and mentoring. The #byetobags program has been primarily based on Saint Louis Zoo grounds and has reached over 7,700 visitors, provided over 10,000 bags. As our program continues to gain traction, we have spread into the St. Louis Metropolitan area. For example, we now have a partnership bag with Dierbergs, which spreads awareness of the benefits of using reusable bags, and provides support back to our program.

47) *Quantifying Hybridization Between Smallmouth Bass and Spotted Bass in the Southern Ozark Highlands.* Kaitlin N. Sulkowski, Joe C. Gunn, Lori S. Eggert **ABSTRACT:** Spotted bass (*Micropterus punctulatus*) are native to river systems in southeastern Missouri, but their range has expanded to include some tributaries of the Arkansas River and they have been introduced to parts of the Missouri River system using stocking methods. Smallmouth bass (*Micropterus dolomieu*) have a native range that coincides with the native distribution of *M. punctulatus*. Where their home ranges have overlapped there has been evidence of hybridization. We collected a total of 95 samples of *M. punctulatus* and *M. dolomieu* throughout the Ozark highlands and used the Spin-Column protocol from the Qiagen DNeasy Blood and Tissue Kit to extract nuclear DNA. DNA was analyzed at 15 microsatellite loci that are known to amplify in both *M. punctulatus* and *M. dolomieu*. After fragment analysis, we genotyped and tested for deviations from Hardy-Weinberg Equilibrium within populations. We then used Bayesian cluster analysis to infer population structure. We found strong support for two genetic clusters that corresponded to *M. punctulatus* and *M. dolomieu* populations. We found low levels of admixture between clusters, but some individuals showed evidence of potential introgression. Using the results from this study, conservation agencies can reevaluate management and stocking procedures for *M. punctulatus* and *M. dolomieu* to minimize hybridization. Maintaining genetic diversity and preventing the loss of adaptive genes increases taxa's ability to respond to stochastic events. Understanding introgression between these species can help managers adapt practices to better maintain genetic diversity within and integrity between these species.

48) *Naïve survival and metamorphosis rates for a Cope's Gray Treefrog population at Mozingo Lake, Nodaway County, Missouri.* T. R. Sutton and J.D. McGhee **ABSTRACT:** There is need to better understand Cope's Gray Treefrog (*Hyla chrysoscelis*) reproduction. We attempted to assess tadpole survival and metamorphosis rates for the species at Mozingo Lake, Nodaway County, Missouri. We placed two small plastic wading pools at random locations for 3 small ponds and 2 lake inlets to act as sites for treefrogs to deposit eggs. We collected a subset of tadpoles at pools where eggs were laid to observe in the lab for estimating survival and metamorphosis rates. Only two pools were used by frogs. Rate of metamorphosis varied greatly for each individual within the population. We found that the mortality rate was higher during the middle of metamorphosis. This information can help monitor the health of the gray treefrog population and potentially the health of the surrounding habitats in MOERA's ecosystem.

49) *Darter Movement Along a Missouri Stream Gradient.* Molly Takacs and Aaron D. Geheber **ABSTRACT:** The movement of fishes may be dependent on the distance between suitable habitat patches in dynamic stream environments. The Orangethroat darter (*Etheostoma spectabile*) is a smallbodied fish (family Percidae) most frequently found in prairie streams and tributaries of central Missouri. Unlike many darters, *E. spectabile* occur most commonly in sluggish riffles near quiet pools rather than streams with continuously strong water flow. Little is known about the movement patterns of small stream fish species such as darters, and few studies have examined their migratory patterns. Because of this, the Orangethroat darter is an optimal study species for testing movement patterns in streams that have considerable distance between riffle habitat sites. We hypothesized that *E. spectabile* would show little-to-no movement between adjacent riffles in Post Oak Creek, Missouri, due to the generous spacing among these habitats. Movement patterns were tracked using visible implant elastomer (VIE) tags below the dorsal fins. A total of five riffles were kick seined a total of five times over a period of four months to collect darters. Analysis of movement patterns of *E. spectabile* taken from Post Oak Creek showed that almost no movement occurred between the five riffles studied. Results supported the hypothesis, and based on the 294 individuals caught, thirty-seven were recaptured within their home riffle, and only two were found to have moved any distance. Methods used, result implications, and future directions of study will be discussed.

50) *Mapping the Effective Field of an Electrofishing Boat to Inform Evaluations of Catchability.* Mike Thomas, Zachary Ford, Andy Turner, and Craig Paukert **ABSTRACT:** We sought to identify locations in the electrical field where specific capture-prone response thresholds (i.e., immobilization, forced swimming, surfacing, twitch) were met for Smallmouth Bass (*Micropterus dolomieu*), Flathead Catfish (*Pylodictis olivaris*), and Blue Catfish (*Ictalurus furcatus*). By mapping the field of an electrofishing boat, fisheries managers can visualize differences from changes in boats and equipment settings, and may be able to support data collected from field evaluations. We designed a floating, voltage gradient probe and used a rope-triangulation method to record measurements at specific grid locations and multiple depths. This information can also be used by managers to avoid fish injury by providing distances in which voltage gradient thresholds may be encountered. In combination with future field evaluations of catchability for these species, these results may inform managers of how specific equipment settings, anode arrangement, species-specific catchability, and environmental factors can be used to further standardize and improve current sampling protocols.

51) *Paternity Determination of Missouri Black Bears (Ursus americanus).* Chelsea L. Titus, Madison Harris, Leah Berkman, and Lori S. Eggert **ABSTRACT:** Genetic studies revealed that the Missouri black bear population contains individuals from two genetic lineages – many that have descended from the Arkansas black bear reintroduction and fewer that are from a genetically unique population, which could represent a remnant of the historical Missouri bear population. As the Missouri population continues to grow, it is important to continue to monitor genetic diversity and understand how much, if any, gene flow occurs between the two lineages. Though the two lineages coincide within the same Missouri range, it is unknown if the two lineages are interbreeding and if reproductive success may be skewed in favor of the reintroduced or putative remnant lineages. To address these unknowns we used 15 microsatellite markers and genotyped DNA samples isolated from cubs and mothers (n=29 pairs) during den checks and other adult bears (n=106) captured during field studies from 2010-2018. We used a maximum likelihood approach to infer genotypes of potential fathers. From there, we determined lineage ancestry of actual and potential genotypes. We then applied assignment tests to determine the genetic lineage of each parent and assess levels of admixture between lineages. These results will allow MDC to anticipate population genetic changes in Missouri's black bear population as it expands.

52) *Perceptions of carnivores on the landscape.* Lauren Toivonen, Dr. Matthew E. Gompper, Dr. Charles Nilon, Dr. Shari Rodriguez **ABSTRACT:** Public perception of carnivores was assessed from over 1,100 surveys distributed across a spectrum of natural resource and general events occurring in Missouri and Arkansas. The majority of respondents had positive views in regards to their opinions and experiences with carnivores. For those who showed concern about carnivores, the biggest concerns were in regards to the safety of pets and livestock. When asked about specific carnivore species entering the state via natural recolonization or through a reintroduction program, respondents were in favor for both methods for all five species, but natural recolonization showed a higher percentage of support. While the majority of responses were positive across the spectrum, logistic regression was utilized to identify demographic variables that might indicate a more negative perception. It was revealed that gender, age, education level, and occupation all might influence an individual's response, but these variables are dependent on the question.

53) *Dozer trawl as a fish community assessment tool in a highly turbid lake.* Kristen Towne, Eddie Sterling, Zach Sanders, Jeremy Hammen, and Emily Pherigo **ABSTRACT:** Conventional boat electrofishing (EF) is one of the most commonly used techniques for sampling fish in standing water bodies. However, EF becomes difficult when turbidity is too high for dip netters to reliably see and catch stunned fish. Another electrofishing gear type, the dozer trawl (DT), was developed by the Columbia Fish and Wildlife Conservation Office for the detection of Silver Carp. This gear type removes the turbidity limitation and human dipper bias from the technique by combining electrofishing with a push trawl. Both gear types were deployed in Silver Lake (turbidity 253–486 NTU) at the Swan Lake National Wildlife Refuge in October of 2018 to assess their effectiveness in assessing the fish community. The DT was able to capture more fish (813 vs 103) in less pedal time (83.5 min vs 90 min) than EF. Additionally, although the DT captured more species than EF (15 vs 10), the catches of the two gear types were similar in their diversity (Simpson's diversity index of 0.32 and 0.37 for DT and EF, respectively). The DT also exhibited equal or lower variabilities in catch per unit effort (number of fish per 1,000 meters) than EF for the majority of the species caught. Finally, there appeared to be no difference in the length frequency of fish caught between the two gear types. Although the electrified dozer trawl was originally developed for the detection of Silver Carp, these results suggest it can be an alternative technique for the assessment of warm water, lentic fish communities in highly turbid systems.

54) *Lemna minor growth and morphological responses to different forms of silver.* Trang Tran, Jordan Heiman, La Toya Kissoon-Charles **ABSTRACT:** Silver has no known biological function but has been used in various products for many years, because of its antimicrobial properties. The use of silver nanoparticles (AgNPs) in particular, has been increasing in many consumer products such as food storage containers, toothpaste, cosmetics, household appliances, and textiles. These AgNPs can enter household wastewaters and ultimately aquatic ecosystems due to inadequate wastewater treatment processes to remove these contaminants. When AgNPs enter aquatic ecosystems, they can pose threats to various aquatic organisms. Previous studies have shown that AgNPs can have negative effects on organisms' cells and cell components by compromising the blood-brain barrier, damaging DNA, inhibiting growth, degrading protein, and causing chlorosis. *Lemna minor* is a small floating aquatic plant which takes up nutrients directly from the water column. It is fast growing and easily harvested. All these characteristics make it a great candidate for toxicology studies. We exposed different initial numbers of *Lemna minor* fronds (20, 40, and 80 fronds) to 160 µg/L silver nanoparticles or silver nitrate to determine the effects on growth and morphology. After two weeks of exposure, we harvested all plants to determine effects on dry biomass and area cover. Samples from a control and AgNP groups were also examined under a scanning electron microscope to determine morphological differences.

55) *Spring ephemeral forbs, mesophication and prescribed fire in a Missouri oak-hickory woodland: implications for management, restoration and conservation.* D. Alexander Wait **ABSTRACT:** The spring ephemeral guild is a potentially important component of Ozark woodlands. Spring ephemerals provide nectar and pollen to early season pollinators, and they function as a "vernal dam". However, there are no long-term studies documenting the effects of prescribed fire on this plant guild. Spring ephemerals are also not commonly examined when documenting mesophication. I examined species richness and similarity between 2008 and 2018 in three woodland units managed for wildlife in southwest Missouri (Drury-Mincy Conservation Area). "Control" "degraded-woodland" units have not been burned since 1950, "Recently Burned" woodland units have been burned on a two to three-year rotation since 1999, and "Continuously Burned" woodland/savannah units have been burned on a two to four-year rotation since 1980. A total of 26 species were identified across all units. Species richness is highest in Continuously Burned, and lowest in Recently Burned units. Spring ephemeral species richness has significantly declined in all units, with the greatest decline in Recently Burned units. Species are more similar in Control and Recently Burned (61% similarity), than Recently Burned and Continuously Burned (40%), units. The recent burning regime used to manage, and ostensibly "restore", degraded woodland units has thus far reduced spring ephemeral species richness. Longer periods between burns or growing season burns are suggested to sustain the ecosystem services provided by spring ephemerals. However, this MO Conservation Area is not necessarily indicated to be a good candidate for conservation and biodiversity benefits of spring ephemerals even though prescribed fire is reversing variables associated with mesophication.

56) *Restoration of native aquatic vegetation in spring-fed ponds.* Hannah Whaley, LaToya Kissoon-Charles

ABSTRACT: Wetlands are important to both wildlife and water quality. There are many different types of wetlands, including marshes, swamps, bogs, springs, and ponds. These ecosystems provide food, habitat, act as a filter, alleviate flooding, and serve as buffer zones intercepting runoff into water bodies. Numerous wetlands have been destroyed for alternative uses such as agriculture and development. This is detrimental to local ecosystems and can have large impacts on water quality. Restoration of wetlands is an important step in helping negate these effects. However, human-made wetlands are susceptible to various problems. For example, many human-made wetlands may lack a seed bank of native plants and can thus be vulnerable to weedy and opportunistic invasive plant species. These human-made wetlands can also be more susceptible to eutrophication due to their physical and chemical properties, hydrologic conditions, and watershed characteristics. Williams Pond is a spring-fed eutrophic pond at the George Washington Carver National Monument, in Diamond, Missouri. This pond contains both nuisance and invasive aquatic vegetation. We removed some of this vegetation by raking in the spring and summer. Before and after raking we conducted vegetation surveys to determine if there is a response in the native aquatic plant community in this pond. Physical and chemical data were also collected to determine relationships with the aquatic plant community. A survey of other similar spring-fed ponds will also be conducted to determine their physical, chemical, and biological characteristics and to better understand these systems and their function.

57) *Relationship between water temperature and flow in Missouri streams based on landscape-scale factors.*

Joanna Whittier, Jacob Westhoff, Bridget Whitehead, and Del Lobb **ABSTRACT:** Stream temperature is linked with stream discharge primarily as a function of energy exchange, volume, and source. Higher discharge levels lower stream temperature, and tend to be more influential over shorter time-frames and in larger watersheds. Although stream temperature generally is not directly correlated with discharge, the moderating effects of discharge can have a substantial influence. Our objective was to determine the relationship between stream temperature and flow across aquatic subregions (Plains [PL] and Ozarks [OZ]) and stream flow classifications to predict how stream temperature could change with differing discharge levels. We developed water temperature models for both annual and late summer relationships in each subregion and stream class. We used generalized additive models to identify the relationships between predictor metrics and hourly water temperature. This statistical approach allows for nonlinear relationships between predictors and dependent variable, assumes no interaction between predictors, and provides a regression model to evaluate relationships between predictors and response. Our findings indicated the relative response of water temperature varies across Missouri's aquatic subregions (annual model: PL 1.1 °C increase, OZ 2.2 °C increase) and stream flow classes with slight seasonal differences. These robust stream temperature - discharge models provide a scientific basis for land managers and decision makers to evaluate how management actions and other activities that modify stream discharge may lead to alterations in stream temperature and thus aquatic biota. The approach we used for this project provided a conservative estimate for change in water temperature under varying discharge levels.

58) *An Analysis of Mesocarnivore Communities at Prairie Fork Conservation Area.* Jena Staggs, Rachel Williams,

Grace Thomas, Abby Williams, and Matthew Gompfer **ABSTRACT:** Mammalian carnivores are known to mediate important top-down effects on ecosystem structure and function. In grassland ecosystems, how the carnivore community is influenced by habitat restoration is poorly understood. We have undertaken a study at Prairie Forks Conservation Area in central Missouri to discern the use of restored prairie, focusing on differential habitat use and activity patterns. PFCA contains grassland habitats of varying age as well as some forest habitat. Compared to historical prairies, PFCA is a fragmented landscape containing edge habitat. A camera trapping survey commenced in late 2016 at PFCA and has collected almost 2 years of continuous data. In addition, another camera trapping survey began at Tucker Prairie, a remnant prairie, in summer 2017 to serve as a control to the restored prairie. Our objective is to examine how carnivore species use the grassland-edge-forest matrix and how activity patterns vary temporally and spatially within it. Camera traps were randomly placed in the varying habitat types and photographs were later identified to species. The data showed carnivores utilizing a crepuscular strategy. Striped skunk and coyote tended to prefer grassland habitat, whereas generalist like the raccoon and opossum showed favor in forested habitat. Activity patterns between species were compared, indicating possible avoidance behaviors. Analyses of the data is ongoing including the following: relative likelihood of detection of species in edge habitat, seasonality of activity patterns of the species, and preference in age of habitat restoration.

59) *Clear-cuts and thinned stream buffers: do riparian zones influence stream function?* Jessica Wilson, Alba

Argerich, Sherri Johnson, Linda Ashkenas **ABSTRACT:** Riparian zones influence stream structure and ecological function by modulating water temperature and stream nutrient concentrations. Although the use of riparian zones as buffers for lateral nutrient inputs is well accepted, the role of riparian vegetation in modifying downstream transport and transformation of nutrients and stream metabolism is less known. This study aims to determine the influence of riparian vegetation on stream functional processes by analyzing water residence times, in-stream nutrient uptake and metabolism across nine headwater streams with different levels of riparian vegetation alteration in the Trask River Watershed, Oregon.