

1) *Stream breath and fish kills: oxygen and CO<sub>2</sub> in streams and rivers.* Alba Argerich **ABSTRACT:** Episodes of low oxygen concentrations are a growing threat to biodiversity in freshwater ecosystems. Hypoxia can occur naturally in streams and rivers and is associated with rising water temperatures and imbalances between ecosystem respiration and primary production. Understanding the natural variability of stream oxygen has become critical in light of a warmer climate and recurrent drought episodes. This talk will go through traditional and new methods to estimate stream ecosystem respiration and primary production in streams and rivers.

2) *Influence of Streamflow and Season on Habitat Selection by Spotted Bass and Shorthead Redhorse on the Lower Osage River, Missouri.* Elisa Baebler, Craig Paukert **ABSTRACT:** Downstream of hydropeaking dams, water depth and velocity fluctuate rapidly, which leads to short-term changes in physical habitat supporting aquatic organisms. While some fish species have been extirpated from flow-regulated systems, other species flourish, which may be related to the persistence of critical habitats complementary to these life histories. We used radio telemetry to evaluate the influence of season and streamflow on the habitat selection of two common, native fishes downstream of Bagnell Dam in central Missouri from April 2016 to June 2017. We studied Spotted Bass (*Micropterus punctulatus*), nest-guarding, sight feeding, habitat generalists and Shorthead Redhorse (*Moxostoma macrolepidotum*), fluvial dependent, migratory, benthic feeders. Spotted Bass selected moderate depths near submerged cover in all seasons and slow velocities during spring and summer. Conversely, Shorthead Redhorse preferred moderately deep and faster flowing habitats during spring and summer and used slow velocities and shallow depths during winter. Spotted Bass and Shorthead Redhorse selected velocity, depth, cover, and distance to shore during stable and/or fluctuating flows, suggesting that fish may respond to streamflow over daily time periods. Spotted Bass used slow velocities (less than 0.4 m/s) in both fluctuating and stable flows, whereas, Shorthead Redhorse preferred fast velocities (greater than 1.0 m/s) in stable flows but did not select velocity during fluctuating flows. Shorthead Redhorse and Spotted Bass habitat selection illustrates that even native fish that have prospered in regulated rivers have habitat requirements which may be better met through managing flow releases to maintain habitats that support native fish of different guilds.

3) *Wildlife and vegetation responses to legacy effects of land management in mid-Missouri.* Tyler Beckerman, Dr. Ben Knapp, Dr. Lauren Pile, Dr. Mitch Weegman **ABSTRACT:** The conversion of forested to agricultural lands resulted in drastic reductions of forested landscapes in the early 1900s. When agricultural practices were abandoned, sites were left to natural succession without active management. In this study, we quantified effects of agricultural abandonment on contemporary plant communities, forest structure, and wildlife communities at the Baskett Wildlife Research and Education Center in mid-Missouri. We used 1939 aerial imagery to classify contemporary forests as 'agricultural legacy' or 'forest legacy' based on if the site had been cleared in 1939. Each legacy condition occurred on two soil series. We randomly assigned 6 points to each forest legacy and soil type. Overstory data were collected within 1/5th acre circular plots, mid-stories were surveyed with 1/20th acre circular plots, and regeneration and invasive plants were surveyed with 8 1m<sup>2</sup> quadrats at each point. Trail cameras were placed at every point and mammal detections were recorded from late February to mid-April 2018. Four avian point counts were conducted at each sample point during the same period. Only birds observed within 1/5th acre plots were counted to ensure that birds were within the studied forest type. The forest legacy plots were dominated by mature white oaks while agricultural legacy plots were dominated by eastern redcedar. Preliminary data suggests a greater presence of invasive plant species in agricultural legacy plots. Greater avian and mammalian abundance and diversity were observed in forest legacy plots. This study demonstrates the dramatic effects of agricultural abandonment on contemporary forest conditions across taxa in mid-Missouri.

4) *Developing a decision support process for landscape conservation design in the Ozark Highlands.* Thomas W. Bonnot, D. Todd Jones-Farrand, Frank R. Thompson III, Joshua J. Millspaugh, Jane A. Fitzgerald, Nate Muenks, Phillip Hanberry, Esther Stroh, Larry Heggemann, Allison Fowler, Mark Howery, Shea Hammond, Kristine Evans **ABSTRACT:** Planning conservation in priority landscapes is hampered by uncertainty in how wildlife species will respond to conservation actions amidst impacts from landscape and climate change, especially when those impacts are also uncertain. Conservation is also made difficult by the complexities of the planning decisions, including tradeoffs among competing species objectives. We piloted a decision-support framework that integrates dynamic-landscape metapopulation models (DLMP) and Structured Decision Making (SDM) to help guide landscape conservation design. This framework allowed a team of partners to choose among scenarios for habitat restoration that best met desired endpoints for focal wildlife species in the Ozark Highlands region under climate change and urbanization. Through the framework, the Ozark Highlands team identified focal species to represent priority ecosystems, designed alternative scenarios, and used DLMPs to model the consequences of each, given concurrent impacts of climate and landscape change. The overall modeled impact of restoration on focal species was positive and presented evidence to support landscape conservation design. Despite the general effectiveness of restoration, species-specific responses to individual scenarios varied through interactions with

landscape change processes such as urbanization and climate change and the demographic processes affecting each species. The planning team theoretically identified a scenario that targeted 1.2 million ha of restoration across private and protected lands, based on predicted future landscape conditions that best reduced the average risk across species. With the development of this framework, we demonstrated that planning for viable populations across broad scales can be achieved under global change. The integration of DLMPs with SDM enabled decisions to be more objective and transparent, and thus more defensible. This framework has the potential to overcome many of the uncertainties and complexities that are inherent in the process of long-term, large-scale conservation planning.

5) *Hornyhead Chub Spawning Habitat in the East Fork Black River.* John Brant, Craig Paukert **ABSTRACT:** Available spawning habitat for native stream fishes can be altered by the presence and operation of upstream dams; thus, identifying the habitat requirements needed by these fish can guide restoration efforts. Male Hornyhead Chubs (HHC), *Nocomis biguttatus*, like males of other *Nocomis* species construct gravel spawning mounds that are also used by other lithophilic spawning fishes. Therefore, HHCs can play an important role in stream ecosystems. However, little is known about HHC spawning site selection. Our objective was to determine habitat characteristics that HHC males select for spawning in the East Fork Black River downstream of Lower Taum Sauk Dam, Missouri. We conducted surveys in riffle/run complexes throughout a 6.3 km section in the spring and early summer of 2017, and measured habitat characteristics at 29 spawning mounds and 87 random points to represent available habitat. Discrete choice models revealed depth, velocity, and wetted width as significant characteristics at the microhabitat scale. Mounds are most likely to be constructed at a depth of 0.3 meters, a water velocity of 0.18 m/s, and sites with larger wetted widths. Results will help us better understand the effects of flow, water quality, and substrate characteristics on native fishes downstream of dams.

6) *Habitat Associations and Distributions of Endemic Crayfishes in the Meramec River Drainage.* Joe Chilton, Amanda E. Rosenberger, Robert DiStefano **ABSTRACT:** Understanding the habitat associations and distributions of rare species is important to make informed management and policy decisions. The Freckled Crayfish (*Cambarus maculatus*) and Belted Crayfish (*Faxonius harrisonii*) are two of Missouri's rare and endemic crayfish species. Both species are listed as vulnerable on Missouri's list of species and communities of conservation concern due to their limited range and potential to be impacted by anthropogenic activities. Their native range is limited to the Meramec River drainage in eastern Missouri. We sampled 140 locations throughout the Meramec River drainage for these two crayfish species. At 60 of these locations, we gathered local- and landscape-scale habitat variables to be evaluated through occupancy modeling for association with crayfish presence. Crayfish were collected using kick-seines, drag seines, and visual timed-searches. We found benthic habitat factors, such as large substrate size and aquatic vegetation were associated with the presence of these two crayfish species. In addition, we discovered that both species inhabited a larger range within the Meramec River drainage than previously documented. This information will guide conservation managers in future projects and policy decisions regarding these two species.

7) *Using camera traps to map feral hog distribution in Missouri.* Mary Clay, Matthew Gompper, Justan Blair **ABSTRACT:** Feral hogs (*Sus scrofa*) are highly destructive, prolific pests that damage forests, agricultural resources, and wildlife habitat in Missouri and many other states. Efforts to eliminate feral hogs in Missouri have intensified in recent years, and the need for basic information about the population in the state has also increased. It is particularly important to develop a data-driven map of hog distribution that could be updated periodically to show that control efforts are decreasing the range of feral hogs and therefore the scope of their damage. The objectives of my study were to 1) determine feral hog occupancy in southern Missouri and 2) Create a repeatable procedure for determining feral hog occupancy that can be used in the future to measure success of eradication efforts. Approximately 115 camera traps were deployed in the Houston-Rolla District of the Mark Twain National Forest from May 2018 through January 2019. Data from these camera traps as well as additional camera traps located on Fort Leonard Wood were combined to create an occupancy model and protocol for future occupancy assessments. Managers may use this information to determine where feral hogs should be found and where to concentrate resources, making management more efficient. Additionally, managers can demonstrate progress of feral hog removal following elimination efforts and show a reduction in hog populations.

8) *Bobwhite Quail Response to Management – Missouri State University Journagan Ranch, Mtn Grove, Missouri.* Clint Dalbom **ABSTRACT:** Missouri State University's Journagan Ranch is a 3,300-acre working cattle ranch located in southcentral Missouri about 10 miles south of Mtn. Grove, Missouri. The ranch was a gift to MSU from the Leo Journagan Family in 2010 with a goal of allowing students the opportunity to study livestock production and conservation in a "real world" setting. The Journagan Ranch supports a herd of 1,000 head of registered Hereford cattle. In 2015 the Missouri Department of Conservation and Missouri State University partnered on a conservation project that includes putting wildlife friendly conservation practices on the ground on this working cattle ranch. One of the measurements used to monitor this

project is a fall covey count survey to document the bobwhite quail population and record the response to management. Conservation practices installed in this study area include, livestock fencing, woodland restoration, wildlife water establishment, cedar harvest, glade restoration, prescribed fire, pollinator plantings, creating livestock water, and establishing native warm season grass. 2018 marks the fourth year of data collection for bobwhite quail population numbers. Quail numbers have shown a fourfold increase in areas where wildlife management has been done, while increasing the efficiency of the livestock operation. This presentation will look at the quail numbers and response to management on the Journagan Ranch.

9) *Adaptive management – research partnerships to restore shortleaf pine mixedwoods.* Daniel C. Dey, John M. Kabrick, Benjamin O. Knapp, Steve Lyzack, Scot Robinson, Michael Stevens **ABSTRACT:** Shortleaf pine was once a dominant species in the Missouri Ozarks but now only about 10% of the original pine mixedwoods remain. Despite our best efforts, we continue to suffer the loss of pine. Novel disturbance regimes over the past 50-100 years have promoted hardwoods over pine. In the absence of recurring fire, hardwood litter accumulates and becomes a barrier to shortleaf regeneration. In addition, hardwood advance reproduction has been accumulating and increasing in competitiveness. Any reductions in overstory density releases well-established hardwood advance reproduction that are able to outcompete new pine seedlings.

New silvicultural prescriptions are necessary to restore pine. Prescribed fire is effective in reducing litter and preparing suitable conditions for pine regeneration. Repeated fire may be necessary to sustain suitable seed bed conditions until sufficient seed is produced. Alternatively, pine (container or bareroot) seedlings may be underplanted in shelterwoods. Annual fires over decades or herbicides may reduce the density of hardwood advance reproduction under closed canopy overstories. Once pine seedlings are established, overstory density needs to be reduced substantially to provide adequate light (>50% full sunlight) for good pine growth, but this also releases hardwood competition. Recurring fire under partial overstories may be used to develop large pine advance reproduction and set back hardwood regeneration. Or, pine can be fully released in a clearcutting, but this may necessitate tending or thinning during stand initiation to ensure adequate pine stocking at canopy closure. We are evaluating novel sequences and timing of practices to restore pine-oak forests and woodlands.

10) *Using Drone-Based Imagery to Enhance Conservation Projects.* Toby Dogwiler, Bennett Conway, Shay Hostens, and Bailey Pfitzner **ABSTRACT:** Many conservation projects could benefit from on-demand, high resolution aerial photography and digital elevation models (DEMs). This data is useful for creating base maps, conducting “before and after” comparisons, and rapid reconnaissance and site assessment. Overlapping imagery acquired with small unmanned aerial systems (aka sUAS or drones) can yield three-dimensional data, such as Orthomosaics and DEMS, through “structure from motion” photogrammetry (SfM). The addition of multispectral, thermal, and other types of imagery further expands the possible applications of these data.

The ease-of-use of sUAS allows efficient capture of these types of data at an accessible cost for most project budgets. sUAS and SfM technologies are revolutionizing the potential to quantify landscape features and ecosystems with high accuracy and resolution and thereby enhance conservation and natural resource projects. Conservation and natural resource scientists are increasingly interested in adopting these technologies to add value to projects and decrease costs. However, many experienced and novice practitioners fail to understand how the choices made during data acquisition and processing can affect the overall quality and accuracy of the final products. When investigators use SfM products for quantitative analyses, it is important to understand and follow best practices and QA/QC workflows to ensure that conclusions are based on robust data. Many investigators also fail to plan for the archival and storage of these data sets, which can be quite large, and may have unforeseen future value. This talk will discuss strategies and best practices for acquiring, processing, and analyzing drone-based imagery with examples from on-going research.

11) *A Structured Approach for Incorporating Manager Feedback into the Survey Design of a Standardized Riverine Fish Sampling Protocol.* Corey G. Dunn, Craig P. Paukert **ABSTRACT:** High complexity makes large rivers challenging to sample. Although sampling efficiency is paramount, other survey-design properties may improve usability and the likelihood of a protocol’s adoption into standardized sampling programs. We employed a structured approach that incorporated manager feedback when designing Missouri’s Midsized Rivers Fish Sampling Protocol developed from 36 surveys across six rivers. First, a team of Fisheries Management Biologists and Research Scientists identified sampling objectives (detecting 80% [less-intensive protocol] and 95% [more-intensive protocol] of species at a site) and sampling preferences (maximizing efficiency and preferred gears, minimizing total gears, prioritizing detections of Species of Conservation Concern [SOCC]). Next, we used computer simulations to narrow down the 287,496 candidate protocols to six (less-intensive) and four (more-intensive) protocols that optimally represented manager preferences. Managers then allocated weights to their preferred alternative protocols within a multi-criteria decision framework. Although managers apportioned similar weights across less-intensive protocols, the highest weighted protocol indicated managers valued sampling efficiency over greater use of preferred gears (electrofishing, seining). Managers agreed on a more-intensive protocol, requiring the

fewest samples, little trawling, high electrofishing investment, and no hoop nets. Both preferred protocols are more efficient, and detect higher percentages of species and SOCC (less-intensive = 73% of SOCC, more-intensive = 93% of SOCC) than traditional single-gear protocols (electrofishing or seining-only = 57–63% of total species, 30–61% of SOCC). By designing the survey around the vast sampling experiences of managers, these protocols will likely be more operational under time and logistical constraints typically faced by managers.

### 12) *Impacts of a Concentrated Animal Feeding Operation on Aquatic Communities: What's at "Steak"?*

Aaron D. Geheber, Daniel A. Marschalek, Daniel M. Wolcott **ABSTRACT:** Concentrated Animal Feeding Operations (CAFOs) may result in increased animal waste inputs into nearby freshwater systems, altering physical and chemical properties of the ecosystem. When these alterations occur, biotic communities are often impacted as a consequence. In Johnson County Missouri, a CAFO is planning to consistently house 6,999 cattle (up from 999) at the upper reaches of the Crawford Creek watershed. To examine the potential impacts the operation may have on this aquatic system, we quantified biotic (fish and invertebrate communities) and abiotic (dissolved oxygen, pH, ammonia, and temperature) parameters within the watershed. Data were collected from 10 sites on a monthly basis starting in May 2018. Sampling occurred prior to the increased concentration of cattle being housed at the CAFO in order to generate baseline data of the aquatic system prior to potential impacts. To date, we have firmly established baseline measures for biotic and abiotic parameters in Crawford Creek, and we are continually monitoring potential CAFO impacts on aquatic communities. Experimental design, including spatial and temporal scale of study, and monitoring efforts moving forward will be explained and discussed.

13) *St. Louis Area Biodiversity and Ecological Network.* Scott George **ABSTRACT:** St. Louis lies the interface of two biomes (Prairie Plains, Ozarks Highlands) and the confluence of two continental-scale wildlife corridors (Mississippi and Missouri Rivers). The Meramec River adds to area biodiversity. Progress has been made in preserving and restoring natural communities; composed of core areas and smaller patches, within a highly fragmented, urban/agriculture matrix. Ecosystem wildlife services depend on the ability of meta-populations to move between natural areas to forage, reproduce, migrate and disperse. Local extinction rates are typically high in small, isolated patches (e.g. island biogeography). Wildlife corridors are needed to connect these isolated populations.

The common factors used to determine ecological significance and conservation priorities are; patch size/configuration, high quality/unique communities, rare species and land preservation status. The "connectivity" of patches is crucial in highly fragmented landscapes, but is species-specific and requires extensive population information to predict. A practical approach is to identify existing/potential corridors between natural areas for protection and restoration. A conceptual ecological network or "green infrastructure" plan is proposed for the St. Louis area. The primary components are natural migration pathways (e.g. rivers/floodplains) and remnant natural communities, which have not been developed due to steep topography (e.g. bluffs and slope forests). The existing corridors are often fragmented by large, high traffic roads. Practical methods to ameliorate the fragmentation effects of roads and improve wildlife crossings are suggested.

### 14) *Establishing Agroforestry Silvopasture Systems in the Missouri Ozark Region.* Michael Goerndt

**ABSTRACT:** This project aims to study the methods, challenges, production, sustainability and economics of establishing and managing silvopasture systems in the Missouri Ozark Region. From a research aspect, analyses of silvopasture will be accomplished by establishing study sites at the Missouri State University College of Agriculture Journagan Ranch property, a location ideally suited for establishment and study of all aspects of silvopasture systems. In addition to traditional data collection and analyses of the forestry, forage and soil components, we will incorporate state-of-the-art data collection and analysis through use of Unmanned Aerial Systems (UAV) mounted with a multispectral sensor. The resulting high-resolution remote sensing data will enable us to build precise spatial/temporal models of tree and forage growth and health over time in the silvopasture systems. Data from both the traditional analysis and remote sensing analysis will provide vital information to analyze short-term and long term economics of silvopasture establishment and management. Our proposed project also includes strong teaching and outreach components. The teaching component will support the work of two graduate students and three undergraduate students, while providing them with valuable experience in field work, research, and collaboration, while onsite field trips and labs will greatly enrich the education of more than 150 students taking relevant courses through the duration of the study. The outreach component will greatly increase the capacity of the investigators to disseminate vital information about silvopasture establishment and management to landowners, producers, silvopasture professionals, and multiple other stakeholders.

### 15) *Visitor Perceptions of Climate Change Impacts in Missouri.* Lisa Groshong, Sonja Wilhelm Stanis,

Mark Morgan **ABSTRACT:** Missouri's outdoor recreation resources provide numerous mental, physical, and social values to millions of people each year and serve as a major contributor to the statewide economy. However, climate change threatens

these benefits. This project sought to explore climate change perceptions of outdoor enthusiasts in Missouri as a step toward managing natural and cultural resources for ongoing climate resilience.

This study used quantitative and qualitative approaches to measure climate change impacts of nature-based tourists in Missouri. Although visitors see many of the same environmental changes observed and predicted by researchers (i.e., increased flooding and drought, heat waves), they are reluctant to attribute causation to climate change and human influence. Political affiliation is closely tied to belief in climate change. Visitors recognize climate-related health threats (i.e., heat strokes and vector-borne diseases) but are unlikely to perceive themselves as vulnerable. Visitors see few options to cope with climate impacts; rather, they seek to avoid them.

These findings suggest a number of climate-change related management challenges, including an increased demand for emergency response and seasonal/ temporal shifts in visitation patterns. Visitors suggested numerous areas for education and action. Staff should be trained to educate the public about the mechanics of climate change and personal prevention strategies for adverse health impacts (i.e., heat strokes, drowning in flash floods, tick diseases). Further, outdoor recreation resources should be managed to demonstrate climate-friendly practices (i.e., installing solar panels and pervious pavers; removing invasive species) and examples that focus on local impacts.

16) *How can prescribed burning and harvesting restore shortleaf pine-oak woodland at the landscape scale in central United States? Modeling joint effects of harvest and fire regimes.* Hong S. He, Wenchi Jin, Stephen R. Shifley, John M. Kabrick, Brian K. Davidson

**ABSTRACT:** Prior stand-scale studies suggest that prescribed burning and harvesting could be effective for restoring pine-oak woodlands. However, previous short-term, stand-scale studies provided little insight into long-term, landscape-scale outcomes. To estimate outcomes of alternative restoration treatments on future species composition and forest structure, we employed an integrated field and modeling approach to simulate effects of prescribed burning and harvesting on the restoration of shortleaf pine-oak woodland composition and structure in the Mark Twain National Forest for a 100-year period. Six scenarios were modeled: no management, burn only, harvest only, and a combination of harvest with burns treatments followed by fire-free intervals of differing starting times or durations to facilitate regeneration recruitment. Both no management and prescribed burn only scenarios cannot restore current forest to historical woodland condition (i.e., 40–80% percent canopy cover or less than 55% stocking); however, scenarios including harvest can restore current forest to woodland condition in late 2020s. All of the treatments that included a combination of burning and harvesting reduced total basal area, which fluctuated around 13 m<sup>2</sup> ha<sup>-1</sup> throughout the simulation than those under no management and prescribed only scenarios. The simulations suggested that shortleaf pine would become the most dominant group, followed by white, red oak groups, and other species with combined prescribed burning and harvesting. When coupled with harvest, the prescribed burning regime affected species composition: increasing the number of burns increased the basal area and density of shortleaf pine and decreased the basal area and density of white oak group species.

17) *Using species distribution modeling to target eastern spotted skunk research and management efforts.* Summer D. Higdon, Maggie MacPherson, Matthew E. Gompper

**ABSTRACT:** The eastern spotted skunk is a small, elusive mephitid native to the eastern and Midwestern U.S. Beginning in the 1940s, their populations declined range-wide and have not recovered. Reasons for the decline remain unknown, but modernized agriculture, increasing use of pesticides, habitat loss, overharvest, and disease have all been implicated; likely, a combination of several confounding factors resulted in the population crash. Today, the plains spotted skunk subspecies is petitioned to be listed federally under the Endangered Species Act, but some basic ecological knowledge like habitat associations remain limited. A clear understanding of factors driving eastern spotted skunk occurrence is necessary for targeted research and management efforts. Thus, we developed a species distribution model to predict where eastern spotted skunks are located throughout the Ozark and Ouachita mountain regions. We used presence-only data collected in Ouachita National Forest, Ozark National Forest, and southern Missouri using track plates and camera traps from 2005-2018. We characterized each known eastern spotted skunk location using environmental factors including land-use type, canopy cover, understory density, coarse woody debris, time since burn, and distance to roads. We used the MaxEnt program for modeling species distributions to estimate where eastern spotted skunks are most likely to occur in the Ozark and Ouachita mountain regions. Our results will be used to prioritize future research and management efforts.

18) *Intensive harvest of bigheaded carps using the Unified Method in a floodplain lake in Missouri, USA.* J.C. Jolley, D.C. Chapman, K. Lawson, W.J. Doyle, K.J. Meneau

**ABSTRACT:** Intensive and efficient harvest methods for invasive Asian carp in the Mississippi River Basin may alleviate negative effects of overabundance and are desired by fisheries managers. Commercial desirability of these fish may provide economic benefits, as well. We conducted a mass harvest at Creve Coeur Lake, Missouri using the Unified Method which was developed by Chinese fishers for harvesting carp from floodplain production lakes. The method consists of using a variety of driving, herding, and netting techniques, in unison,

to concentrate large numbers of fish from large waterbodies to a defined collection location. We used a combination of boat electrofishing, electrified trawling, and boat-mounted acoustic deterrents to drive fish from a series of block-netted cells in the lake to concentrate fish. Driving methods were extremely successful and 80% of the lake was mostly cleared of fish in seven days of work. Fish behavior eventually changed when high concentrations were created and driving methods had greatly reduced effectiveness. Fish were not successfully driven into an Iruka-style stownet likely due to a combination of water depth, physical location, and mouth opening size. We used beach seining techniques using block nets to capture large schools of fish that had formed. Four seine hauls resulted in 108 metric tons of Asian carp removed from the lake. Preliminary estimates suggest that at least 50% of the Asian carp (> 40,000 fish) were harvested from the lake. Analyses of companion environmental DNA, hydroacoustics, and mark-recapture data will provide additional information on efficiency of harvest.

19) *Spatial variation in composition of mussel communities in relation to modeled habitat suitability in the Meramec drainage of Missouri.* Kayla Key and Amanda Rosenberger **ABSTRACT:** State-wide mussel surveys have documented declines in mussel diversity in the Ozark region, including the Meramec River basin, a hotspot of mussel diversity in the Midwestern United States. One primary challenge to conservation of mussels is identifying suitable habitat. Mussel communities are influenced by hydrologic and geomorphic characteristics of streams that vary with stream size. We generated a fundamental niche model for mussels in the Meramec Drainage based on the presence of species-rich mussel beds and then compared species composition of mussel beds in relation to model predictions. We ask the following questions: 1) Does not only richness, but species composition of mussel beds vary with projected habitat suitability, 2) do we find specific community groupings in areas across the spectrum of suitability, 3) Is species richness an effective conservation unit in mussel habitat modeling efforts? We compared mussel assemblages from three subwatersheds in the Meramec Drainage in Missouri: mainstem Meramec, Bourbeuse River, and Big River. We found that species richness was a useful, representative metric for modeling mussel bed distributions. Community composition of mussel beds act in an additive manner making beds with the most species effective in identifying areas that also can only support lower species beds. We present comparisons made among rivers, species-richness classifications, and habitat suitability. The information provided by this study will help to further support management and monitoring of mussels on a community level to improve conservation and threat management efforts.

20) *Can clearcut harvest reset long-term successional trajectories of hardwood forests of mid-Missouri?* Benjamin Knapp; Samantha Anderson; Patrick Curtin; Casey Ghilardi; Robert Rives **ABSTRACT:** In much of the Central Hardwood Forest Region, upland forests have shown patterns of change from stress-tolerant species (e.g., oak) to shade-tolerant, mesic species (e.g., maple) through time. In part, this situation is related to the general lack of management across much of the forested landscape. In Missouri, relatively poor soils allow for easier oak management than areas further east. We used two datasets from mid-Missouri to describe: 1) successional patterns of upland forests over a forty-eight year period (1968-2016) with no management using long-term monitoring plots; and 2) effects of clearcutting on forest composition and dominance thirty years after cutting using a separate dataset from clearcuts sampled in 2016. Both datasets contrasted forests on relatively xeric (west-facing, shoulder/ridge) and mesic (northeast-facing, lower slope) sites. In 1968, forest composition differed by site conditions but was dominated by white oak on both mesic and xeric upland sites. Through time, sugar maple significantly increased in importance value with no management, creating a bottleneck midstory dominated by sugar maple. On the xeric sites, clearcutting in the 1980s resulted in contemporary stands dominated by oaks (49% of dominant trees), whereas on the mesic sites oaks made up only 26% of the dominant trees. Results from this work demonstrate the pattern of maple encroachment in upland forests of mid-Missouri in the absence of forest management and the potential for clearcutting to regenerate stands with oak dominance; however, clearcutting does not appear to guarantee successful oak regeneration in this region, as results depended on site conditions.

21) *Mapping flood patterns to address current and future management needs on the Lower Missouri River.* Garth A. Lindner, Edward A. Bulliner, Kristen L. Bouska, Craig P. Paukert, Robert B. Jacobson **ABSTRACT:** Within Missouri there are more than 85,000 acres of public conservation lands in large-river floodplains. Floodplain lands are highly dynamic and challenging to manage, particularly as future climatic conditions may be highly variable. Floodplain managers may need tools to help them understand the effects of climatic variability on conservation lands. This project worked with floodplain managers to identify the information most needed to improve management under climatic variability, and to develop decision making tools with applications to conservation lands. Our survey revealed that time, funding, and a perceived disconnect between research and management limited the ability of managers to use new information. However, managers were willing to partner with scientists to identify science needs, relevant spatiotemporal scales, and products useful for management decisions. Floodplain managers agreed that metrics of inundation, including depth, extent, frequency, duration, and seasonality are the most useful metrics for management of floodplain conservation lands. We developed digital spatial layers of these metrics of inundation from numeric flood inundation models under historic and climate change scenarios. We applied this method to the lower 500 miles of the Missouri River, making 45 spatial layers available to aid

in current and future management decisions of conservation properties. Patterns of floodplain inundation vary longitudinally, with channel incision acting as the dominant control. Annually, climate change is estimated to increase the duration, frequency, depth, and extent of floodplain inundation. However, these patterns vary seasonally, with inundation increasing in the spring and decreasing in the fall.

22) *Predicting future tree performance and survival of shortleaf pine (*Pinus echinata*) through novel height growth percentiles.* Stephen J. Lyczak, John M. Kabrick, Daniel C. Dey, David R. Larsen, and Benjamin O. Knapp

**ABSTRACT:** Growth percentile charts are a common way to assess development of everything from human infants to livestock. Typically, selected attributes are assigned to a peer-group, then ranked. While many animals have the added benefit of custodial care to increase growth and survival probability, trees must rely on favorable stand dynamics, site characteristics, and competitive ability to survive. To quantify these variables, we propose a mechanism for assessing early tree growth performance through height-growth percentile rankings and using those percentiles to predict future performance and survival probability for shortleaf pine in the Missouri Ozarks.

Over 4000 planted 1-0 shortleaf pine seedlings across three sites were analyzed. Trees were assigned the following percentiles based on heights years one and seven: <25th, 50th, 75th, and >90th. Probability of changing percentile was calculated using logistic regression. Trees initially in the lowest percentile had a higher probability of remaining in that percentile (57%) or dying (25%) than moving to a higher percentile (21%) in year seven. In the 50th percentile, there was a 47% probability to decline or die, and 53% probability to maintain or increase percentile. Conversely, trees in the highest initial percentile were more likely to maintain that status (48%) or move into the 75th percentile (32%) than die (0%) or decline to the 50th or below percentiles (20%) in year seven. Overall, significant mortality and percentile declines occurred in the 50th percentile and below, while initially taller trees were more likely to survive and maintain or increase their height class over time.

23) *Mapping MO Invasive Plants.* Dacoda Maddox, Lauren Pile, Hank Stelzer, Brian Davidson, Dan Dey

**ABSTRACT:** The USDA Forest Service, along with our state partners, including University of Missouri Extension, is working to map the distribution and dominance of non-native invasive plants in Missouri. It is well known that the problem of invasive plants in Missouri continue to worsen. Mapping Missouri's invasive plants can help landowners, natural resource managers, and policy makers make better, more informed decisions on the detection and management of invasive plants. We are actively engaging citizen scientists and natural resource professionals to aid in this mapping effort. Using ESRI's Survey123, we developed an app-based tool that will allow individuals and organizations to document the presence of invasive species in their area, either at home, while recreating, or on the job contributing to a statewide interactive map. The survey will aid in identification as well as provide information on control and management with embedded links. To introduce the app, we conducted three, two-hour, workshops in Columbia, Jefferson City, and Rolla. These workshops provided an opportunity to learn about the ecology, management, and threats of Missouri forests, the invasive plants that impact them, a tutorial on the app, and native plant alternatives to common invasive ornamental plants. We also provided a publically-available ArcGIS Story Map highlighting the data collected and how we can continue to work together for monitoring and managing invasive plants in Missouri. This project will help not only document new and pervasive plant invaders but to also foster a state-wide community of sharing and conversation regarding the importance of our natural resources.

24) *Investigating Perceptions of Wildlife and Vegetation in Urban Vacant Lots.* Andrew Mallinak,

Charles Nilon, Robert Pierce **ABSTRACT:** Vacant lots are a prevalent issue in many urban, residential areas nationwide, causing property value declines and further neighborhood blight. These lots are often targeted by city officials to become planned greenspaces, though nearby, marginalized residents may not adequately be involved in the process. This exclusion disempowers residents and provides greenspace that while ecologically useful, may not benefit residents. St. Louis, Missouri is one of many Midwest cities dealing with a large number of vacant lots, with most of the vacancy concentrated in the predominantly low-income, African-American north side. The city has selected several lots in two north side neighborhoods to implement various management strategies for storm water control and biodiversity conservation. To understand residents' management preferences for the lots, I administered semi-structured interviews combined with vacant lot photo-evaluation surveys to residents in both neighborhoods. I created themes from the interview transcripts and photograph scores that explain how residents perceive the wildlife and vegetation in their neighborhood vacant lots and how that perception affects their preferred lot management and use. Top ranked photograph scenes exhibited a clear line of sight and signs of care such as mowing, fencing and litter absence. Interview themes surrounding vacant lot perception and management preference were safety, neighborhood image, poverty, city mistrust, and community change. While wildlife was sometimes seen as tolerable or appreciated, most wildlife was viewed negatively as a form of nuisance or danger. Vegetation was pivotal in how residents felt an area was cared for and whether a vacant lot was seen as being safe and usable, with low, uniform vegetation preferred.

25) *Insect conservation at two taxonomic levels: endangered species and ecosystem functioning.* Daniel A. Marschalek **ABSTRACT:** Conservation plans frequently list goals of preserving both biodiversity and ecosystem functioning. Endangered species require immediate attention to prevent extinction, while ecosystem processes and diverse groups of species must be maintained to prevent the further decline of biodiversity and the services they provide. Insects compose the majority of species on Earth and their ecological roles are critical for proper ecosystem functioning. Therefore, entomological research at the population and community levels can contribute to management and conservation of native ecosystems. This talk will discuss research projects from San Diego, California, and make connections to Missouri insects. These projects included population-level assessments of endangered butterflies to develop efficient monitoring protocols, followed by ecological studies investigating the impacts of management and how to alleviate threats. Data from two specific studies led to the conclusions that moderate cattle grazing was most appropriate for the Laguna Mountains skipper, and habitat fragmentation was limiting post-wildfire recolonization of the Hermes copper butterfly. A community-level study correlated landscape composition with pollinating and decomposing insect communities, and quantified the rate of these ecosystem functions due to the different communities. Beetles involved in decomposition exhibited a negative correlation with non-native land cover, and decomposition rates were lower in smaller, more isolated urban preserves. These research projects combine quantitative entomological and ecological research with the goal of informing data-driven decisions for the management of native communities. This research structure could also assist conservation of Missouri species and communities, including the loamy-soil tiger beetle, regal fritillary, and prairie pollinators.

26) *Evaluating the Community Wealth Impacts of Wild Harvesting in the Ozark Highlands.* Sarah Hultine Massengale **ABSTRACT:** Local food systems are a popular topic and regularly advocated as a strategy for community economic development, often focusing on farmers' markets, community gardens, farm to school and local restaurant menus as common practices. Wild harvesting is another local food system practice, but despite significant research and literature about wild harvesting in natural resources circles, local food systems research and practice has often overlooked the contributions that informal activity, self-procurement, and non-traditional market exchanges contribute to community food systems. Comprehensive rural wealth, a new framework developed by USDA-Economic Research Service, provides a tool for rural economic development that considers multiple forms of capital including social, financial, human, natural, and physical, and allows for evaluating a wider range of costs and benefits of local food systems practices within a local context. This presentation will share the results of a study to better understand and document the rural wealth impacts of wild harvesting in the Ozark Highlands. Using the comprehensive wealth framework, this study evaluated the potential impacts of investments in the local food system practice of wild harvesting, and what the impacts imply for rural development. Additionally, this research project utilized narrative inquiry and critical reflection sessions as methodology for valuing local harvester knowledge and developing more participatory research opportunities. The benefits and challenges of this methodology will also be discussed.

27) *The Role of Tributary Habitats in the Recovery of the Lake Sturgeon, a Missouri Endangered Species.* Michael J. Moore and Craig P. Paukert **ABSTRACT:** Large tributaries often provide spawning and nursery habitat for large river fishes and may be less altered than the mainstem large rivers. We used telemetry to identify tributary use and habitat selection of Lake Sturgeon, a Missouri endangered species, in two Missouri River tributaries: the Osage and Gasconade rivers, near the southern edge of their range. We implanted 96 adult/subadult Lake Sturgeon with acoustic transmitters in the Osage and Gasconade Rivers from 2015 to 2018 and relocated fish by remote receivers in the tributaries and mainstem Missouri River and monthly manual tracking. Ninety adult/subadult Lake Sturgeon have spent 75% of their time in tributaries. Bayesian discrete choice models determined that Lake Sturgeon selected deeper habitats across all seasons. Lake Sturgeon also selected habitats closer to the main channel in all seasons except spring when they moved closer to the bank in faster flows. Lake Sturgeon did not select habitats based on substrate composition or cover. This information may help inform river conservation and the consideration of tributaries into conservation strategies for large river fishes.

28) *Evaluating the Prairie Fork Reconstruction Progress: How Do You Know When You're Close Enough?* Chris Newbold **ABSTRACT:** Prairie Fork Conservation Area (PFCA) is a 911 acre property located in Central Missouri with an on-going prairie, savanna and woodland reconstruction project. Prairie reconstruction activities consist of control of existing invasive plant species, harvesting seed from nearby remnant natural communities, and dormant season plantings in reconstruction sites. In 1999, prior to reconstruction activities, an area-wide inventory was conducted to assess the state of the plant communities at PFCA. In 2017, we conducted follow-up vegetation sampling to evaluate the success of 12+ years of invasive species control efforts and prairie plant community reconstruction activities. Permanent vegetation sampling points across PFCA were compared to established points on remnant prairies that provided source seed for reconstruction efforts. Sampling points were also located so that comparisons could be made across reconstruction age classes (not planted, 1-3 year old plantings, 4-7 year old plantings and 7-12 year old plantings.) Mean native and adventive species richness per plot were compared between pretreatment, different reconstruction age classes and remnant prairies. Mean-C (coefficient of plant



species remnant dependence) and native species richness per M2 (native density) values were also computed and tested for differences across unplanted sites, reconstruction age classes and remnant prairies. Remnant prairies had significantly greater mean-C and native density values than reconstruction plantings ( $P < 0.05$ ). However, our 7+ year old reconstruction plantings had a mean-C value approaching the remnant sites (7+ year old reconstructions =  $3.24 \pm 0.19$  95% CI vs. remnant prairies =  $3.73 \pm 0.14$  95% CI) and mean native density showed similar trends (7+ year old reconstructions =  $10.74 \pm 1.17$  95% CI native species per M2 vs. remnant prairies =  $12.99 \pm 0.72$  95% CI native species per M2.) Invasive plant species have also shown declines in importance values over time as reconstruction efforts progress. These vegetation community monitoring data are being used to measure success in our prairie reconstruction efforts and are intended to help managers make decisions on additional, future reconstruction and management efforts.

### 29) *A Survey of Regal Fritillary (Speyeria idalia) on Select Southwest and West Missouri Prairies.* Chris Newbold, Jerod Huebner, and Steve Buback

**ABSTRACT:** The regal fritillary (*Speyeria idalia*) butterfly is a tallgrass prairie endemic that is currently declining across much of its range, primarily due to habitat loss. Considering their declining status and current review being conducted by the United States Fish and Wildlife Service, assessing the distribution and size of remaining regal fritillary populations in Missouri is important. In 2018, we conducted a small pilot project to survey regal fritillaries on 18 private and public Missouri Department of Conservation, Missouri Prairie Foundation, and Nature Conservancy prairies in western and southwestern Missouri. The objectives of the surveys were to: 1.) test the feasibility of using count surveys and N-mixture modeling to estimate regal fritillary populations, and 2.) provide information on the status of regal fritillaries at 5 prairie “complex” locations in western and southwestern Missouri. Surveys were conducted using a combination of dependent-double observer line transect count and distance-from-observer methodologies. Regal fritillaries were documented at 4 or the 5 prairie “complexes” surveyed. Dependent double observer count data generated detection rates of regal fritillaries that ranged from 0.6707 – 0.9185. Modeling of dependent double observer count data produced biologically reasonable population estimates and densities across all prairies surveyed. Distance from observer modeling produced estimates that, on average, tended to be greater than the estimates generated from dependent double observer count data. Although the dependent double observer count surveys seem promising in estimating regal fritillary populations sizes and distributions, further surveys, including mark-recapture surveys are needed to test their accuracy.

### 30) *Statewide Lake Assessment Program – Update of long-term water quality in Missouri reservoirs.*

Daniel V. Obrecht, John R. Jones, and Rebecca L. North **ABSTRACT:** Missouri’s lakes and reservoirs provide drinking water, recreational opportunities, and economic benefits across the state. Monitoring water quality in these systems is the first step in ensuring that they do not degrade to the point of impairing one or more uses. The Statewide Lake Assessment Program (SLAP) is a long-term effort by the University of Missouri Limnology Laboratory to gather water quality data on Missouri’s lakes and reservoirs. The goals of the program include describing the trophic state of Missouri’s water bodies, monitoring for long-term trends, and determining the factors that influence lake productivity. Water quality parameters monitored by SLAP include total phosphorus, total nitrogen, algal chlorophyll, Secchi transparency, non-volatile suspended sediments and algal toxins (Anatoxin, Cylindrospermopsin, Microcystin, and Saxitoxins). Monitoring occurred on 70 water bodies across the state during the 2018 summer sampling season. This presentation summarizes the latest results from this long-term effort, with a focus on the range of trophic conditions found within the state. Notable long-term water quality trends in individual lakes will also be highlighted.

### 31) *Who’s in Control, Light or Nutrients? Exploring Phytoplankton Co-Deficiency in Missouri Reservoirs to Inform Algal Bloom Management.* Erin L. Petty, Daniel V. Obrecht, Rebecca L. North

**ABSTRACT:** With harmful algal blooms increasing in frequency, intensity, and duration around the globe, interest is mounting to understand the role of light and nutrients in managing suspended algae within freshwater ecosystems. This presentation will explore the interaction between limiting resources (light and nutrients) and their influence on algal biomass and primary productivity across a gradient of typically turbid Missouri reservoirs. Sampled between May and early October of 2018, the reservoirs represent a gradient of environmental characteristics, which include differences in trophic status, morphology, and watershed land-use. A suite of physiological light and nutrient deficiency indicators were used to determine the dominant growth-limiting factor(s) for each algal community. Measured indicators included available solar radiation, nutrient concentrations and ratios, photosynthetic efficiency, gross primary productivity, and other photosynthetic-irradiance parameters derived from fluorometric light curves. Nutrient addition experiments were also conducted to examine algal response to singular and combined additions of phosphate, nitrate, and ammonium. We expected the communities in many, if not all, of these systems to be co-deficient in light and nutrients, meaning that both limit growth and productivity. Results will be informative for devising management strategies to control algal productivity and limit algal bloom development.

32) *Voluntarily Use of Nonlead Ammunition on National Wildlife Refuges.* John H. Schulz, Sonja A. Wilhelm Stanis, and Elisabeth B. Webb **ABSTRACT:** Research has documented the effects of lead ammunition on eagles and other wildlife, but little research has been conducted on behavioral mechanisms affecting the voluntary use of nonlead ammunition. Recently, the U.S. Fish and Wildlife Service (FWS), Midwest Region, implemented a program encouraging the voluntarily use nonlead ammunition on National Wildlife Refuges (NWR). Our objectives were to assess FWS refuge staff perceptions of the program and explore factors influencing program support. The program occurs on 54 NWRs in the upper Midwest. We conducted systematic observations at managed deer hunts ( $n = 12$ ) and semi-structured interviews with refuge staff ( $n = 21$ ). Observations showed 193 hunters participated ( $M = 16.1$ ,  $SD = 14.6$ ) with nonlead presentations lasting  $<4.0$  minutes ( $M = 3.7$  min,  $SD = 1.4$  min). Preliminary interview analysis suggested four themes. First, FWS refuge staff attitudes toward the program appeared to be affected by their social background and deer hunter status. Second, human health concerns of ingesting lead bullet fragments were thought to be a more compelling argument than bald eagle mortality while recognizing human health is not an agency responsibility. Third, staff agreed with the program but expressed concern about implementation given other refuge priorities. Finally, FWS staff recognized a ban on lead ammunition is politically problematic but a voluntary program is not sustainable long-term. This does not imply lack of support, rather frustration of implementing a program with uncertain long-term outcomes.

33) *Indiana bat (*Myotis sodalis*) maternity roost site selection at national wildlife refuges in northern Missouri.* Dane Smith, Elisabeth Webb, Sybill Amelon, and Shauna Marquardt **ABSTRACT:** The onset of white-nose syndrome in 2006 has contributed to steady declines in the rangewide population of the federally endangered Indiana bat (*Myotis sodalis*). Understanding maternity habitat selection on national wildlife refuges (NWRs) in Missouri could help reverse declining population trends. Missouri hibernacula account for more than 40% of the rangewide Indiana bat population, and maternity roost selection is critical to the species' recovery because reproductive success hinges on availability of appropriate maternity habitat. Furthermore, public lands are less likely to be converted to another landcover type and more likely to be managed for wildlife. We captured *M. sodalis* and tracked individuals using radio telemetry at Swan Lake NWR during the summers of 2017 and 2018. Roosts with  $\geq 30$  emerging individuals were characterized as primary, whereas those with  $< 30$  individuals were characterized as alternate. We selected three available trees for each used roost and measured identical habitat covariates at used and available trees. Because *M. sodalis* has been shown to select for different characteristics at primary and alternate roosts, we analyzed the two roost categories independently using conditional discrete choice models to compare habitat characteristics at used and available trees. Preliminary results indicate that *M. sodalis* at Swan Lake NWR selected primary roost sites with low canopy coverage and taller trees of moderate DBH while selecting alternate roost sites with high snag density. These findings can inform habitat management efforts to preserve and restore summer maternity habitat for *M. sodalis* on public lands in northern Missouri.

34) *Implementation of a Silver Carp (*Hypophthalmichthys molitrix*) Demographics Protocol in a Large River System.* Edward Sterling, Jeremy Hammen, Jahn Kallis, Emily Pherigo, and Jason Goeckler **ABSTRACT:** Silver Carp (*Hypophthalmichthys molitrix*) are an invasive fish that was introduced to the greater Mississippi and Missouri River basins in the 1970's. Silver Carp pose an ecological threat to native fish species and an economic threat to the recreation industries of Midwestern waterways. Therefore, management actions are being employed to control this species and mitigate potential impacts. Assessing progress in achieving management goals (e.g. prevention, containment, and eradication) requires data-informed decision making processes. Standardized monitoring programs can provide the necessary metrics to evaluate such management strategies. Historically, standardized sampling of Silver Carp has been difficult with common fisheries techniques. Therefore, novel gears were developed, tested, and utilized to effectively capture a broad size range of Silver Carp. In 2018, a standardized Silver Carp demographics protocol was initiated with the electrified dozer trawl on five pools of the Illinois River to assess population characteristics. Each study pool was sampled with 50, five minute trawl-transects stratified randomly by habitat (i.e. backwater, main-channel, side-channel). This design was replicated for each pool in spring and fall in order to determine year class strength, quantify recruitment, and estimate growth of small fish. Overall, 2,804 Silver Carp measuring 40 to 850mm were captured. Demographic information was collected from each Silver Carp captured in order to obtain reliable estimates of each pool's population. Overall, latitudinal trends were observed with regard to relative abundances, catch-rates, size-structure and condition of each pool. Continuation of this study over time will help scientists and managers evaluate the effectiveness of previous management efforts and inform future Silver Carp management. Expanding a standardized sampling strategy such as this in the greater Mississippi River basin, including the Missouri River basin, will inform a national approach to the management and control of Asian Carp.

35) *Progress toward a Predictive Egg Quality and Spawning Potential Index in Paddlefish.* Ben Thomas, Dr. Scott Lankford **ABSTRACT:** In the past, Blind Pony Fish Hatchery (BPH), operated by the Missouri Department of Conservation (MDC) has experienced inconsistent ovulation, fertility, and development rates in female paddlefish. Even if

ovulation occurs, some paddlefish eggs stop developing prematurely; at times only half of the paddlefish spawned have resulted in usable fry. This inconsistency decreases the effective management of the put-grow-take paddlefish fishery, as well as drives up MDC's production costs. This project aims to develop a paddlefish broodstock ranking index for both egg quality and spawning readiness. The goal is to improve MDC's efficiency in selecting fish that will spawn in response to the hormonal injection and produce high-quality progeny that are more likely to survive the rearing process.

Due to the limited knowledge, available on paddlefish reproduction there are sparse techniques and spawning protocols available, and even fewer molecular assays. Because of this, the creation of a broodstock ranking index of about 20 female fishes a year requires the development and optimization of the required scientific end points. The specific end points to be evaluated include spawning readiness indicators (i.e., egg polarity index [PI] and an egg bioassay) and egg/progeny quality indicators (i.e., plasma estradiol, testosterone, and cortisol concentrations). The data presented were developed from tissues collected during the spawning of the 2015, 2016, 2017, and 2018 year classes and include the optimization data required to validate the following endpoints: PI, egg bioassay, and the hormone concentrations of estradiol, testosterone, and cortisol.

36) *Assessment of niche partitioning in two urban mesocarnivores.* Mariah Whitmire, Tara Domzalski, and Daniel M. Wolcott **ABSTRACT:** According to the competitive exclusion principle, species that compete for the same limiting resource should not be able to coexist. For species with significant niche overlap (e.g., mesocarnivores like the Raccoon and Virginia Opossum), it is assumed that the niches are partitioned temporally or spatially. Previous studies have demonstrated that these two syntopic species partition niches temporally; however, these findings could be overestimated due to sampling methodology (i.e., time-stamped single-capture trapping). With the advent of new technologies (i.e. camera traps), we reevaluated this hypothesis at a University of Central Missouri-owned green space located in Warrensburg, Missouri. From January to April 2018, camera traps were placed throughout the study area and baited with a mix of corn and dry dog food (assumed limiting factor). Entry times into camera field of vision were recorded for both species, and temporal overlap was assessed using directional statistics. Initial findings demonstrate that niches are partitioned neither temporally nor spatially, with significant overlap in entry times and cameras capturing both species in single images. Results are discussed in light of possible behavioral modifications utilized within this heavily urbanized location.

37) *A Low Water Crossing Impacts Northern Hog Sucker (*Hypentelium nigricans*) Movement in an Ozark Stream.* Jeff M. Williams, Hope R. Dodd, Debra S. Finn **ABSTRACT:** Streams are complex, dynamic systems that rely on connectivity to maintain natural function. Low-water crossings are common within headwater streams and have been seen to restrict the longitudinal movement of fishes when compared to natural reaches. It is ecologically important to continue evaluating the effects of these barriers on the movement behavior of different fish species. Missouri's Current River contains a single low-water crossing spanning both the main channel and a side channel, potentially disrupting longitudinal movement of fishes. In July 2017, we tagged Northern hog sucker (radio tags, N=50) above/below the crossing and followed their movements monthly to determine potential impacts of the crossing on the movement behavior of this large, strong swimming species in relation to fish passage and maximum displacement. Eleven months of movement data shows that fish passage is limited (N=4). Passage occurred in both the upstream/downstream direction and followed periods of high flow and tagging events. Suckers below the crossing exhibited nearly eight times greater mean movement and maximum displacement than fish above the crossing. On average, suckers moved away from the crossing with below fish making larger downstream directed movements (1650m) than upstream (368m) and above fish making larger upstream directed movements (217m) than downstream (34m). The results of this study suggest that the Cedar Grove low-water crossing impacts Northern hog sucker movement by limiting passage during low flow conditions and influencing the direction of maximum displacement among mobile individuals.

38) *Quantifying relationships between watershed characteristics and hydroecological indices of Missouri streams.* Sean J. Zeiger, Jason A. Hubbart **ABSTRACT:** There is an ongoing need for multidisciplinary investigations that will lead to policy changes that target and reduce natural and anthropic alterations to hydroecological indices important for regional environmental flows management. Watershed characteristics (i.e. topography, land use and land cover (LULC), soils, and geomorphic variables) and hydroecological data were assessed for general trends between ecoregions at gauged watersheds (n = 115) in Missouri, USA. Univariate ordinary least squares (OLS) and multivariate least absolute shrinkage and selection operator (LASSO) regression models were fit to selected hydroecological indices, and models were validated using a split-site approach. Key results included: 1) significant differences ( $p \leq 0.05$ ) were observed between hydroecological indices of different ecoregions, particularly low flows statistics; 2) urban land use was associated with moderate ( $0.25 < R^2 \text{ adj.} < 0.75$ ) to strong ( $R^2 \text{ adj.} \geq 0.75$ ) influence on more hydroecological indices (31 of 171 indices) compared to other LULC indices and watershed characteristics assessed, especially urban land use - high flow frequency relationships (5 of 11 indices;  $0.77 \leq R^2 \text{ adj.} \leq 0.85$ ); and 3) univariate ordinary least squares (OLS) regression models performed better overall relative to least absolute shrinkage and selection operator (LASSO) regression models at validation sites. Results indicate that management efforts should focus on reducing high flow frequency in urban areas to reduce impacts on hydrogeomorphology, physical habitat and

water quality of urban streams in Missouri, USA. These results hold important implications for other regions globally, where urban land use has altered high flow frequency.