

**MNRC 2022 – Posters**

Presenter/Contact	E-mail	Authors	Institution	Title	Abstract
Akeem Ajao	ajao11@missouristate.edu	Akeem Ajao and D. Alexander Wait	Missouri State University	Sassafras Sapling Dominance as a Result of Prescribed Fire in an Oak Woodland	Oak woodlands extend over a large range of the central U.S. However, there is evidence that oak dominance is unsustainable under current management regimes and climate change. Even more concerning, there are very little data to assess regeneration of oak species in Southwest Missouri Ozark woodlands. We assessed sapling density and height of oak and sassafras (<1.0 m) over a twenty year period at the Bull Shoals Field Station located in the 1200 ha Drury Conservation Area (Taney County, Missouri). 50% of the conservation area was classified as degraded oak woodland (cover>80%). Prescribed fire has been used to manage some woodlands for 22 years (cover now<80%). Oak sapling stem densities have ranged between 230-340/0.1 ha across all woodlands. However, starting around 2014, sassafras saplings started to increase in the woodlands where burning was initiated 22 years ago, while it was, and still is, rare in the unburned woodlands. As of fall 2021, after a spring burn, sassafras density is 560/0.1ha while oak is 171/0.1 ha. Sassafras mean height is 25cm, leaf water content is 64% and specific leaf weight is 23 m <sup>2</sup> /kg. Oak mean height is 10cm, leaf water content is 47% and specific leaf weight is 14 m <sup>2</sup> /kg. Our data indicate that sassafras is becoming the dominate sapling species in a “degraded” woodland where fire alone is being used to restore the woodland. The effects on ecosystem services may be significant given the differences in water use and growth rates of oaks and sassafras saplings.
Teri Arceneaux	tfa88s@missouristate.edu	Teri Arceneaux	Missouri State University	Downstream trends of metals concentrations in different size fractions of contaminated channel sediments in Turkey Creek, Tri-State Zn-Pb District, SW Missouri and Kansas	The Tri-State Mining District spanned portions of Missouri, Kansas, and Oklahoma, and was a global producer of Zinc (Zn) from 1870-1950. Mining within this region resulted in tailings piles consisting of coarser “chat” grains (typically 0.5-8 mm), as well as finer particles (<0.3 mm) which were dispersed into land areas and streams. Although over 70 years have passed since final mine closures, metal contamination at levels of environmental concern still occurs within channel sediments. This study focuses on quantifying spatial patterns of metal contamination in channel sediments for three different size fractions (<0.25 mm, 1-2 mm, and 4-8 mm) within Turkey Creek (30 km long), located in Missouri and Kansas. The objectives of this study are to identify controls on the dispersal of tailings and metals within the stream, evaluate how mining tailings compare to particles found naturally in the Turkey Creek region, and assess spatial relationships between contaminated river segments and past mining operations. Eighty-nine sediment samples were collected September 21-22, 2021, which will be analyzed for Zn and Lead (Pb) using X-Ray Fluorescence (XRF) for fine fractions, with tailings grain counts to be completed for coarser fractions. Additionally, other geochemical influences on metals contamination will be evaluated through correlations with organic matter, iron (Fe), and calcium (Ca) contents. Contamination of finer-grained sediments is expected to occur further downstream from mining sources as compared to coarse tailings. However, coarser tailings particles may be a more consistent indicator of specific mine source contamination as their downstream mobility is limited.

Tyler Bennett and Hunter Weidenborner	tyler.bennett@siu.edu	Tyler Bennett, Hunter Weidenborner, Hadley Boehm, Craig Paukert	Southern Illinois University	Determining Hybridization of Age 1-2 Striped Bass Using a Body Depth to Total Length Ratio	Past research has shown that a body depth:total length ratio (D:TL) of approximately 1:3 can be used to distinguish between adult Striped Bass and adult Striped Bass x White Bass hybrids. However, no quantitative analysis has been conducted to determine whether the same holds true for juveniles. Therefore, our objectives were to 1) determine if a D:TL ratio can be used to distinguish between juvenile Striped Bass and hybrids, and 2) whether a 1:3 ratio accurately predicts hybridization in age 1-2 (206-369 mm) fish. Individuals (n = 25) from each of two year classes (2019, 2020) were randomly sampled from a hatchery tank containing a mix of Striped Bass and hybrids. Total length (mm) and body depth (mm) were measured, and fin clips were collected from each individual. Fin clips were sent to a genetics lab where RAD sequencing was used to definitively determine hybridization status for each individual. The mean D:TL of individuals genetically identified as Striped Bass (mean = 0.205) did not differ from those identified as Hybrid Bass (mean = 0.255) for both year classes (P < 0.05). We found that a D:TL of approximately 1:4 could be used to correctly identify fish 90% of the time (hybrid D:TL > 0.24, Striped Bass D:TL < 0.24). Our results suggest a D:TL ratio is still an effective method for determining hybridization in smaller fish, though a D:TL closer to 1:4 may be more appropriate for distinguishing between Striped Bass and hybrids at smaller sizes.
Leah Berkman	leah.berkman@mdc.mo.gov	Leah K. Berkman, Jessica A. Brooks, and David Duvernell	Missouri Department of Conservation	An assessment of SECR methods for estimating swamp rabbit abundance	Genetic analyses of non-invasive samples, such as hair or fecal material, provide a convenient way to identify individuals without the need for capture and tagging. With the ability to distinguish individuals and document their presence in space and time, spatially explicit capture-recapture (SECR) models can estimate abundance. This strategy has shown promise for the federally endangered New England cottontail ( <i>Sylvilagus transitionalis</i> ) but it has not yet been applied to swamp rabbits ( <i>S. aquaticus</i> ), a species of conservation concern in many states. Their wetter and warmer habitat accelerate DNA degradation, and potential differences in habitat use (e.g., wider ranging, more conspicuous latrines) can change the sampling coverage and intensity required for a credible SECR estimate. Thus, an assessment of these techniques for swamp rabbits is necessary before applying them on a larger scale. We screened a new suite of highly polymorphic microsatellite markers and assessed genotyping performance to optimize genetic identification of swamp rabbits from fecal pellet samples. We then estimated the sampling intensity required for a robust estimate of abundance from a SECR model. With this assessment, we provide recommendations for improvement and conditions under which this method may be used for the estimation of swamp rabbit abundance.
Indi Braden	isbraden@semo.edu	Indi Braden and Michael Aide	Southeast Missouri State University	Experiential Learning in Soil Health and Conservation Practices at Southeast Missouri State University	Soil health and conservation practices have become an important aspect to agricultural production. Riparian management zones provide plant cover, wildlife habitat, soil conservation, and streambank stability along water sources. A riparian management zone was established along Williams Creek at the David M. Barton Agriculture Research Center, in Gordonville, MO. The four-acre riparian zone consisted of native trees and shrubs and a vegetative filter strip of native grasses and forbs. The riparian zone was evaluated to determine species survival. Of the five tree species and four shrub species that were planted, all tree species and three of the shrub species were present. In addition, to the flora of the riparian area, diversity of fauna that were observed indicated potential improvements to wildlife habitat. In addition to the riparian zone, a bioreactor was established to filter any water flow from the sub-surface irrigation system to reduce

					nutrient loads flowing off farm. Long-term assessment of the area will be needed to provide researchers and producers more information.
Jessica Brooks	jessica.brooks2@mdc.mo.gov	Jessica Brooks, Dave Duvernell, and Leah Berkman	Missouri Department of Conservation	Divergence Between Wild <i>Notropis topeka</i> and Hatchery-raised Descendants	The topeka shiner ( <i>Notropis topeka</i> ) is a species of minnow that was placed on the endangered species list due to habitat destruction and sedimentation. Diminishing numbers shrank their range until only two refugial populations remained in Missouri, one in Moniteau Creek (Cooper County) and one in Sugar Creek (Daviess and Harrison County). Fish were taken from both locations to form hatchery stocks for use in founding and maintaining new populations of topeka shiner throughout Missouri. We used eight microsatellite markers to explore the divergence between the two source populations (Moniteau and Sugar) and any divergence or loss of diversity between the wild Sugar Creek population and their hatchery-raised descendants. Wild samples from each drainage were shown to be significantly divergent from each other through principal component analysis, STRUCTURE analysis, and $F_{st}$ . There did not appear to be a significant loss of diversity between the wild Sugar Creek samples and samples from the hatchery.
Octavia Buschhaus	S535333@nwmissouri.edu	O. R. Buschhaus and J. D. McGhee	Northwest Missouri State University	Estimating Survival and Detection Parameters for an American Bullfrog Population in Northwest Missouri	The estimation of survival rates and the assessment of the probability of capture of adult bullfrogs aids in understanding species population dynamics. In this study, we obtained estimates of the weekly survival rates of American Bullfrogs ( <i>Lithobates catesbeianus</i> ) using capture-mark-recapture (CMR) methods on a population in a single pond under field conditions in Northwest Missouri. We performed an analytical study on the survival rate of a local <i>L. catesbeianus</i> population using a live capture Cormack-Jolly-Seber (CJS) model in the MARK software. We compared five models regarding detection rate ( $p$ ) and survival ( $\phi$ ) using AIC. The two best performing models selected assumed constant weekly survival and a constant detection probability. We conclude this result is largely a function of low capture rates and that further studies should aim to capture and mark a larger proportion of population to better assess these population parameters.

Cary D. Chevalier	cchev@missouriwestern.edu	Cary D. Chevalier	Missouri Western State University	The MWSU Student Chapter of The Wildlife Society: An Example of Student Organizations as Professional Development Vehicles for Applied Learning Experiences.	Every college/university has some student organizations, each addressing an area of interest to some students. A constant challenge of any student organization is attracting and retaining active members. Undergraduates have lots to do in the 4 short years they have, on average, to become competitive for the coming job market or graduate school. Student Chapters of The Wildlife Society are no exception. I herein offer some suggestions as to what sets an excellent Student Chapter apart from others. Student Chapters must have a clear mission and relevant goals. These must be known and understood by all student members, and their faculty advisor(s). The Student Chapter must have an involved faculty advisor whose work unit understands and supports his/her efforts. There must be demonstrable "context" to the students' professional development. Students must be empowered and encouraged, but guided, to develop and lead their organization. The Student Chapter should address what I call the "Trilogy Success": Leadership of development, Skill development, and Professional development. The Student Chapter must be integrated into the degree program culture. I suggest it be considered as a "Capstone Applied Learning Experience" that begins when the students join, and continues until graduation. The Student Chapter should have demonstrable context relating to the students' degree requirements, and reinforce and extend experiences begun in the course environment (lecture and/or lab). The strategic purpose of a Student Chapter should be to provide Applied Learning through the Trilogy of Success mentioned above outside the traditional classroom format.
Cary D. Chevalier	cchev@missouriwestern.edu	Cary D. Chevalier, Jeremy Reynolds, Jason Kusilek, and Anthony Rademann	Missouri Western State University	Urban Wildlife Management success: Eight years of Canada goose ( <i>Branta Canadensis</i> ) population management on Missouri Western State University campus.	In 2014 we began a Canada goose ( <i>Branta canadensis</i> ) population monitoring and management project on the campus of Missouri Western State University. The restoration of Canada Goose in NW Missouri has not only been successful over the years, but in some areas, like on our campus, goose populations were reaching levels where they were becoming nuisances. Geese were increasingly nesting near buildings. Nesting geese would often harass people walking by, and defecate with increased frequency near building entrances and on sidewalks, thereby creating potential health hazards as well as general messes. Our objectives were to 1) determine the extent of nesting activity; 2) map the distribution of nesting sites on campus; and 3) institute a population recruitment control program to help keep our goose population at a level where they would be considered treasures rather than nuisances. During the spring nesting season, we surveyed the entire ~ 600 acre campus. We used mapping GPS and GIS to map nest locations and monitor nest site activity. We counted and oiled all known eggs with corn oil and/or spiked eggs, then documented hatching success. In 2014 – 2021 we recorded the locations of 10, 12, 12, 16, 14, 16, 17, and 7 nests, respectively. After treatment, broods observed were 5, 2, 0, 0, 1, 0, 0, and 0 for years 2014 - 2021, respectively. The goose reproductive success on campus for these six years was reduced by 50% our second year of effort, then by 100% thereafter for known nests.

Skylar Ciccolini	sjcf9r@mail.missouri.edu	Skylar Ciccolini, Alejandro Chavez Trevino, Michael Byrne	University of Missouri	Movement Patterns, Home Range Size, and Habitat Selection of the Prairie Kingsnake ( <i>Lampropeltis calligaster</i> )	Snakes are important predators of rodents, birds, and amphibians in tallgrass prairie ecosystems. The effects of prairie management actions, such as prescribed burning and grazing, on snake species are poorly understood. Prairie kingsnakes ( <i>Lampropeltis calligaster</i> ) are species of early successional habitats, making them a good model species of the effects of management actions on prairie snake. Additionally, despite their widespread distribution, scientific literature contains startlingly little insight into the spatial ecology of prairie kingsnakes. Few studies have investigated home range sizes or evaluated the movement patterns of this snake and even less information is available concerning this species in the state of Missouri. The purpose of this study was to determine the home range size, movement patterns, and habitat preference of prairie kingsnakes at Prairie Fork Conservation Area, a restored prairie habitat in Missouri. Through the use of coverboards, we captured snakes from April-July, surgically implanted them with VHF radio transmitters, and tracked them using radio telemetry from spring into early winter. We tracked nine snakes (four females, five males) during April-November, 2018-2021. We will present results of home range size and habitat selection analyses, but preliminary results from kernel density analyses indicate a mean home range size of 11.58 ha (SD=5.23 ha) and a mean core area size of 2.58 ha (SD=1.49 ha). The data gathered in this study begins to bridge the gaps in the literature and could promote new research questions concerning the ecology of this species.
Jackson Clubb and Benton L. Winfrey	jacksonclubb@mail.missouri.edu	Jackson Clubb, Benton L. Winfrey, Lauren Pile Knapp, Ben Knapp, John Kabrick, Dan Dey, Todd Hutchinson, Debbie Page-Dumroese, Susannah Lerman, Dave King, Aliza Fassler, Will Rumph, Cheryl Coon, Lennie Pitcher, Brian Davidson, and Kyle Steele	University of Missouri	Impacts of seeding and soil treatments on log landing pollinator habitat	Thanks to scientific research, we know today that some species of plants are better suited as wildlife habitat than others. Given the significance of wild bees and other pollinators to our natural and agricultural ecosystems, it's important for us to understand how we can improve the diversity, richness, and abundance of the native plants they require. Log landings specifically can be left somewhat barren and compacted after a harvest, and any re-establishment of native vegetation tends to be suppressed by invasive plant species. Applying restoration techniques could increase native plant species abundance, diversity and richness, thus improving pollinator habitat on these landings. The Pollinator Habitat in Log Landings (PHILL) project was designed to enhance these habitats for pollinators across the Hoosier, Shawnee, and Mark Twain National Forests of Indiana, Illinois, and Missouri. Three soil treatments and a control were applied across five landings in each National Forest to improve soil conditions, along with the seeding of a range of competitive, pollinator-friendly native plants. Study treatments included biochar amendment to the soil, soil ripping to reduce compaction, a combination of ripping and biochar, and a control treatment. Each treatment was split into subplots to be seeded and left unseeded. Here we will present preliminary results of treatment effects on plant diversity, richness, and abundance within the first year of this ongoing study. Results will influence management efforts of foresters, landowners, agriculturalists, and those working to improve pollinator habitat restoration.

Shelly Colatskie	Shelly.Colatskie@mdc.mo.gov	Samantha M. Matchefts, Linda C. Tossing, and Shelly N. Colatskie	Missouri Department of Conservation	Population Study of Migrants at World Bird Sanctuary	<p>The World Bird Sanctuary began a spring migration study in 2009 on approximately 40 acres of the 310 acres at the World Bird Sanctuary in St. Louis County, Missouri. The study area is an undeveloped area of the sanctuary facing north-east that consists of an oak and hickory dominated forest with a dry creek ravine. The site is located adjacent to the Meramec River Valley and is part of the Meramec Valley Important Bird Area. Twenty-five single high mist nets, and two triple high canopy nets were placed throughout the study area. Nets were opened daily from approximately April 15th to May 15th, from sunrise and closed after a minimum of four hours. All captured birds are removed from nets, identified, sexed, aged, banded, and released. During 2009, we captured 205 birds of 29 species, compared to 2021, we captured 1,072 birds of 65 species, which was our highest year to date. Due to the Covid-19 pandemic and restrictions within St. Louis County, 2020 was not part of the study. In 2021, our top 10 species were: Tennessee warbler, Swainson's thrush, Nashville warbler, gray-cheeked thrush, ovenbird, red-eyed vireo, tufted titmouse, northern cardinal, indigo bunting, and white-throated sparrow. In the last 12 years, we have banded 6,538 birds of 88 species and recover our bands locally. During the 2021 session, we recovered a summer tanager that we initially banded in 2013. We are excited to continue to monitor this site during spring migration to see how bird populations continue to use this site.</p>
Hannah Eades	Eades97@live.missouristate.edu	Hannah Eades	Missouri State University	Mining Contamination and Legacy Floodplain Sedimentation in Turkey Creek, Tri-State Mining District, Southwest Missouri	<p>Historic mining activities often leave a legacy of metal contamination in channel sediments and floodplain soils that can degrade water quality long after mine closure. The Tri-State Mining District (1870-1950) was a global producer of zinc (Zn) and lead (Pb) in Missouri, Kansas and Oklahoma. Several studies have assessed metal contamination risk in active channel sediments. However, none have evaluated the role of floodplain deposits as storages and long-term sources of metal pollution. This study evaluates the vertical and downstream trends in Zn and Pb contamination in floodplain deposits along Turkey Creek (30 km long) which drains heavily mined areas in Missouri. Landform characteristics, deposit stratigraphy, and mining/land-use trends will be used to assess dispersal and storage patterns of legacy sediment and metals at the watershed-scale. Channel and floodplain surveys were completed at 11 sites at each site 2-3 overbank profiles sampled in 10 and 20 cm intervals then analyzed for Zn and Pb, sand, and organic content. Spikes in metal profiles are expected to occur during the heaviest mining periods with depths and thicknesses of contaminated deposits increasing downstream. Floodplain sedimentation rates were likely highest along Turkey Creek during periods with highest soil erosion rates and ore production.</p>

Elande' Engelbrecht	ee48s@MissouriState.edu	Elande' Engelbrecht	Missouri State University	Long-Term Impact of Historical Logging on Forest Watershed Hydrology in the Missouri Ozarks	<p>Big Barren Creek watershed (191 km<sup>2</sup>) drains the Mark Twain National Forest in the Ozark Highlands of southeastern Missouri. This area experienced exploitative logging between 1880 and 1920 that reduced the distribution of shortleaf pine within the region by 90% to an oak- dominated forest today. Natural stream channels are typically multi-threaded, relatively wide and shallow, gravel/cobble size bed material, and mature trees often growing along the bed. However, in some stream reaches the channel has apparently reached a geomorphic threshold and has transformed to a deeper, single-threaded channel system. Modern channel widths are on average 2.6 times larger than what was reported in General Land Office (GLO) records from 1821. To better understand the hydrology of the watershed a stream gage monitoring study was initiated in 2015. Results suggest significant runoff events are generally isolated to the late winter and early spring prior to full leaf-on conditions and that water yields are relatively lower in watersheds with higher percentage of shortleaf pine. To further understand the impact of tree species on watershed response a hydrology model was developed to simulate a near bankfull flood event during the early spring. Results show that runoff depth is 17-37% higher today and peak discharge is 7-25% higher for the same rainfall with increasing pine cover. This suggests the conversion of pine- to oak- dominated forest may have initiated a long-term geomorphic response in these small headwater streams that is being exacerbated by recent increase in rainfall intensity due to global climate change.</p>
Hope Fillingim	<a href="mailto:hfp82@mail.missouri.edu">hfp82@mail.missouri.edu</a>	Hope Fillingim, Benjamin Knapp	University of Missouri	Effects of fire season and heat exposure on shortleaf pine seed germination	<p>There is interest in Missouri in restoring and managing shortleaf pine ecosystems. Prescribed fire is a tool often used in shortleaf pine management. Burning can improve natural regeneration by removing litter and increasing seed contact with mineral soil. Prescribed fires are commonly conducted after seedfall, however, raising questions about the role of season of burn in shortleaf pine regeneration success. This study examines shortleaf pine seed germination in relation to fire season and heat exposure in both a field and lab setting. For the field component, four shortleaf stands were divided into four plots and assigned one of four burn season treatments: unburned control, fall burn, early spring burn, and late spring burn. Plots were seeded with 74,100 seeds per hectare in November 2020, following fall burns. Three parallel transects per plot were sampled for germinants in May 2021 following burn treatments. The fall burn treatment had a significantly greater number of germinants than the control, and the late spring burn had significantly fewer than the control. The lab component was designed to test shortleaf seed response to exposure to five temperatures at three time durations. Temperature treatments included 60, 80, 120, 200, and 270 °C, for a duration of 1, 5, and 10 minutes, each applied to 90 seeds before greenhouse germination trials. Temperatures greater than 80 °C prevented germination. Together, these results indicate that prescribed burning is an effective site preparation to improve shortleaf pine germination, but heat from fire can reduce germination if burning occurs after seedfall.</p>

Jordan Galliher	EivaziF@lincolnu.edu	Jordan Galliher, William Doggett, Frieda Eivazi	Lincoln University of Missouri	Struvite as a Potential Slow Release Phosphorus Source for Sustainable Agriculture	Phosphorus (P) resources in nature are limited and its availability is usually affected by adsorption and fixation in soil. In fact, obtaining sufficient P for organic and conventionally grown crops is a global challenge for the 21st century. As predicted by the agronomists, the supply of P will limit increases in agricultural production in forthcoming decades specifically under organic production. Struvite (MgNH <sub>4</sub> PO <sub>4</sub> , 6 H <sub>2</sub> O) is a water-soluble phosphorus mineral that can be synthesized from diverse phosphorus-rich waste streams. Struvite has potential to be used as a slow release ammonium phosphate fertilizer, especially when blended with highly water-soluble phosphorus fertilizers such as monoammonium phosphate. Because struvite is a slow-release multi-nutrient fertilizer, crops can more efficiently use released P, therefore it meets nutritional demands of crops in a better way. Struvite can limit the soil phosphorus losses that typically occur under treatment with fast-release synthetic fertilizers. Pot experiment was conducted to test and compare the effect of different phosphorus fertilizers (di-ammonium phosphate (DAP), triple super phosphate (TSP) and struvite (STR) on corn growth and phosphorus uptake. Two soils used for pot experiment were silty clay with one soil treated with manure in a long-term experimental study and the other soil with zero fertility received. Corn plants were grown in the greenhouse for the period of six weeks. Fresh biomass and dry weight of corn was recorded and plant samples were prepared for total and available P analysis. Results will be discussed.
Kelsey Gillenwater	kgillenwater@missouriwestern.edu	Kelsey Gillenwater, Brandon Johnson	Missouri Western State University	Applied Learning through professional internships: Natural History Biologist internship in Outreach & Education with Missouri Department of Conservation. Our experience teaching fishing clinics to the public.	In May of 2021 we begin our internship under TJ Peacher with the Missouri Department of Conservation as Community Education Assistants (CEA) with the Discovery Nature Fishing Program. We covered all Northwest counties. . The main goal of our job as a Community Education Assistant (CEA), was outreach and education. We taught four lessons known as the Discovery Nature Fishing (DNF) Program. Lesson One: Equipment, Casting, and Proper Fish Handling; Lesson Two: How to Tie a Knot and Bait a Hook; Lesson Three: Five Common Missouri Fish-Their Anatomy, Habitat, and Life Cycle; Lesson Four: Fishing with Lures and Fishing Regulations. During lessons we created hands-on activities such as rigging their own line, tying knots, and getting to see and handle the equipment before fishing. Over the course of our internship we developed our professional skills. We learned how to work with the public, manage time by creating schedules, learning to change our objectives based on our audience. Duties that were required were to maintain fishing equipment, participate in recruiting community volunteers, drive department vehicles/equipment, and to use our community outreach to educate the public about fishing, and allow them the chance to fish. Outside of fishing we were also given the ability to work with other outdoor skills education events such as the archery clinic. This internship has given each of us many different career skills to take into future jobs, as well as, teaching us different information in the conservation field.

Carsen Goodman	Goodman199@live.missouristate.edu	Carsen Goodman, Michael Goerndt, William McClain, Melissa Bledsoe, Toby Dogwiler	Missouri State University	Modeling Crown Cover Response in Converted Silvopasture Agroforestry Systems Using Remotely-Sensed Data	The Missouri Ozarks are well known for high production in both timber products and cattle production. Most areas are also not well suited for many other agricultural practices such as row cropping, so forests and grazing lands dominate the landscapes. Such characteristics provide high potential for the agroforestry practice known as silvopasture. This study monitors the establishment of two different types of silvopasture systems, plantation and conversion types. In the plantation silvopasture, two cultivars of black walnut ( <i>Juglans nigra</i> ) were planted, football and kwikrop. The converted stand was monitored over six flights during the 2020 and 2021 growing seasons using an unmanned aerial system (UAS) equipped with a multispectral sensor and RGB camera. The multispectral imaging was used to create canopy height/cover models as well as build models predicting seasonal climate stress variables such as leaf water potential and leaf chlorophyll content of the trees within the converted silvopasture system. This particular part of the project uses our ability to create canopy height models (CHM) from 3-D imaging to develop empirical techniques and statistical models to predict percent canopy closure over time following the initial thinning used in creating the converted silvopasture. This research will be extremely important to researchers and practitioner to predict growth dynamics for both the tree and forage components over time and to schedule follow-up thinning actions when necessary to sustain healthy silvopasture systems.
Katie Grong and Hannah Alkier	grong19@missouristate.edu, alkier98@live.missouristate.edu	Katie Grong, Hannah Alkier, Bob Pavlowsky	Missouri State University	River-floodplain connectivity and riparian management for NPS in Blue River, metropolitan Kansas City, Missouri	Riparian corridors can provide water quality benefits through nonpoint source (NPS) reductions. However, few studies have examined the influence of human activities on channel-floodplain connectivity and riparian buffering capacity. As part of a larger NPS load modeling project, this study will evaluate the effects of land use change and riparian corridor characteristics on NPS loads in the Blue River watershed near Kansas City, Missouri. In addition, the Blue River Channel Modification Project was authorized by Congress under the Flood Control Act of 1970 resulting in the channelization of a 12-mile urban segment including numerous concrete slope stability structures along banks, grade controls, and flood walls. While channelization aims to contain flood events within the channel, it can degrade a healthy riparian vegetation zone and increase the risk of downstream floods. This presentation describes two studies aimed to assess the effects of past and present land use and channel modifications on the role of riparian corridors as NPS filters, buffers, and sources. The first will examine how hydrologically connected floodplain areas along the Blue River have been functioning as sinks and sources for sediment historically as land use has changed. The second study will focus on evaluating the effectiveness of riparian buffers in reducing contemporary NPS loads in the Blue River. These studies will provide information to better understand the NPS buffering capacity of riparian corridors and possible options for NPS management.

Josh Hess	joshhess@missouristate.edu	Josh Hess, Joseph Nash, Robert T. Pavlowsky	Missouri State University	Geomorphic Patterns of Riparian Tree Mortality and Recovery after a 500-Year Flood Event on an Ozark Highlands River	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. However, the effects of flood events on riparian forests in the Ozark Highlands are not well understood. This study assesses the effects of a large flood (> 500-year recurrence interval) during April-May 2017 on riparian forests on the North Fork of the White River, Missouri. Two post-flood (August 2017 and March-August 2021) field surveys were conducted to assess patterns of riparian forest damage, mortality, and recovery. Initial post-flood riparian tree mortality was 43% of 511 trees surveyed. Repeat surveys in 2021 showed mortality increased to 79%. Additionally, patterns in canopy cover and forest damage were examined spatially and temporally through ArcGIS and aerial imagery. Post-flood canopy cover was reduced to 17% of the pre-flood extent, increasing to 37% in 2020. Damage patterns are related to landform with recovery rates increasing downstream from head to tail of a large bar-floodplain complex. This information can be used to understand ecological disturbance by floods and to improve management practices in Mark Twain National Forest.
Abby Huffman	alhykc@umsystem.edu	Abby Huffman, Benjamin Knapp, Daniel Dey	University of Missouri	Light Availability and Deer Herbivory effects on Planted White Oak ( <i>Quercus alba</i> ) Seedlings	Despite its abundance in the overstory, white oak ( <i>Quercus alba</i> ) is underrepresented in the seedling and sapling layers in many forests of central and eastern United States. The failure of white oak to regenerate and recruit into larger size classes has been attributed to many interacting factors, including insufficient light availability and herbivory by deer. The goal of this project is to add to the existing knowledge of silviculture practices that encourage oak regeneration by analyzing the effects that herbivory and light availability have on white oak seedlings. We planted 800 bare-root white oak seedlings across 32 research plots located in upland forests of mid-Missouri. The research plots were divided between two different stands, one with a canopy thinned to a basal area of 70 ft <sup>2</sup> per acre and one with an unthinned canopy (142 ft <sup>2</sup> per acre basal area). Plots were then assigned to one of four additional treatments: an untreated control, midstory removal, deer exclosures, or a combination of both midstory removal and deer exclosure. All midstory trees (DBH ≤ 11.5 cm) were removed in plots assigned to a midstory removal. Deer fences were installed around the planted seedlings in plots assigned to deer exclosures. We report on the effects of the herbivory and light availability treatments on white oak seedling size, mortality, and intensity of browse after one growing season.

Lydia Jefferson	msslajeff@gmail.com	Lydia Jefferson, Alba Argerich	University of Missouri	Evaluation of Processes that Impact Stream Metabolism in Urban Study Sites	The estimation of a stream's metabolism has previously been used as an indicator of its aquatic health. Stream metabolism results from two major processes, primary production and ecosystem respiration. Environmental influences, such as organism diversity, have been shown to affect stream metabolism. In the Southwest Missouri Tri-State Mining District, there are mine adits that continue to discharge heavy-metal contaminated water into nearby streams. One of these mine adits discharges into Lone Elm Creek, in Joplin, Missouri. Heavy metals accumulate in sediments, which negatively impacts the microbes and other aquatic organisms that reside there. Since heavy metals are unable to biodegrade, they bioaccumulate through the aquatic food web. In this study, we investigated the relationships between land use and stream metabolism by analyzing various parameters from two urban streams, one affected by legacy mining (Lone Elm Creek, Joplin) and one not affected (Flat Branch Creek, Columbia, MO). We collected temperature, dissolved oxygen concentration, and dissolved oxygen saturation from both streams using an optical oxygen sensor. Dissolved oxygen concentrations in both streams showed a strong diel pattern, from subsaturation to supersaturation following light availability. Flat Branch was colder and had higher levels of dissolved oxygen than Lone Elm, most likely reflecting differences in riparian canopy cover and general water quality. Sediment column experiments will be conducted to investigate how ecosystem respiration rates are affected by the presence of heavy metals. This study seeks to improve the understanding of how the overall health of these freshwater bodies relates to land use practices.
Kaira L. Kamke	Kaira.Kamke@mdc.mo.gov	Kaira L. Kamke, Samantha L. Holcomb, Brett H. P. Landwer, and William R. Mabee	Missouri Department of Conservation	<i>Faxonius punctimanus</i> (Spothanded Crayfish) (Decapoda: Cambaridae) invasion of a wadeable stream in the Osage River Basin of Missouri	An adult Form I male specimen of the crayfish <i>Faxonius punctimanus</i> (Spothanded Crayfish) was found in Elm Springs Branch tributary to Tavern Creek in the Osage River drainage within the Ozark Highlands in Missouri during 2020. Sampling techniques and taxonomy used in collection and identification of the specimen are provided, and habitat characteristics of the reach where <i>F. punctimanus</i> was found to occur are presented. <i>Faxonius punctimanus</i> is regarded as an invasive species within the Osage River drainage basin in Missouri, and extensive sampling efforts combined with detailed studies of biotic communities, physical habitat, and water quality of sites invaded by <i>F. punctimanus</i> are warranted to assess status of this species regarding effects to freshwater organisms and systems where it is invasive.
Dylan J. Klewer	dklewer@cassville.k12.mo.us	Dylan J. Klewer & Lynda R. Miller	College of the Ozarks	Tardigrade Distribution in Ozark Lichens, Barry & Taney County, Missouri, U.S.A.	Tardigrades remain an under-documented group in Missouri and in the United States. In this study, lichen samples from fallen tree branches were collected in Barry and Taney County, Missouri. We investigated the biodiversity and the distribution of tardigrades with regards to lichen species where they were found. Tardigrades were collected from 61 samples of lichens from Southwest Missouri. Twelve species of lichens were examined from tree bark and independent branches. A total of 178 tardigrades representing 9 species were identified. Tardigrade communities varied with respect to lichen morphology. <i>Teloschistes chrysophthalmus</i> , a fruticose lichen, had a strong correlation with <i>Ramazzottius</i> sp.; a tardigrade species which has a unique arrangement of claws. Our preliminary data suggests that there is an association between tardigrades and lichen substrate morphology. Additionally, this work establishes the first recording of tardigrades in Barry County, Missouri and documents the collection of the tardigrade <i>Barbaria bigranulata</i> ; the first record for the collection of this tardigrade in the state of Missouri and second recording of the species in the United States.

Katrina K. Knott	katrina.knott@mdc.mo.gov	Katrina K. Knott, Michelle Seers, Emma Coleman, James Baker, Jeff Wenzel	Missouri Department of Conservation	A risk assessment of Pb exposure for wild turkeys from the Big River watershed in southeast Missouri: examining the potential health impact for wildlife and consumers	Wild turkeys are a potential receptor for toxic effects from exposure to Pb contaminated soils from the Big River Watershed, and there is concern that elevated Pb in muscle could be a health concern for consumers. Gizzard content (grit), feathers, liver, kidney, and muscle (breast and thigh) were collected from male hunter-harvested turkeys to determine whether tissue concentrations of Pb exceeded adverse health thresholds. Tissue concentrations of Pb from turkeys harvested in SEMO (n=22) were compared to tissue concentrations in turkeys harvested in uncontaminated regions in northeast and central Missouri (reference, n=15). For all tissues, Pb concentrations were greater in turkeys from SEMO than at reference sites. For all tissues, Pb concentrations were greater in turkeys from SEMO than at reference sites. Pb concentrations in bone of 50% of SEMO turkeys exceeded 20 ppm dw (range, 0.6 - 871 ppm dw) suggestive of excessive lead exposure (Franson and Pain 2011). Kidney Pb concentrations (kidney Pb range 0.03 – 4.5 ppm ww) exceeded thresholds for subclinical lead poisoning (>2 ppm ww) in 20% of SEMO turkeys. Concentrations of Pb in muscles were similar between breast and thigh (0.037.6 ± 0.034.7 ppm ww) and below consumption advisory thresholds (< 0.30 ppm ww) for the majority of individuals examined. Elevated Pb concentrations (>0.9 ppm ww) in the breast muscle of 3 turkeys was suspected to be due to use of Pb shot by hunters. Muscle of turkeys harvested adjacent to the Big River are safe to consume, but the consequences of Pb exposure to the health of individuals and the overall population are unknown.
Joseph Kollie	joseph.kollie844@my.lincolnu.edu	Joseph Kollie and Sean J. Zeiger	Lincoln University of Missouri	Monitoring understory microclimate variability in a highly instrumented representative deciduous forest of central Missouri	Understanding understory microclimate variability is important for sustainable forest management. The objective of this study was to monitor understory microclimate variability in a representative deciduous forest located in the University of Missouri Baskett Wildlife Research area, central Missouri. Understory microclimate data were collected using 3 m tripods instrumented to continuously monitor climate variables [photosynthetically active radiation (PAR), rainfall/through fall, wind speed and direction, air temperature, relative humidity, leaf wetness, soil moisture, and soil temperature] at five (5) sites positioned at the terminus of five transects in the footprint of an Ameriflux tower (MOFlux). Additionally, a microclimate station was deployed as a control site where trees were cleared over 20-years before this study. Spatiotemporal trends in understory microclimate variables were quantified and explored graphically highlighting differences in microclimate between landscape positions with different physiographical characteristics across growing season 2021. Results showed significant differences (CI=95%; p-value < 0.05; n = 6) in cumulative rainfall and through fall, soil volumetric water content and soil temperature between sites. Observed 30-min soil temperature was 5.0 °C greater on average, and diel soil temperature range was 4.0 °C greater at the deforested control site compared to understory sites. Differences between cumulative rainfall and through fall ranged from 90 to 210 mm. More subtle, but still potentially ecologically relevant, differences in microclimate variables were observed between understory sites located at different landscape positions. Results from this study point to general trends in microclimate that hold important implications for sustainable forest management efforts in central Missouri.

Konner Larkin	klarkin@missouriwestern.edu	Konner Larkin	Missouri Western State University	Francis Marion and Sumter National Forest Fuels Monitoring With Terrestrial LiDAR	This poster presents information regarding terrestrial LiDAR fuels monitoring at the Francis Marion and Sumter National Forest in South Carolina. This research was part of an 11 week internship through the U.S. Fish & Wildlife Service and the Directorate Fellowship Program. This was an interagency project and the data collected will be used to create models and expand fuels monitoring research. For this project we used terrestrial LiDAR and fuels transects to collect various forest metrics, fuels metrics, and habitat metrics. This research will help land managers create burn plans and be more knowledgeable about the habitat and location they manage. As this project grows it can be expanded to new locations and comparisons between sites can be conducted. This interagency terrestrial LiDAR project has updated old ways of fuels transects while providing valuable metrics for future research into natural resource management.
Veronica Lee	vmlhx5@mst.edu	Veronica Lee, Dave Duvernell	Missouri University of Science and Technology	An Empirical Comparative Assessment of Assay Efficacy for eDNA Metabarcoding of Ozark Fish Communities	Environmental DNA (eDNA) sampling provides a method for assessing fish communities that has potential as a supplement to traditional sampling methods due to its ability to save time as well as its non-invasive nature. The process of metabarcoding utilizes the polymerase chain reaction (PCR) to amplify targeted segments of mitochondrial DNA among organisms of interest. Published studies have included a variety of optimized assays targeting several gene regions for surveying fish taxa. We conducted a survey of four Ozark fish communities using five different published assays in order to evaluate efficacy of each for metabarcoding. Water samples were collected from four different river drainages, the eDNA extracted, and then PCR amplified with the five different mitochondrial gene markers. Three assays targeted segments of the 12s rRNA gene region, one targeted a 16s rRNA gene region, and one a portion of the COI gene region. PCR products were sequenced, and the raw sequence data were processed using the Barque v1.7.3 ( <a href="https://github.com/enormandeu/barque">https://github.com/enormandeu/barque</a> ) metabarcoding analysis pipeline with a curated reference database of available Missouri fish DNA sequences. We conducted an empirical evaluation of the number of species detected by each, overall resolution of closely related taxa, and accuracy of species identification in order to determine which primers were most effective for our studies of Ozark fish communities.
Aaron Loucks	Aaron.Loucks@mdc.mo.gov	Aaron Loucks, Jon Wheeler, Jasmine Batten	Missouri Department of Conservation	MDCs Role in Monitoring Hemorrhagic Disease in Deer	Hemorrhagic disease (HD) is the general term used to describe two different, but related viruses; Epizootic Hemorrhagic Disease virus (EHD) or bluetongue virus (BT). EHD primarily affects white-tailed deer and can cause significant mortality events. Most deer die quickly from the disease and therefore have no obvious clinical signs. Missouri monitors and reports individual HD cases and outbreaks contributing nationally to a larger monitoring effort. Due to the nature of these viruses, the need for a more centralized and widely used reporting and response protocol is needed to effectively track and monitor outbreaks. This effort can get lost as HD moves forward alongside CWD surveillance and management on the same landscape. MDC is working towards improving communicating with partners, landowners, and the public on the continued importance for immediate HD reporting to potentially reduce the impact of these diseases.

Eric Ludwig	ejl8r4@umsystem.edu	Eric Ludwig, Veronica Lee, Dave Duvernell	Missouri University of Science and Technology	Developing a complete mtDNA reference database for Missouri fishes	Environmental DNA (eDNA) metabarcoding is an effective method for assessing fish communities. Environmental DNA is extracted from water samples and polymerase chain reaction is used to amplify targeted DNA segments for high throughput sequencing. DNA sequences are assigned to species by comparison to a reference sequence database. The complete list of fishes in Missouri waters includes 238 recognized species. We have compiled a database of all available mtDNA sequences for fish species found in Missouri using a combination of whole mitogenomes extracted from GenBank along with the results of our own sequencing efforts. In total, the whole mitogenomes of 112 Missouri fish species have been published in GenBank. Our lab has sequenced whole mitogenomes for an additional 41 species. We have generated partial mtDNA sequences for 27 of the species that remain. DNA sequence identification errors are minimized when the reference database that is utilized to identify sequences is sorted to include only species that are present. Our goal is to generate a comprehensive Missouri database that can be parsed by drainage for future eDNA metabarcoding fish community studies.
Kathleen McCoy	Kathleen.McCoy@mdc.mo.gov	Kathleen McCoy, Jon Wheeler, Alicia Burke, Jasmine Batten	Missouri Department of Conservation	Monitoring possible disease outbreaks is critical to protecting the health of wildlife in Missouri	The Missouri Department of Conservation's Wildlife Health Program is charged to assess, monitor, and sustain wildlife health across Missouri. This responsibility is centered around public service, public trust, and public health. As the state's Wildlife Life Health unit we are charged with knowing the health of wild animal populations, tracking changes, and doing what we can to keep wildlife populations healthy, and reduce or prevent risk where possible. The Missouri Department of Conservation is committed to detecting new and emerging wildlife health concerns and preventing and minimizing the impacts of wildlife diseases when possible.
Kylee Nissen	knissen@missouriwestern.edu	Kylee Nissen	Missouri Western State University	Applied Learning through professional internships: Natural History Biologist internship with Missouri Department of Conservation.	This summer I had the pleasure of interning with the Missouri Department of Conservation as the Assistant Natural History Biologist for the Northwest Region. The Northwest Region is responsible for overseeing conservation sites within 19 counties. Surveying the natural communities within these counties was a big part of my job this summer. By seeing what plants and insects are found in a community, biologists are able to have an indication whether management efforts have been successful or if improvements need to be made. Surveying these areas is also important because it is a way to maintain accurate county records for the abundance of certain species. Along with surveying various sites I also gained hands on experience monitoring an endangered species; the Prairie Fringed Orchid. This species is federally listed as Endangered and is only known to be found in three sites around the state. Monitoring this species and being able to see it at every stage in its life cycle this summer was a truly unique experience. Another incredible experience I gained this summer included assisting the St. Louis Zoo in a reintroduction project for the American Burying Beetle. The American Burying Beetle was the first insect to be federally listed as endangered and we continue to see unstable numbers for their populations. Having the opportunity to help in this reintroduction project was unbelievable and I hope it results in a successful stable population. It is impossible to fully express how much I learned through the duration of this internship. It truly was an amazing experience that taught me a variety of skills needed to be successful in this career field.

Bailey O'Brian	Bailey.O'Brian@mdc.mo.gov	B.M. O'Brian, R.J. DiStefano, and M.G. Glon	Missouri Department of Conservation	Evaluation of Pet Trade Regulations for Management of Invasive Crayfish in Midwestern States	<p>The aquatic pet trade is increasing in popularity in Europe and North America, leading to wide-spread transport and introductions of non-native species, including crayfishes, into natural waters. Over 30 crayfish species have invaded North American waters, often changing aquatic ecosystems and impacting native species. The live bait industry has historically been one of the most important pathways for non-native crayfish introductions in the United States; however, increasing numbers of recent crayfish introductions have been linked to the pet trade, and this pathway also requires proper attention from natural resource managers. The Missouri Department of Conservation (MDC) responded to this problem in 2014, implementing regulations restricting the sale of all crayfish species except the Virile Crayfish (<i>Faxonius virilis</i>) by Missouri bait and pet stores. However, MDC has never monitored regulation compliance by pet stores. We designed a survey of all 125 Missouri pet stores in 2019 to determine their level of compliance. Missouri Department of Conservation Agents visited all stores and gathered evidence of crayfish sales by inspecting displayed livestock and interviewing owners/employees. Simultaneously, we conducted a comparative survey of 60 pet stores in Ohio, a state where minimal regulations exist to limit the sale of crayfish in pet stores. Crayfish were sold (illegally) at 11 of 125 (8%) Missouri stores and included 4 non-native species. Thirty-one of 49 (63%) Ohio stores sold crayfish, including 3 non-natives. Results suggest that the Missouri regulation has been effective at managing and possibly reducing pet store sales of potentially invasive crayfish.</p>
Maya Parker-Smith	mjp6g3@umsystem.edu	Maya Parker-Smith and Lauren Sullivan	University of Missouri	Seed Rarity and Granivore Preferences in Restored and Remnant Prairies	<p>In the last 200 years, land-use change and urbanization has led to major habitat loss throughout all ecosystems, but the North-American tallgrass prairie is one of the most imperiled ecosystems in the world. Restored and reconstructed prairies have been increasingly prevalent to combat this issue, but they never seem to replicate their remnant reference site. Though seed mixes used in restorations mimic the diverse species composition of remnant prairies, the resulting restoration lacks the desirable species richness. This study looks at one possible cause of this disparity: post-dispersal seed predation by granivores, specifically small mammals and insects. There are few studies looking at granivore preferences and how their targeted predation could affect the seed availability and recruitment. Therefore, using available literature and lab seed-rain data, we chose species that are common, uncommon, and rare in seeded prairies – all species have been included in seed mixes for the studied prairies. We applied this categorization to three different plant functional groups – grasses, legumes, and other forbs – and two different seasons – summer and fall. Overall, we used eighteen species to examine granivore preferences in a remnant prairie and three restored prairies of different ages. We will analyze their consumption patterns to determine if there is a correlation between granivore dietary preferences and seed rarity within tallgrass prairie ecosystems.</p>

Ashton Parsley	Ashton.parsley@mdc.mo.gov	Ashton Parsley, Jon Wheeler, Jasmine Batten, Alicia Burke	Missouri Department of Conservation	MDC Cooperator Sampling Program	The Missouri Department of Conservation's (MDC) Chronic Wasting Disease (CWD) surveillance program has been one of our strongest tools in monitoring and managing CWD. The Cooperator Sampling program has significantly increased MDC's ability to detect the disease as early as possible in new locations and monitor changes in disease occurrence over time. This program includes relationships with taxidermist and meat processors across the state. MDC highly values these partnerships in CWD sample collection from hunter-harvested deer. Meat processors and taxidermists are helping provide different levels of hunter service for hunters and their families wanting to get their meat tested. MDC wants to highlight the importance of the Cooperator Sampling Program and how participation helps us all in learning how the disease is spreading, making informed management decisions, and keeping the public updated and informed.
H. Jaxson Priest	hjp1016@live.missouristate.edu	H. Jaxson Priest, Debra S. Finn	Missouri State University	The power of pools: macroinvertebrate resilience in an intermittent Ozark stream	Intermittent streams are fascinating systems that lose surface flow for long periods but typically maintain high levels of aquatic macroinvertebrate diversity at the annual scale. Despite being the most common type of stream globally, intermittent streams are understudied, especially in the Ozarks. We studied an intermittent tributary of Bull Creek in Southwest MO to assess community dynamics through time and evaluate traits associated with resistance and resilience to drying. From October 2020 to September 2021, we monitored water level and temperature using Solinst Levelloggers, and we collected macroinvertebrates monthly from four reaches that varied in annual water availability using a combination of quantitative and semi-quantitative methods. In the lab, we identified all individuals to the lowest taxonomic level feasible and assigned biological traits relevant to resistance and resilience. In October, most of the stream was surface-dry, but we found an abundant and diverse community present in small, isolated pools in two of the sample reaches. After flow resumed in November, the community expanded into previously dry reaches and diversity increased throughout winter and spring-, including colonization of stoneflies and caddisflies. Most taxa had traits associated with resilience such as strong adult flight and fast seasonal development, but many taxa present in isolated pools during the dry phase had opposite traits, such as weak flight, long life cycle, and the ability to breathe air. Our results indicate that perennial pools might be crucial for sustaining diversity in intermittent streams and their maintenance should be considered when managing these systems.

Jeremy Reynolds	<a href="mailto:jreynolds4@missouriwestern.edu">jreynolds4@missouriwestern.edu</a>	Jeremy Reynolds	Missouri Western State University	My Internship with the Missouri Department of Agriculture: An applied learning partnership between a natural resource agency and Missouri Western State University.	In 2020 I accepted a paid, temporary, position as an Invasive Pest Surveyor with the Missouri Department of Agriculture (MDA); Plant Industries Division after discovering the position on our University WildCon Listserv. As a surveyor for MDA I was responsible for the placement and periodical monitoring of 56 Lindgren funnel traps in 8 Northwest Missouri counties. For this particular survey the target species was the Walnut twig beetle ( <i>Pityophthorus juglandis</i> ). The tiny beetle has become a concern in Missouri due to it leading to the deaths of a large number of black walnut ( <i>Juglans nigra</i> ) trees in Colorado as a vector for the fungus ( <i>Geosmithia morbida</i> ). The trio of walnut, beetle, and fungus is collectively known as Thousand Cankers Disease. In 2010 populations of Walnut twig beetle were found in Tennessee and natural resource agencies in Missouri took notice. Missouri is home to more than 50 million walnut trees and the timber and nut meat they provide are a valuable economic resource in our state. The lessons and skills I learned included locating appropriate trap site locations, maintaining traps and equipment, keeping accurate records and collecting data. More importantly I found myself working for an organization I had never even considered as a viable career opportunity and making relationships and networking within the MDA. This internship taught me two important lessons. Take advantage of all the professional development opportunities your University has to offer and look outside your comfort zone to gain valuable experiences you may have otherwise missed.
Hannah N. Robinson	<a href="mailto:HNB2000@live.missouristate.edu">HNB2000@live.missouristate.edu</a>	Hannah N. Robinson, H. Jaxon Priest, and Debra S. Finn	Missouri State University	Life-History of a grazing caddisfly in an intermittent stream	Intermittent streams, by definition, are dry during portions of the year. Nonetheless, intermittent streams in the Ozarks contain high levels of diversity in aquatic invertebrates. Among these are grazing caddisflies, which can be important links in aquatic and terrestrial food webs. We hypothesized that a common caddisfly <i>Agapetus illini</i> (Trichoptera: Glossosomatidae) has fast-seasonal development but develops asynchronously across intermittent stream reaches that vary in duration of surface water. We studied two reaches – one that maintained small pools during the dry season and one that dried completely – in Shelton Creek, a small tributary of Bull Creek in the White River Watershed, Southwest Missouri. We quantitatively sampled the benthos for <i>A. illini</i> monthly from October 2020 to June 2021. In the lab, we measured head capsules of all individuals with an ocular micrometer, and we are currently evaluating size distributions through time between the two sample reaches. Preliminary results suggest that <i>A. illini</i> larvae first appear in December, two months following the return of surface flow. By January, both reaches had a range of larval sizes, but larvae from the wetter reach were larger on average, a pattern that suggests developmental asynchrony between reaches. Pupae first appeared in April at both reaches. Because Shelton Creek loses surface flow for several months, <i>A. illini</i> likely uses egg diapause or the hyporheic zone as refuge for early development stages. The abundance and rapid growth of <i>A. illini</i> in an intermittent stream suggests that these small, underappreciated systems contribute substantially to local food webs.

Patrick Saulys	ps9s@missouristate.edu	Patrick Saulys, Robert Pavlowsky	Missouri State University	Recent climate change influence on river flooding and channel erosion on Big River, Missouri Ozarks	Stream channel formation and stability are primarily controlled by the flood regime imposed by climate and land use factors. Recent climate change has led to more intense precipitation events and increased flood magnitude and frequency in the Ozark Highlands. This study will test the hypothesis that recent climate-driven flooding has caused channel widening along 200 km of the Big River (2,500 km <sup>2</sup> ) which drains the Missouri Ozarks. Bank lines and bar areas were digitized from aerial photographs for 2018, 2007, 1990, 1970, 1954 and 1937 and analyzed at 500 m intervals to determine areas of high and low erosion rates. Preliminary results indicate that channel widening has been occurring in Big River since the 1970s in association with increases in moderate (2-yr RI) and more extreme (10-yr RI) floods. At the segment scale, the channel widening rates for Big River ranged from 0.2 to 0.4 m/yr since 1970. Around 65% of the channel length showed widening of >0.1 m/yr since 1990. Subaerial bar area also increased by 50% since the 1970s from about 5,000 m <sup>2</sup> /km in the 1970s to 7,500 m <sup>2</sup> /km in 2018. Preliminary results suggests that recent climate change is causing channel widening, excessive bank erosion, and increased bar activity in Big River. The results of this study can inform future planning and management efforts to reduce the likelihood of flood damage and habitat loss due to climate change effects.
Michelle Seers	mrseers@mail.missouri.edu	Michelle Seers, Jacob Franzak, Katrina Knott	University of Missouri	Pathological changes in the hepatopancreas of Longear Sunfish from the Big River indicate toxic effects due to lead exposure.	Lead (Pb) is implicated in toxic effects including metabolic disturbances, impaired hematopoiesis and anemia in fish and wildlife. We hypothesized that organisms exposed to Pb would exhibit signs of organ cytotoxicity as indicated by increased prevalence of cellular necrosis, inflammatory cells, and melanomacrophages. Longear Sunfish (LSF) were collected from 3 Pb-contaminated sites on the Big River in southeast Missouri MO that has been impacted by historic mining and contain a gradient of elevated in-stream sediment concentrations of Pb (50-1200 mg/kg dry weight). LSF collected from the Castor River (sediment Pb < 20 mg/kg dry weight) were used as reference. Organo-somatic indices (OSI) of the hepatopancreas and pathologies of the hepatopancreas and kidneys were examined. Data were compared among locations and in relation to the concentration of Pb in fillet and blood. OSI of hepatopancreas (0.652 + 0.155 %) of LSF from contaminated sites were lower than the reference site (1.016 + 0.243 %, respectively). LSF from Pb-contaminated sites also had a greater occurrence and severity of histopathological lesions (e.g. necrosis and cell vacuolation) in the liver and kidney. The density of melanomacrophages in the liver of LSF was positively correlated with the concentration of Pb in blood and fillets. These data support our hypothesis that chronic exposure to Pb-contaminated sediment can result in cytotoxic effects in aquatic species. Melanomacrophage density was a reliable histological indicator of toxicity. The sub-lethal effects of Pb in biota should be considered in management and regulatory decisions to preserve sustainable populations.

Sanjeev Sharma	ss4692s@MissouriState.edu	Sanjeev Sharma, Grace K. Hall, and D. Alexander Wait	Missouri State University	Twenty Years of Leaf Production in a Southwest Missouri Oak Woodland: Why is Climate and Phenology Only Correlated with Open Woodlands?	Missouri Ozark woodlands are a unique but imperiled ecosystem type as a result of fragmentation, lack of proper management and a changing climate. Management, conservation, and restoration of Ozark woodlands is a conservation priority. The ecosystem services provided by Ozark woodlands are generally understood/accepted and include carbon and nutrient sequestration via primary productivity. We have assessed over- and mid-story leaf production, collecting leaves in baskets every fall, in a 1,200ha conservation area in SW Missouri since 2000. Fifty percent of the area was considered degraded woodland (cover>85%); ≈20 ha had canopy cover <50% because of burns initiated in 1980 on historically “savannah/glade” habitat; ≈30 ha have not been burned in over 70 years; and ≈550 ha have been burned regularly since 1999 and have about 70% cover. Leaf production is significantly different across the woodlands and between years and ranges from 93-409 g/m <sup>2</sup> /year (decomposition rates vary between 40-140 g/m <sup>2</sup> /year). Variance between woodlands is not significantly different, but variance across years is significantly different. We are attempting to build regression models based on precipitation, temperature, and phenology to predict how climate affects primary production. Yearly precipitation and phenology significantly predict leaf production in the continuously burned open woodlands – and accounts for up to 40% of the variation between years. No other simple linear regression models predict production within and across years. Therefore, we need to develop models that link intra- and interannual variation in management, temperature, precipitation, and phenology to track the effects of climate on productivity in Ozark woodlands.
Jermayne Smith	jsbzy@mail.missouri.edu	Jermayne Smith and Dr. Samniqueka Halsey	University of Missouri	The effects of remnant and restored prairies on small mammal and tick diversity.	Tallgrass prairies are one of the most endangered ecosystems in North America with less than one percent of its original remaining. The restoration of tallgrass prairies is often centered on reestablishing plants, with only minor efforts directed toward the animals that inhabit these areas. Restorations of prairie habitat usually occur on abandoned land that was formerly cropped or fallowed, bringing both opportunities and threats for wildlife species. Small mammals play important ecological roles in many ecosystems, including serving as hosts for tick vectors. We sought to determine the impact prairie restorations have on both the small mammal and tick community by comparing a prairie restoration with a remnant prairie in Calloway County, Missouri. Specifically, we asked how time since restoration impact both species abundance and diversity. At two sites, Prairie Fork Conservation Area and Tucker Prairie, from May - September 2021, we identified and captured small mammals and searched them thoroughly for ticks. We captured a total of 456 mammals representing white-footed mice ( <i>Peromyscus leucopus</i> ), prairie vole ( <i>Microtus ochrogaster</i> ), deer mouse ( <i>Peromyscus maniculatus</i> ), Opossum ( <i>Didelphidae</i> ), and Eastern cottontail ( <i>Sylvilagus floridanus</i> ). We found 83 individual ticks representing 2 tick species, Lonestar ( <i>Amblyomma americanum</i> ), American dog tick ( <i>Dermacentor variabilis</i> ) on 34 mammals. The importance of this research is to understand how management actions aimed at restoring tall-grass prairies can affect the small mammal community and how that influences ticks that are disease vectors in Central Missouri.

Carolyn Stephen	casqf@umsystem.edu	Carolyn Stephen, Dan Drees, Lauren Sullivan	University of Missouri	Effects of prescribed fire over 20 years on the ground flora and stand structure of three Missouri Ozark community types in the Current River Watershed	Historically, fire and climatic conditions primarily drove Ozark woodland and glade community structure. Due to many decades of fire suppression, these communities dramatically changed in their structure and composition. Many studies show that a reintroduction of fire can have restorative effects on ground flora and the midstories in these communities by reducing midstory tree density, allowing for greater light penetration to the ground layer, and reducing leaf litter accumulation. Our study looks at the effects of repeated prescribed fire on ground flora species richness and cover and stand structure over 20 years to investigate these impacts in the Ozark National Scenic Riverways over a longer timeframe and across a heterogeneous landscape of multiple habitat types. We present preliminary findings for this study.
Andrea C. Trigueros	actn2v@umsl.edu	Andrea C. Trigueros and Patricia G. Parker	University of Missouri-St. Louis	Limits on geographic range in non-native sparrows	Introduced species are an opportunity to investigate the evolutionary and ecological processes of range expansions and local adaptation to novel environments. Two closely related sparrows with similar life histories and overlapping native ranges, the Eurasian tree sparrow ( <i>Passer montanus</i> ) and house sparrow ( <i>Passer domesticus</i> ), were introduced in the United States in the mid-1800's. Despite their overlapping native ranges and similar introduction history, the geographic ranges of the introduced <i>Passer</i> species are strikingly different, with the house sparrow being found across the entire country while the Eurasian tree sparrow remains restricted to a few midwestern states. The current study therefore aims to determine why only one <i>Passer</i> species has become so widespread, while <i>P. montanus</i> has maintained a restricted introduced range. In this study, we propose to (I) investigate the role of pathogens in restricting or facilitating geographic expansion; (II) compare genetic divergence and diversity between the introduced <i>P. montanus</i> population in the United States and their ancestral population in Germany; and (III) quantify competition between introduced sparrows by measuring niche overlap. Understanding the evolutionary and ecological processes underlying the limits of geographic ranges can inform us on invasion success and may have broader applications that extend to all species whose ranges are shifting and adapting to a rapidly changing world.
Jacob VanVickle	jvanvickle2@missouriwestern.edu	Jacob VanVickle	Missouri Western State University	Applied Learning Partnership between Clay County Parks and Recreation and Missouri Western State University: My Applied Learning Internship.	I worked for Clay County Parks and Recreation summer of 2021. I participated in helping maintain the park's ability to host visitors for camping, hiking, swimming, fishing, and picnicking. My duties were predominately with the park maintenance group where I learned how a state park functioned and how it is maintained. I visited with park visitors, as well as experienced all aspects of maintaining a top notch county park. For example, I did landscaping, invasive species eradication as well as the mundane but essential tasks of making sure bathroom facilities were clean and sanitized. I interacted with visitors to help make sure their campsite was cared for and that they were informed of various programs available to them during their stay. I answered questions about the park and its natural resources. My internship with Clay County Parks and Recreation was a very useful and rewarding experience. I gained valuable experience learning how a county park functions and is maintained, and I experienced valuable networking with other professionals and leaned many new skills.

Emily N. Wilkinson	Enw2015@live.missouristate.edu	Emily N. Wilkinson and D. Alexander Wait	Missouri State University	Spring Ephemeral Forb Species Richness and Similarity is Not Increasing in a Previously Degraded Missouri Oak Woodland After 21 Years of Prescribed Burns	The spring ephemeral guild is a potentially important component of Ozark woodlands. Spring ephemerals provide nectar and pollen to pollinators early in their above ground season when few other plants are in bloom, and they function as a "vernal dam" by temporarily sequestering nutrients and preventing leaching from forest systems during a period of high nutrient availability. However, there are no long-term studies documenting the effects of prescribed fire on this important plant guild in southwest Missouri woodlands. We have sampled species richness and species similarity across three woodlands in Taney County, MO that vary in overstory cover and prescribed fire frequency. Woodlands that have canopy cover between 30-40% with spring burns every 3-5 years since 1980, woodlands that were considered "degraded" but now have canopy cover between 60-85% as a result of burning every 2-5 years since 1999, and woodlands that are considered "degraded" that have canopy cover between 80-95% and have not been burned in over 70 years. Canopy cover is highly correlated with leaf litter depth, which can affect species richness of spring ephemerals. Burning removes leaf litter, although the burns are also occurring when spring ephemerals are emerging. Nonetheless, leaf litter cover is correlated with canopy cover. We hypothesized that prescribed fire in degraded woodlands would promote spring ephemeral species richness and similarity with open woodlands over time. However, species richness and similarity has not increased in burned woodlands between 2008-2020 and is very low (0-8 species per year out of 26 across all the woodlands).
Brandy Williams	bcw2n9@umsystem.edu	Brandy Williams, Lauren Sullivan, Alejandro Chávez-Treviño	University of Missouri	Grassland Bird Seed Dispersal and Seed Preference in Missouri Prairies	Missouri's historic landscape consisted of over 15 million acres of tallgrass prairies, and today less than 1% of this historic landscape remains due to conversion to cropland. This has led to the decline of prairie plant species as well as grassland birds that rely on tallgrass prairies for nesting habitat, food, and protection. During the winter months, grassland birds mainly consume prairie seeds, but little is known about the role they play in endozoochory. The goal of our study is to assess the role that grassland birds play in seed consumption and dispersal in prairies. Our research questions are 1) of the most abundant plant species, which is preferred by grassland birds and 2) what plant species are being dispersed by grassland birds through excrement. To answer these questions, we will set up four transects within Tucker Prairie, with 16 excrement collection stations, as well as four feeder stations with seeds from four of the most abundant tallgrass species within the prairie. To address question 1, we will make observations at the feeder stations and collect data on the species present and how much time is spent at each feeder. To address question 2, we will germinate samples from the collection stations and identify the plant species based on morphology. We hypothesize that distance to edge from each collection station will affect the type of plants that are germinated. We also hypothesize that there will not be a significant preference in seeds since grassland birds are generalists.

Tammy Wilson	tmwilson@usgs.gov	Lauren E. Mott, Matthew R. Acre, Tammy M. Wilson, Josey L. Ridgway, and Robin D. Calfee	U.S. Geological Survey (USGS), Columbia Environmental Research Center (CERC)	Electric Fish Handling Gloves: A Method to Reduce Tagging Mortality	Fisheries scientists have increasingly relied on anesthesia to conduct experimental procedures on fish before release into the wild. Traditional chemical sedation methods, such as MS-222, extend impairment and require a 21-day holding time prior to release. Recent advances have introduced electric fish handling gloves (EFHG) which administer lower-voltage, non-pulsed DC to elicit stage-IV sedation, but EFHG efficacy is largely unknown. We tested this new technology on 91 Silver Carp ( <i>Hypophthalmichthys molitrix</i> ) from September to November 2020. Our study consisted of three trials with 91 tagged Silver Carp and 27 controls. During the first two trials, fish undergoing surgery and controls (i.e. no surgery) were held overnight and handled with EFHG. Trial three fish were not held overnight, and controls were released without EFHG handling. The first two trials resulted in 100% mortality for tagged and control fish and may be attributed to overnight holding, but further research is needed. Our third trial resulted in 71% survival for tagged fish and 100% survival for control fish. Our results provide support for the use of EFHG for rapid immobilization and recovery. This study demonstrates EFHG are a suitable alternative to traditional anesthetics, allowing researchers to avoid restrictions on fish release following surgery.
Jackson Winslow	jww79s@missouristate.edu	Jackson Winslow, Dr. Deb Finn	Missouri State University	Searching the hyporheic zone: Does immediate pump sampling give an accurate picture of the invertebrate community?	The hyporheic zone is the wetted area beneath the surface of a streambed that provides habitat for many aquatic invertebrates and contributes substantially to biomass production. Hyporheic invertebrates can be collected by pumping wells that have been pounded into the streambed. However, it is unclear if driving the wells causes local disturbance and, if so, whether invertebrates pump-sampled immediately following well installation accurately represent the full community. We asked the following questions in a second-order Ozark stream in southwest Missouri: Does immediate pumping produce samples with lower diversity and abundance compared to samples pumped several days after driving wells? If so, does diversity and abundance recover following several days without disturbance? During low-flow conditions in October 2021, we installed 12 wells to a mean 45cm depth every 4-5 meters along a lateral gravel bar. We pumped six wells both immediately after installation and one week later, and we did not pump the other six the wells until one week after installation. We are currently processing samples in the lab and will present invertebrate community comparisons among three groups: (1) wells pumped immediately after driving (N=6); (2) samples from the same six wells pumped one week after installation (N=6); (3) wells solely pumped one week following installation (N=6). Although historically neglected, research interest in surface/subsurface ecological connectivity in streams is currently expanding, and our results will provide practical methodological insight for future studies.

Alyka Zahnd	cbarta1@missouriwestern.edu	Alyka Zahnd, Lauren Tinoco, Amie Haddock, Jessica Poush, Harrison Meers, Mehreen Tai, Kaitlyn Atkins, Brian Jenkins, Devon Lindstrom, Rachael Prawitz, Csengele Barta	Missouri Western State University	Does the synthesis and release of secondary negative allelopathic metabolites into the soil provide a competitive advantage to Amur honeysuckle ( <i>Lonicera maackii</i> )?	Invasive species, employing a large array of strategies, through which they negatively impact the germination, growth, survival, or reproduction of native species, are a threat to biodiversity. Decomposing leaves of the invasive Amur honeysuckle ( <i>Lonicera maackii</i> ) leach a variety of allelopathic phenolic substances into the soil, with devastating inhibitory effects on native plant species in the region and affect multiple trophic levels. The seedling inhibitory mechanism of these phenolics has not yet been studied. We explored the inhibition mechanism triggered by honeysuckle leaf extracts in germinating standard (control, Rbr), gibberellin (GA) synthesis deficient (Rosette-Dwarf, ros) and GA overproducing (Tall, ein) mutants of field mustard ( <i>Brassica rapa</i> L. var. <i>rapa</i> ) in Petri dish seed and seedling development essays. The metabolite profile of the decomposing honeysuckle leaf extracts was analyzed using high performance liquid chromatography (HPLC). Extracts (0.01-0.2 g/mL) significantly decreased the germination of mustard seeds and inhibited seedling development in a concentration-dependent manner with most pronounced impacts on the ros mutants. The ein seeds were able to overcome inhibition, with only a delay in their germination, at the highest extract concentrations. We observed a similar relationship when control seeds were treated with exogenous GA (up to 100 $\mu$ M), with the strength of inhibition decreasing with increasing GA amounts. We hypothesize, that the phenolic allelochemicals in the honeysuckle leaf extract alter the hormonal balance in germinating mustard seeds, effect that can be alleviated by higher than physiological GA concentrations. Metabolite analysis of the extract revealed a profile rich in phenolic molecules, dominated by apigenin and luteolin and their derivatives. Seed and seedling assays performed with synthetic pure apigenin and luteolin at physiologically relevant concentrations (0.002 mM for both) showed that while both cause inhibition in standard control seeds and their individual effects can be relieved by GA. Interestingly however, the molecules inhibit seed germination in a synergistic manner, with a 4-fold higher efficiency than expected from the sum of the individual compound's effects. A better understanding of the inhibition mechanism by allelopathic agents is expected to contribute to the better understanding of plant-plant communication and competition and will aid the developing of efficient invasive species management approaches in the future.
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Alyka Zahnd and Jessica Poush	azahnd1@missouriwestern.edu	Alyka Zahnd, Jessica Poush and Csengele Barta	Missouri Western State University	John Rushin Teaching and Research Prairie at Missouri Western State University: First-Year Vegetation Success Survey of a Conservation Prairie	<p>Prairies, populated by a vegetation blend of grasses, herbs, shrubs, and tree species, historically covered over 400,000 square miles of North America. Due to land use change and agricultural repurposing, prairie coverage has declined to less than 5% of its historical values. In recent years, the scientific efforts focused on prairie restoration have increased, establishing the basis of science-informed management practices. Missouri Western State University, in collaboration with the Missouri Department of Conservation and private land conservationists, has become one of the championing institutions of on-site prairie restoration. In 2018, 26 acres of land was dedicated for prairie conservation to one the Department of Biology's retired faculty members, Dr. John Rushin. The John Rushin Teaching and Research Prairie serves as model prairie ecosystem designed to facilitate research, education, applied learning, and outdoors setting for students, faculty, and the community. Now, as part of a long-term ecological and eco-physiological study framework, focused on a first-year survey of the emerging prairie vegetation after the initial seeding in the beginning of 2020, and the relationship between emerging native species and invasive species. Based on our initial survey, we found that in its first year after seeding, only a proportion of the seeded prairie vegetation emerged successfully, while invasives and noxious weeds were still prominent. Further prairie management and successful competition between prairie species and invasives are expected to alter species composition in the following years, potentially shifting towards a higher success of native prairie species. The planned differential management practices, starting in 2022, are expected to reveal best-fit management practices to ensure native success and conservation.</p>
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