MWPARC's Virtual Annual Conference: Changes in Amphibian and Reptile Populations Throughout the Midwest

October 1 & 2, 2021

Schedule and Abstracts

Schedule
MWPARC Virtual Meeting
Changes in Populations throughout the Midwest
October 1-2nd 2021

(All sessions are in Central Standard Time)

Friday October 1, 2021	
11:00	Welcome and Announcements MWPARC Co-chairs Jennifer Buchanan and Melissa Youngquist
11:15	Keynote Speaker: Changing populations in the Midwest Mike Lannoo
12:15	Break
12:30	Spring Movement Ecology of Blanchard's Cricket Frog (*Acris blanchardi*) in Southwestern Wisconsin Andrew Badje
12:45	Searching for Amphibians in Need of Conservation on Mined Lands Emma M. Buckardt*
1:00	Subsurface tile drainage contributes to elevated neonicotinoid brain concentrations in juvenile Northern Leopard Frogs (*Rana pipiens*) Kaitlyn Campbell*
1:15	Predicting Olympic Torrent Salamander (*Rhyacotriton olympicus*) habitat suitability at the stream reach level in federally managed forests Travis Kurtz
1:30	Response of terrestrial salamanders to the decade following timber harvest in hardwood forests Alison Ochs*
1:45	Working Forests and Wood Turtles: Effects of Forest Management on a Species of Conservation Concern Tricia Brockman*
2:00	Task Team Meetings (PARC TNT, CCITT, and Crayfish Frog)
3:00	Virtual Social Hour (Kahoot Trivia and break-out room chats)

*Indicates student presentation for Brodman Student Award

Saturday October 2, 2021	
9:00	Equity: how do we start? Jennifer Y. Lamb and Bob Brodman (PARC DEITT)
10:00	TSA Updates: Jordan Gray
State Updates	
10:15	North Dakota: Matthew T. Smith
10:20	South Dakota: Drew Davis
10:25	Nebraska: Dan Fogell
10:30	Kansas: Daren Riedle
10:35	Missouri: Jeff Briggler
10:40	Iowa: Paul Freese
10:45	Minnesota: Chris Smith
10:50	Wisconsin: Gary Casper

Saturday October 2, 2021 CONT.	
10:55	Illinois: John Vanek
11:00	Indiana: Nate Engbrecht
11:05	Michigan: Yu Man Lee
11:10	Ohio: Megan Seymore
11:15	Breakout room lunch chats
12:30	Conservation Genetic Status of Blanding's Turtle and Spotted Turtle in Indiana Mark A. Jordan
12:45	Temporal variation in occupancy dynamics of ringed (*Ambystoma annulatum*) and marbled (*A. opacum*) salamanders in Missouri Tom Anderson
1:00	Temporal changes in unisexual and sexual Ambystoma salamander populations in southeast Michigan Katy Greenwald
1:15	Patterns of Herpetofaunal Diversity in a Suburban Preserve District: Insights from a Decade of Monitoring John Vanek
1:30	Highlights of the Midwest Regional Species of Greatest Conservation Need Project Karen Terwilliger
2:00	Poster Presentations
3:00	Awards and Closing Remarks

*Indicates student presentation for Brodman Student Award

Silent Auction and t-shirt sales will start September 26, 2021 and continue until October 4, 2021

DEITT Talk

Equity: how do we start

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Science and our societies are stronger when they incorporate diverse voices. How can we ensure that we hear and value these voices in different spaces? In this workshop, we'll focus on how one tool, the Equity Compass, can help start that process. We will introduce the Compass and its application within PARC's Diversity, Equity, and Inclusion Task Team (DEITT). Participants will then be split into working groups to discuss how they could apply the Compass within the spaces they occupy. Prior to attending, please read this short summary about the Equity Compass: https://tinyurl.com/2z84hhf4

Abstracts

(Alphabetical order by author's last name)

Temporal variation in occupancy dynamics of ringed (Ambystoma annulatum) and marbled (A. opacum) salamanders in Missouri

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Documenting species occurrences in different habitat patches across spatiotemporal gradients is critical for understanding demographic trends. Species occurrence information also can help inform management actions by determining what patches constitute consistently occupied areas versus more infrequently used areas. Identification of the drivers of consistently occupied patches is then critical, as they may indicate high quality habitats. We monitored the occurrence of ringed (*Ambystoma annulatum*) salamanders, a Species of Conservation Concern, and marbled (*A. opacum*) salamanders across a 10-year period (2012-2021) at Fort Leonard wood, Missouri. We repeated surveyed between 50-166 wetlands for the presence of each species during the larval period using a combination of minnow traps and dipnets. We analyzed whether occupancy was predicted by either habitat variables (e.g., canopy cover or hydroperiod) or climatic variables (e.g., drought or winter severity). We found that ringed salamanders showed a significant positive trend in occupancy through time, with the estimated mean percentage of sites occupied increasing from 54% to 77%. In contrast, marbled salamanders showed a significant decline in estimated occupancy, from 42% to 29%. Annual detection probabilities always exceeded 80% for ringed salamanders in all years, while detection probability of marbled salamanders never surpassed 36%. In both species, winter temperatures and fall drought severity indices were positively related to occupancy probabilities. This indicates warmer winters and less severe droughts in the fall increased the likelihood of larval occurrence. Habitat features had limited effect on ringed salamander occupancy, while marbled salamanders had moderate increases in occupancy in response to shorter hydroperiods and reduced amount of forest surrounding wetlands. Overall, our results show that species co-occurring within the same landscape can have contrast trends in occupancy.

Spring Movement Ecology of Blanchard's Cricket Frog (*Acris blanchardi*) in Southwestern Wisconsin

Andrew Badje, Tyler Brandt (Wisconsin Dept. Natural Resources), Tara Bergeson (Wisconsin Dept. Natural Resources), Rori Paloski (Wisconsin Dept. Natural Resources), Joshua Kapfer (University of Wisconsin - Whitewater)
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The Blanchard's cricket frog (*Acris blanchardi*), experienced widespread declines in distribution and abundance along its northern range in the late 1900s. Since the 1990s, herpetologists have searched for remaining populations and begun long-term monitoring efforts. Species experts have additionally begun researching the key facets of the species' ecology and life history in hopes of preventing future declines and to manage for healthy and sustainable populations. The objectives of our research were to study the phenology, movements, habitat use, and life history of Blanchard's cricket frogs in southwest Wisconsin through visual encounter surveys and marking techniques in spring 2011. This presentation will report on our key findings and how those results are driving conservation efforts for this species in Wisconsin today.

Working Forests and Wood Turtles: Effects of Forest Management on a Species of Conservation Concern

Tricia Brockman, Gary J. Roloff (MSU), Bradly A. Potter (USFWS), Darren A. Miller (NCASI)
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The wood turtle (*Glyptemys insculpta*) is a species of conservation concern that occurs in both public and private forests. In private, working forests in Michigan, the wood turtle is the focal species of a collaborative conservation effort among the U.S. Fish and Wildlife Service (USFWS), National Alliance of Forest Owners (NAFO), National Council for Air and Stream Improvement, Inc. (NCASI), Michigan State University (MSU) and others. Our goal is to determine the relationship between recent forest management (~15yrs), drainage basin condition and occupancy probability of wood turtles in watersheds that include forests owned and/or sustainably managed by NAFO member organizations in Michigan's western Upper Peninsula. We are accomplishing this by 1) conducting replicated surveys in 25 basins to parameterize detection probability and determine occupancy of wood turtles, 2) using radio telemetry to document spatial and temporal use in managed forests by wood turtles, and 3) reconstructing recent forest management in each basin to relate to wood turtle occupancy. We predict that drainage basin condition will have a more significant effect on wood turtle occupancy than recent forest management, and that occupancy will be positively related to presence of recent forest management. We are also developing management recommendations for wood turtle conservation working in close collaboration with foresters from NAFO member organizations. Preliminary results from the last two seasons show that gravel pits are used as nesting areas when present, turtles in densely forested areas take advantage of old logging roads for thermoregulation, home ranges occur in a variety of management types and stand ages, and the most turtles remain within ~200m of flowing water throughout the active season. We will complete our final field season in 2022.

Searching for Amphibians in Need of Conservation on Mined Lands

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The loss and fragmentation of wetland habitat has altered amphibian populations across the North America. Southeast Kansas's landscape has been dramatically impacted by urbanization, agriculture, and a rich history of coal mining, which has left few native habitats intact. Eastern Newts (Notophthalmus *viridescens*) and Spring Peepers (*Pseudacris crucifer*) are listed as Species in Need of Conservation in the state of Kansas due to their limited range and infrequent occurrence. Our study aims to assess the connection between these species' distributions and landscape composition in a region that has been highly altered by strip-mining. We conducted dipnet and trapping surveys at 30 wetlands and call surveys at 65 sites throughout Crawford and Cherokee Cos. in southeast Kansas. Surveys were conducted primarily on mined lands and were completed six times from March 16 to June 30, 2021. A previously unknown population of Eastern Newts was discovered on the western edge of their range. Spring Peepers were heard calling at 57% of the sites and primarily heard in the Spring River Sub-basin. Further analysis will be conducted to understand how occupancy is related to landscape composition for these species, as well as other target species in the region. Knowledge of the status and distribution of amphibians in our study region will support conservation efforts in previously mined landscapes.

Subsurface tile drainage contributes to elevated neonicotinoid brain concentrations in juvenile Northern Leopard Frogs (*Rana pipiens*)

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Neonicotinoids are a new type of highly water-soluble insecticide used in agricultural practices to eliminate pests. These broad-spectrum toxicants target and bind almost irreversibly to postsynaptic nicotinic acetylcholine receptors (nAChRs) in the central nervous system of invertebrates, resulting in overstimulation, paralysis, and death. Imidacloprid, the most commonly used neonicotinoid, is often transported to nearby wetlands through subsurface tile drains, agricultural runoff, or aerial wind drift, where it comes into contact with non-target organisms. Although it is widely accepted that neonicotinoids have selective toxicity for insects, the validity of this notion has been recently challenged with several studies showing affinity for nAChRs in vertebrate brains. To determine if imidacloprid could cross the blood-brain barrier in amphibians, we collected juvenile *Rana pipiens* from tile and reference wetlands in eastern South Dakota and quantified imidacloprid in whole brain samples. Additionally, we measured individual brain regions using ImageJ and quantified aqueous neonicotinoid (imidacloprid, clothianidin, thiamethoxam) concentrations in water samples. Cumulative neonicotinoid levels in water samples were more than 7 times higher at tile wetlands compared to reference sites. Additionally, amphibians collected from tile wetlands had imidacloprid brain levels that were nearly 2.5 times higher, suggesting these insecticides can cross the blood-brain barrier and may have higher binding affinities than previously thought. We also found tile wetland amphibians had slightly shorter cerebellum brain regions along with a negative relationship between imidacloprid brain concentration and cerebellum

width at tile sites. These results indicate tile drains contribute to elevated aqueous neonicotinoid levels, which can bioaccumulate in non-target organism brain tissue and potentially alter brain morphology.

Community Structure of Freshwater Turtles in Northeastern Illinois Marshes

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Illinois has lost over 90% of its natural wetland habitats, leading to a substantial reduction in freshwater turtle populations. Several threatened and endangered turtle species, including Blanding's and Spotted turtles, occur in isolated wetlands in Northeastern Illinois marshes, making these habitats a priority to conserve. Specifically, understanding trends in community structure can help develop conservation plans. We compiled and analyzed data from several multi-year research projects to determine freshwater turtle species diversity, richness, and evenness trends at five sites throughout Northeastern Illinois. We found overall species diversity was low across the five sites, whereas richness and evenness varied between and within sites. Continued efforts should be made on a site-by-site basis to determine the drivers of these trends.

Timing Prescribed Burns to Avoid Ornate Box Turtles (*Terrapene ornata*)

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The Ornate Box Turtle (*Terrapene ornata*) is a Threatened species in Illinois. They have a disjunct distribution extending across the state through the northern sand prairies, southern till plains, and west along the Illinois River. Land managers regularly use fire to maintain prairie habitat and ecosystem health; however, fires can also inadvertently cause mortality if they are prescribed when Ornate Box Turtles are active above ground. We are monitoring Ornate Box Turtle movement, shell temperature, and soil temperature across Illinois to determine when turtles are at risk from fire. In 2021, the earliest turtle emerged from brumation on 27 March at the most southern site. When it emerged, the soil temperature was 8.3–10.6°C at depths of 1.4–0.3 m. The first turtles emerged at northern sites on 6 April, 11 days after turtles at the southern site. Shell temperature data suggests one turtle was active above ground as late as 4 November at the southern site and 1 November at a northern site. We are continuing to monitor turtle movement, shell temperature, and soil temperature, with a goal to develop a predictive model for managers showing the probability Ornate Box Turtles are above ground and at risk of fire.

Impact of Research Clothing Color on the Behavior and Conservation of Aquatic Anoles (*Anolis aquaticus*)

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Ecotourism provides the public with the ability to experience, appreciate, and learn about the natural world, while having a relatively minimal environmental impact. These experiences are not only important in educating the general public but aid in advocating for the conservation of a natural area and its organisms. Though there is a possibility that human activity might impact animal behavior because many organisms may recognize humans as predators, resulting in organisms using more energy on predator avoidance activities and less energy on activities that are beneficial to their fitness (mating, searching for resources). We determined how human activity, specifically shirt color, affects animal behavior at the Las Cruces Biological Station, Costa Rica. We had two alternative hypotheses: 1) clothing that resembles the sexually selected signaling color (orange) of aquatic anoles (*Anolis aquaticus*), would result in an increased number of anoles captured (capture rate) and anoles observed (anole sightings) due to the importance of the orange dewlap of the anoles in intra-species communication (and based on previous research), or 2) clothing that blends in with the environment (green) would increase capture rates and anole sights due to its conspicuousness. Over the course of this study, two groups of three researchers alternated between four shirt treatments: orange, green, blue, and mixed in which each researcher would wear one of the three shirt colors to mimic an ecotourist group. Researchers recorded the number of anoles observed and the number of both successful and unsuccessful anole captures. Additionally, environmental conditions (temperature, humidity), and individual characteristics (researcher ID, capture method, shirt color) were recorded. We hope that this study will implore researchers and ecotourists alike to consider how human activity could impact the natural world around them.

Temporal changes in unisexual and sexual Ambystoma salamander populations in southeast Michigan

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Climate change drives shifts in organisms' environmental niches, which can lead to changes in distribution and population structure. Unisexual (all female) Ambystoma salamanders reproduce by "stealing" sperm from sympatric males of sexually reproducing species, making them reliant on the presence of these sexual species to persist. We analyzed historic and modern-day unisexual and sexual (*A. laterale*) samples from the University of Michigan's Edwin S. George Reserve using epidermal cell nuclei measurements and microsatellite loci. We found that population composition has shifted away from the more northern-distributed *A. laterale* and toward populations dominated by LLJ unisexuals in five out of six ponds. There was a significant relationship between population composition and pond

size, but not between population composition and canopy cover, mean temperature, or maximum temperature. Changes in population composition could be an important consequence of climate change for the unisexual Ambystoma complex and sympatric sexual species.

Conservation Genetic Status of Blanding's Turtle and Spotted Turtle in Indiana

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Understanding the distribution and level of genetic variation is fundamental to making conservation decisions to prioritize populations and develop strategies for population augmentation. Blanding's Turtle (*Emydoidea blandingii*) and Spotted Turtle (*Clemmys guttata*) are of conservation concern across the Midwest and both species are state endangered in Indiana. We surveyed turtles at historic localities throughout the state during 2017 and 2018 as part of a status assessment supported by the Indiana Division of Wildlife. Turtles were genotyped at 15 and 10 microsatellite loci in *E. blandingii* and *C. guttata*, respectively. Genetic structure among localities within the state was limited for both species but Spotted Turtle populations were somewhat more differentiated. Levels of genetic variation within localities was moderate to high and comparable to other regions within the geographic ranges of each species. Although difficult to detect in long-lived taxa, we did find a signature of genetic bottlenecks in three localities for *C. guttata*. We modeled the retention of genetic variation for the next 200 years and found that both species show approximately 50% loss of allelic variation when populations decline to or are maintained at 20 individuals. Given that our survey effort discovered only a handful of juveniles and focal populations had low capture rates, it is likely that most localities in the state harbor populations that will lose substantial genetic variation over time. We conclude that while genetic variation appears to robust at present, the reduced distribution, apparently low recruitment, and projected loss of alleles for both species argues for management actions to augment populations. If translocation occurs within the state, the minimal genetic differentiation among populations allows a focus on increasing numbers in declining populations without concern for fitness loss that could result from genetic mixing.

Predicting Olympic Torrent Salamander (*Rhyacotriton olympicus*) habitat suitability at the stream reach level in federally managed forests

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Olympic Torrent Salamanders are small and highly sensitive salamanders that inhabit headwater streams throughout uplands on the Olympic Peninsula in Washington state. They are also the only Washington-endemic salamander species currently identified as threatened. We used the known anthropogenic threats to build a candidate model set for a model selection analysis. Based on the results of our analysis, we determined that stream gradient, presence of recently harvested forest, distance to the nearest recently harvested forest, and turbidity are the most important predictors of salamander presence in a given 10-meter stream reach. Using those data we developed a predictive habitat suitability index that we then applied to every applicable stream reach in the Olympic National Park and Olympic National Forest to determine which ones are most likely to contain highly suitable

habitat for our study species. Our results show the utility of this method for predicting areas of habitat suitability across a large geographic range, and also identified areas of potential importance for species conservation in federally managed lands. This approach is applicable to a variety of reptile and amphibian species and allows land managers to use multiple hypotheses based on known threats to spot potential human-wildlife conflicts that could negatively impact sensitive species.

Amphibians and Reptiles of the Lone Star Industries Acquisition, LaSalle County, Illinois

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The Lone Star Industries acquisition is a 10.64 km^2 reclaimed mine complex situated along the upper Vermillion River in south-central LaSalle County, Illinois. Acquired by the Illinois Department of Natural Resources in 2018, the property has an extensive history of mining, initially for coal in the early 20th century and subsequently strip-mined for limestone from the mid-20th century through the early 2000's. These practices resulted in the catastrophic alteration of denning and gestation sites for the state-listed Timber Rattlesnake (*Crotalus horridus*), known from three formal records on the property. In 2020, IDNR initiated biotic surveys and assessment of this new tract to develop best use practices for the transition of this property to a multi-use outdoor recreational area. Employing a variety of survey methodologies—aquatic funnel trapping, visual encounter surveys, and the placement of artificial cover objects —we comprehensively sampled this holding from 01 March 2020 through 12 August 2021 and confirmed the presence of 20 amphibian and reptile species (2 Caudata, 7 Anura, 5 Testudine, and 6 Squamata). No Threatened and Endangered (T&E) nor Species in Greatest Conservation Need (SGCN) were found within the Lone Star Tract, and it appears that the previously known Timber Rattlesnake hibernacula have been destroyed— it is increasingly likely *Crotalus horridus* is extirpated at the Lone Star property.

Weaponry and Wounding in the Western Painted Turtle (*Chrysemys picta bellii*)

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Recent studies show that male Painted turtles (*Chrysemys picta*) may use aggressive behaviors to coerce females into mating, and that sexual weaponry, including tomiodonts and carapace projections, evolved to facilitate. Additional studies of wild populations are needed to corroborate these findings, as are thorough wounding assessments during the reproductive season. The goal of our study was to characterize the anterior carapace shape, tomiodont morphology, and wounding frequencies for a population of Western Painted Turtles (*C. picta bellii*) in central Minnesota. We trapped turtles from May of 2021 to August 2021 across a system of connected lakes in Stearns Co., MN. For each turtle we collected standard measurements and photographed the anterior carapace and tomiodonts. We examined each individual closely for fresh and old wounds on the head and neck, limbs, tail, and shell. We used Hawkshaw et al. (2019)'s landmarks and the geomorph package in R to collect shape and length data from digital images. Painted Turtles are sexually dimorphic for size. We used analyses of covariance (ANCOVA) to determine whether shell shape or other measurements differed significantly

between the sexes. We captured, photographed, and measured a total of 111 unique turtles, including 67 males, 37 females, and 8 juveniles. We excluded juveniles and adults with severe shell damage (N = 2) from analyses. Our results confirm that males and females have significantly different shell shapes, with males having forward projecting points. We found that 75% of females and 71% of males captured had wounds, and that in both sexes wounds most frequently occurred on the ventral neck. These data validate the conclusion of previous studies as well as confirm that wound frequencies may be different across populations.

Long-term monitoring data on Blanchard's cricket frog in northwestern Ohio

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Both for common and rare species, long-term monitoring data is often highly desirable when making conservation decisions. Nonetheless, long term monitoring data are often unavailable or limited for many species. To help fill this gap for a species of conservation concern in the midwestern United States, we assessed the occupancy of 102 water bodies in an agricultural landscape in northwestern Ohio for the presence of Blanchard's cricket frog (*Acris blanchardi*) using standard chorusing surveys. During each breeding season between 2004 and 2008, we completed 695 chorusing surveys at these sites. Starting in 2017, we re-sampled these same sites using 655 chorusing surveys from 2017 to 2021 (1,350 total site surveys over the ten years where sampling occurred). Initial results suggest that while there has been a moderately high amount of population turnover (local extinction – colonization), the overall occupancy pattern is stable or slightly increasing. Several "hotspots" with high occupancy were apparent in both time periods, where populations appeared to be particularly robust and stable. Sites outside the "hotspots" tended to have higher turnover and lower occupancy probability. The average occupancy in both time periods was approximately 30%. These initial long-term data for Blanchard's cricket frog suggest a dynamic but stable metapopulation and position us well to detect future changes.

Halting the Decline of a Jefferson Salamander (*Ambystoma jeffersonianum*) Population: A Conservation Success Story

Brock C. Lorenzen, Andrew R. Kuhns (Illinois Natural History Survey), John A. Crawford (National Great Rivers Research and Education Center), Christopher A. Phillips (Illinois Natural History Survey), and Michael J. Dreslik (Illinois Natural History Survey)
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Global declines of amphibian populations have occurred due to habitat loss, disease, and population fragmentation. However, there are successes in recovery, such as Illinois state threatened Jefferson Salamander (*Ambystoma jeffersonianum*). Jefferson Salamanders occur in isolated populations within two Illinois counties, and only one known population occurs on state-protected land, discovered in 1991 in what is thought to be an old farm pond at Lincoln Trail State Park (LTSP). Previous stage-based population modeling using field data collected from 2004–2005 predicted the population would become extirpated within a decade. Additional ephemeral wetlands were constructed at LTSP in the mid-2000s

to combat the impending prediction of extirpation. Further, restoration of the original wetland commenced in 2010, followed by hydroperiod manipulation in July 2017 to reduce or eliminate predator abundances (e.g., Bullfrogs, Green Frogs, and introduced predatory fish). During the 2021 spring migration, we deployed drift fences (and associated pitfall traps) and minnow traps at the original wetland, in addition to a created ephemeral wetland at LTSP. We captured 126 individual adult *A. jeffersonianum* entering the original wetland and 144 individuals entering the created wetland. We also had successful recruitment indicated by the metamorphosed juveniles exiting both wetlands during the summer. Our preliminary analysis of trespass data shows additional individuals likely entered the wetlands without being captured at the fence in spring 2021. The early results and ongoing fieldwork help illustrate it is possible to recover isolated amphibian populations from a declining trajectory with rapid and focused adaptive management and habitat restoration.

Photoperiod does not affect larval development nor size in a widespread amphibian (*Rana clamitans*)

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As the Earth continues to warm, organisms that shift their phenologies with temperature will experience novel photic environments, as photoperiod (daylength) changes with latitude and time of year. Novel photic environments may modify fitness by disrupting behavior, physiology, and species interactions. Studies investigating how organisms respond to new photic conditions may help us to understand how species are currently responding and how they will respond in the future. Few studies examine how photoperiod affects amphibians, with some data suggesting that photoperiod influences developmental rate under laboratory conditions. We conducted an outdoor mesocosm experiment in which we exposed green frog larvae (*Rana clamitans*) to two different photoperiods: a simulated April photoperiod and an unaltered July photoperiod. We expected larvae in the April photoperiod to develop faster and at a smaller size in order to metamorphose before the end of the season. However, we did not detect any statistically significant differences when examining larval mass, total length, or developmental stage. It is possible that photoperiod may affect green frog larvae in other ways that we did not measure or that effects may not be present until later in development (i.e. at metamorphosis). Data is forthcoming on periphyton, phytoplankton, and gray treefrog development and growth. As amphibians are likely to breed earlier in the year with increasing temperatures, future experiments examining how photoperiod may affect amphibian growth and development are needed.

Response of terrestrial salamanders to the decade following timber harvest in hardwood forests

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Timber harvesting can have strong effects on terrestrial salamanders, which are critical components of forest ecosystems and indicators of environmental change. Effects of harvest methods such as clearcutting have been studied in the short term, but few studies have examined salamander trends throughout the decade following timber harvest. The effects of other harvest methods, such as patch cuts and shelterwoods, also remain unclear. We examined the effects of clearcuts, patch cuts, and

shelterwood harvests on salamander relative abundance one year before and up to eleven years after harvest in clearcuts, shelterwoods, and patch cuts at the Hardwood Ecosystem Experiment (HEE). A total of 41,858 salamanders representing ten species were captured under artificial coverboards over this period with eastern red-back (*Plethodon cinereus*) and zigzag (*Plethodon dorsalis*) salamanders dominating. No significant declines occurred in the first three years following harvest, but salamander captures declined in the 4-6 and 7-11 year periods in clearcuts and patch cuts, and no signs of post-harvest recovery were found. Rapid vegetation recovery and high volumes of coarse woody debris (CWD) following harvest likely protected the microclimate used by salamanders; CWD returned to lower levels 4-6 years after harvest, and a corresponding decline in salamander captures occurred. These years also corresponded to a regional drought that could have increased temperature and decreased moisture in harvest openings, further impacting terrestrial salamanders. Neither the first nor second shelterwood harvests produced declines in salamanders, suggesting that canopy retention could prevent declines due to changing microclimate or drought. Our results highlight the need to consider compound effects of disturbances such as drought and canopy loss and the importance of long-term salamander monitoring following timber harvest.

Turtle's eye view: Is reflected color sexually dimorphic in Western Painted Turtles?

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Pond turtles (Family Emydidae) communicate visually and many have striking colors like yellows and reds. These colors can be costly to maintain and may be under sexual selection. Some species are sexually dimorphic, but we lack data on color characteristics for most taxa. We ask if reflected colors across the body differ between mature males and females in Western Painted Turtles (*Chrysemys picta bellii*). Courtship behaviors in this species include individuals facing one another during foreclaw displays. If color is under sexual selection, then we expect that the areas visible to either partner would be sexually dimorphic. We captured turtles in baited traps and basking traps at three connected lakes in Stearns Co., Minnesota. Two methods were used to assess reflected color, digital photography and spectrophotometry, from a subset of the total turtles captured. For each turtle, we quantified color from the plastral and marginal scutes, and from yellow stripes on the chin and limbs. A total of 70 turtles were photographed under white light LEDs with a Cannon DSLR camera. We used the micaToolbox in ImageJ to identify RGB values from our areas of interest. We collected spectral data with a FLAME spectrometer and PX-2 light source from 18 of these individuals in the same body regions. We used the pavo package in R to calculate measurements of hue, saturation, and brightness. Here we present some of our preliminary findings on reflected color in the Western Painted Turtle. This work will contribute to our understanding of the role of color in communication in a widespread species of turtle. Additionally, comparing two methods of data collection will help show if digital photography alone can be used reliably, as it is more accessible and cost-effective.

A colorful tail: color & biofluorescence in Grey Treefrog Tadpoles

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Biofluorescence occurs when an organism absorbs a wavelength of light, then emits that light back into the environment at a longer wavelength. Biofluorescence is still a burgeoning topic of research and we know little of its possible functions. Tadpoles within the Grey Treefrog complex (*Hyla versicolor* and *H. chrysoscelis*) biofluoresce but we lack a comprehensive description of this fluoresence. These tadpoles exhibit phenotypic plasticity through a red coloration in their tails, which has been observed in the presence of insect predators such as dragonfly larvae. Individual tadpoles with this tail coloration have not been observed under biofluorescent conditions. In this research we ask which parts of the gross anatomy of these tadpoles biofluoresce and if that correlates with traits thought to be important in predator-prey relationships. We sampled tadpoles and their predator communities from two wetlands in central Minnesota. We photographed tadpoles under both white and blue excitation light in the laboratory, and we collected emission spectra from three tadpoles with a FLAME spectrometer. We analyzed the left lateral side of the tail of each tadpole in ImageJ. We collected average red and green reflectance from white light images with the micaToolbox, and grey pixel value from images of fluoresence after correcting for differences in the lighting. Subsequent analyses were completed in R. Both ponds contained invertebrate predators (e.g.,Odonata, Hemiptera) and tadpoles exhibited bright red tails under white light. Tadpoles exhibited whole body fluorescence, with their tails fluorescing primarily red. Green fluorescence was also visible on the body and tail. These preliminary results represent the first quantitative description of biofluorescence in amphibian larvae and confirm that some species of amphibians can simultaneously fluoresce different colors. They may also suggest that biofluorescence plays a role in enhancing the signal of red coloration from the tadpole tails.

Breeding Habitat Selection and Salt Tolerance of ND Anurans

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In the Great Plains, landscape favoring agricultural commodity production has had a negative impact on wildlife habitat and populations. More specifically, recent amphibian surveys in southeastern North Dakota suggest that at least one native amphibian species may be at risk of going locally extinct, while other species may be exhibiting reduced distributions. Given the current amphibian population crisis and land use changes in the Great Plains, it is vital to not only assess the current status of amphibian populations in North Dakota, but also evaluate the habitat characteristics that each species requires for successful. Previous work in portions of North Dakota examined species-specific land use preferences for breeding and core habitat, but there is still a basic lack of understanding of the interrelationship between aquatic breeding habitat characteristics, surrounding land use, and amphibian populations in North Dakota. By surveying amphibian breeding habitats in the spring, monitoring reproductive success during the breeding season, and assessing the relative importance of habit and community factors that influence species presence; we can develop precise management strategies/plans to conserve critical breeding habitats and ensure the persistence of amphibian biodiversity in North Dakota.

Aquatic sites across eastern ND were sampled during the spring and summer from 2018 – 2020. Fifty-eight unique potential breeding sites were monitored for amphibian reproductive activity and biotic and abiotic characteristics were measured monthly for each site. Additionally, a series of lab-based experiments examined the salinity tolerance of one of ND's most abundant amphibian species, the Canadian toad (*Anaxyrus hemiophrys*). Salinity experiments focused on long-term exposure to tadpole and post metamorphosis exposure via soil. Results from these two avenues of research yielded mixed results. Canadian toads exhibited a relatively high salt tolerance, but breeding habitat modeling was inclusive, most likely due to sample size issues.

Recruitment of Blanding's and Wood Turtles in Northern Michigan

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As part of an ongoing research project, we studied recruitment of Blanding's and Wood turtles in northern Michigan. Both of these species are state listed as Special Concern, with a push to get both species evaluated for potential federal listing (Greenwald 2020), so evaluating the success of their recruitment would be an important contribution to their conservation. We have begun to examine recruitment by studying female movements before and after nesting, specific nesting site selection, nest predation, and hatchling movements. Adult females were tracked using radio telemetry and GPS units to give more detailed movement patterns. In order to determine nesting sites, we conducted nesting surveys for multiple weeks. Nests that we observed were affixed with a nest cage and a trail cam placed nearby to observe any predation attempts. After emergence, subsets of hatchlings were tracked daily to observe movement. Telemetry using GPS was of limited success due to poor attachment methods. The GPS units that were nevertheless recovered displayed interesting movements in both Blanding's and Wood turtles. Nesting surveys were moderately successful, with 3 nests were located. These nests had no recorded predation attempts throughout the season. Each nest produced 9-10 hatchlings, and 5-9 of each nest were used for radio telemetry. Most hatchlings had fatal outcomes due to a variety of causes, such as desiccation, predation, and road mortality. Overall, this season of data gave us a glimpse of important movements in both adult females and hatchlings, but it gave us important information to prepare more for the next field season.

Abundance-Habitat Relationships for Wood Turtles in the Northwoods Region

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While many studies have investigated individual-level habitat selection for wood turtles (*Glyptemys insculpta*), the influence of terrestrial and aquatic habitat characteristics on abundance dynamics is not well understood. The goal of this project is to quantify abundance-habitat relationships for wood turtles in the Northwoods region of Wisconsin (WI) and Minnesota (MN). We will conduct standardized population surveys across a minimum of 4 HUC8 watersheds in WI in 2021 and 2022 and incorporate

existing population survey data from multiple additional watersheds in WI and MN. For the 2021 field season, we surveyed 16 sites in 2 watersheds and obtained 242 total wood turtle captures representing 134 unique individuals. The adult male to female ratio was 0.72:1, and 35% of captures were juveniles/subadults (carapace length < 170 mm). We identified 26 candidate local and landscape-scale predictors of abundance based on a comprehensive review of the wood turtle literature. Future analyses will seek to determine the combination of habitat characteristics that best explains variation in estimated wood turtle abundance across the Northwoods region.

Predicted Distribution of Kirtland's Snake (*Clonophis kirtlandii*) in Illinois

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Predictions from species distribution models allow researchers to designate critical habitat for conservation and identify suitable habitat on the landscape where new populations may be discovered. Species distribution models are valuable tools for modeling the potential distribution of threatened species having few existing populations or elusive species that are hard to detect. Kirtland's Snake (*Clonophis kirtlandii*) is a threatened species in the state of Illinois. Kirtland's Snakes' fossorial habits and cryptic coloration make it one of the most elusive snakes to detect in the Midwestern United States. Here we predicted the potential distribution of Kirtland's Snake in Illinois using an ensemble approach. Ten different widely used modeling algorithms were implemented in the R package BIOMOD2, and a weighted average approach was taken to produce the final ensemble model. Six bioclimatic predictor variables were used to inform the model: mean diurnal temperature, mean temperature of wettest quarter, mean temperature of driest quarter, precipitation of wettest quarter, precipitation of driest quarter, and precipitation of warmest quarter. Precipitation of driest quarter was found to have the greatest influence on Kirtland's Snakes' probable distribution. The final model produced in this study was used to identify areas with high suitability for Kirtland's Snake where future survey efforts can be concentrated.

Photo-Identification and Mark-Recapture Methodology to Assess Marbled Salamander (*Ambystoma opacum*) Populations on Kelleys Island

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Populations at the edge of a species' range suffer more frequent episodes of fragmentation and isolation and are more likely to have smaller population numbers than core populations. Peripheral island populations have decreased genetic diversity than mainland populations, and elevated extinction rates because of adverse genetic effects such as inbreeding and genetic drift. This study collects capture mark-recapture (CMR) data to estimate the census population size, sex ratio, and juvenile recruitment to investigate the impact of habitat isolation on genetic diversity in Marbled Salamanders (*Ambystoma opacum*) on Kelleys Island, Ohio. This is a disjunct population located at the northern limit of the species'

range that has been isolated from the mainland for ~4000 years and may be especially vulnerable to decline because of recent habitat degradation (encroachment by invasive plant species). Understanding both census population size and genetic effective population size is important for determining the long-term viability of a population and assessing its probability of extinction. We employ a photo-based CMR technique as traditional CMR methods are invasive, and many methods are unable to be used with salamanders. Interactive Individual Identification Software (I3S) Straighten (v 1.0) and Pattern (v 4.1) were used to assess their viability of use with Marbled Salamanders. The I3S program successfully matched all adult salamander images, with slightly lower success with juvenile salamanders.

Highlights of the Midwest Regional Species of Greatest Conservation Need Project

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The Midwest Landscape Initiative (a partnership between the U.S. Fish and Wildlife Service Science Applications and the Midwest Association of Fish and Wildlife Agencies) sponsored the development of a Regional Species of Greatest Conservation Need (RSGCN) List to provide an effective, collaborative focus and approach for regional wildlife diversity conservation in the Midwest. The one-year process and list development was coordinated by Terwilliger Consulting, Inc. and was completed in August 2021. Of the 2740 Species of Greatest Conservation Need (SGCN) listed in Midwest Association of Fish and Wildlife Agencies' 13 State Wildlife Action Plans, team of taxa experts evaluated 1817 species in 13 taxonomic groups – mammals, birds, reptiles, amphibians, fish, crayfish, mussels, Odonates (dragonflies and damselflies), bumble and solitary bees, Lepidoptera (butterflies, skippers and moths), mayflies, stoneflies, and caddisflies. Of these 1817 species, 340 SGCN met the criteria for RSGCN, a designation signifying that these 19% of evaluated SGCN species should be assessed and managed at a regional scale with collaborative, multi-state efforts. The Reptile RSGCN list includes 16 species out of 124 reptile SGCN in the MAFWA region. The amphibian RSGCN list includes 12 species out of 82 amphibian SGCN in the MAFWA region. Habitat condition, availability, connectivity, and management were considered important limiting factors for both reptiles and amphibians. Additional concerns of climate change, disease, pollution and collection issues and impacts were indicated. During this presentation, we will describe the RSGCN list and specific considerations for amphibians and reptiles in the Midwest region. We hope the RSGCN list will lead to additional resources and efforts for amphibian and reptile conservation.

Patterns of Herpetofaunal Diversity in a Suburban Preserve District: Insights from a Decade of Monitoring

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Herpetofauna are sensitive to habitat loss, fragmentation and degradation, particularly in urban ecosystems. As a result, many populations of urban herpetofauna are relegated to natures preserves embedded within the urban matrix. However, little data exists on herpetofaunal diversity in these urban

nature preserves. Here we describe the results of a long-term and ongoing inventory and monitoring program from the suburbs of the third largest metropolitan region in the country: Chicago. Starting in 2009, we sampled the reptile and amphibian community at 232 permanent monitoring locations stratified across 55 nature preserves in Lake County, Illinois. From 2009—2018 we recorded 11,574 observations of 26 species via artificial cover objects, aquatic traps, and incidental encounters. Preserve richness ranged from 3 to 16 and increased with preserve size ($r2 = 0.383$, $p < 0.001$) and habitat diversity ($r2 = 0.385$, $p < 0.001$), but not preserve age or an index of habitat management intensity (prescribed fire, invasive species removal, etc.). The most widespread species were the American Bullfrog (n = 52 preserves) and Painted Turtle (n = 49 preserves). Five species (Common Musk Turtle, Eastern Newt, Graham's Crayfish Snake, Northern Map Turtle, and Wood Frog) were only detected at a single preserve. Our results demonstrate that urban preserves can foster high levels of herpetofaunal diversity, including rare species, such as the IUCN endangered Blanding's Turtle. However, some historically present species were notably absent (e.g. Spotted Salamander and Eastern Massasauga). We discuss best practices for long-term monitoring in urban environments and offer management recommendations.

Western Painted Turtle population structure and relative efficiency of capture techniques in Marshall County, South Dakota – preliminary results

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Turtles rank amongst one of the most endangered groups of vertebrates, and a good understanding of natural history and population dynamics is necessary to better manage and conserve these species. Even species that are wide-spread and well-studied in other aspects have not necessarily been studied in all of the habitats they occupy. One example of this deficit can be found in the very few studies involving Western Painted Turtles (*Chrysemys picta bellii*) in the prairie highlands of the Coteau des Prairies, South Dakota. In 2019 we began what we intend to be a long-term study of the population dynamics of turtles in this region. Turtles were captured in an inlet pond that drains into Clear Lake in Marshall County, South Dakota using dipnets, basking traps, and hoop traps. Recapture data and blood collected for population genetics will provide information on demographics, habitat use, and movement between habitat types. Here we report on capture rates, population size estimates, and sex ratios from the first two full years of sampling. We found that hoop traps were significantly more effective at catching adult turtles than basking traps while juveniles were only captured by hand. The population of turtles, estimated using the Schnabel index, was 136 in 2020 (based on 46 marked turtles and 8 recaptures) and 94 in 2021 (based on 44 marked turtles and 12 recaptures). Females made up 57% of the sample in 2020 and 47% in 2021, which differs from the more heavily skewed sex ratios reported in other studies on painted turtles in the Midwest. We plan to increase our sampling effort to improve our ability to estimate population size using recaptures and to more reliably capture juveniles.