

Missouri Herpetological Association



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MISSOURI HERPETOLOGICAL ASSOCIATION NEWSLETTER NO. 37

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Cover: Arboreal behavior of *Ambystoma annulatum* during breeding migration at Cuivre River State Park Lincoln County, MO. Photo by B. Schuette. See article page 13.

INTRODUCTION

The Thirty-seventh annual meeting of the **Missouri Herpetological Association** was held on 28-29 September 2024 at the **Bull Shoals Field Station** in Taney, County.

This organization is designed to provide herpetologists in Missouri and surrounding states with an opportunity to meet and exchange ideas regarding current efforts in research and other professional activities. High on the list of priorities is to provide students, involved in research at either the graduate or undergraduate level, (1) the chance to interact with senior herpetologists, and (2) an outlet to present, in a semi-formal setting, the results of their labors.

This newsletter is the result of a decision made at the 1988 inaugural meeting to provide a means of publicly acknowledging papers presented at this and subsequent annual meetings. Further, the newsletter will inform the herpetological community of new distribution records of Missouri's herpetofauna, additions to the bibliography dealing with the state herpetofauna and provide an outlet for the publication of short notes dealing with the natural history of Missouri amphibians and reptiles.

ANNOUNCEMENTS

38th Annual Meeting of the Missouri Herpetological Association

The Thirty-eighth annual meeting of the Missouri Herpetological Association will be held on 27-28 September 2025, location TBD. A "call for papers" will be sent electronically in mid-August. For more information, please contact **Jeff Briggler** at:

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**Abstracts of Papers Presented at the 37th
Annual Meeting of the
Missouri Herpetological Association**

**Bull Shoals Field Station
28-29 September 2024**

**EVALUATION OF ALARM PHEROMONE FUNCTION OF SCENT GLAND
SECRETIONS IN THE COTTONMOUTH (*Agkistrodon piscivorus*).**

Christopher Watson, Tristan Soto, and Brian Greene

Department of Biology, Missouri State University, Springfield, MO

Alarm pheromones – chemical signals used to communicate predation threat – are widespread in gregarious vertebrate and non-vertebrate animals. To qualify as an alarm signal, the chemical must be released upon exposure to a predator and induce behavioral responses in receivers consistent with those expected under direct predation threat. Snakes all possess scent glands from which secretions are released during encounters with predators. Prairie rattlesnakes (*Crotalus viridis*) were reported to exhibit a significant increase in heart rate following exposure to scent gland secretions. Likely because of a presumption of snakes being asocial, no other attempts to explore the alarm pheromone function of scent glands have been attempted. We tested the alarm pheromone hypothesis for scent gland secretions in cottonmouths (*Agkistrodon piscivorus*) using physiological and behavioral response variables. Exposure to scent gland secretions induced a significantly elevated heart rate in resting test subjects compared to controls. In defensive contexts, test subjects in scent gland secretion treatments engaged targets more rapidly and struck more frequently at an aggressor compared to control trials. All response patterns were consistent across snake body sizes, suggesting no ontogenetic component to sensitivity. Finally, cottonmouth responses to copperhead scent gland chemicals were similar to controls, suggesting a lack of heterospecific cue recognition between congeners. The fight-or-flight responses elicited by scent gland chemicals in our study should result in higher survival rates of receivers, supporting kin selection arguments in light of the rapidly increasing awareness of pit viper sociality.

ONTOGENY OF PREY CHEMICAL CUE RESPONSES IN NORTHERN COTTONMOUTHS (*Agkistrodon piscivorus*)

John Echele and Brian Greene

Department of Biology, Missouri State University, Springfield, MO

As gape-limited predators, snakes often exhibit ontogenetic diet shifts where larger prey types are consumed as snakes grow. Diet ontogeny is particularly common in pit vipers where diets of young individuals emphasize ectothermic prey and adults consume mainly mammals. Prairie Rattlesnakes (*Crotalus viridis*) exhibit this pattern and their responses to prey chemicals in laboratory experiments matched the diet shift, suggesting that snakes innately change their diet preference with increasing size. The authors predicted that this sensory pattern should be widespread in vipers. We replicated the rattlesnake experiment on cottonmouth snakes, which also exhibit an ontogenetic shift in diet but consume a larger variety of prey than rattlesnakes and varied diet composition across habitat conditions. In contrast to the rattlesnake study, sensory responses to prey chemicals of cottonmouths from a population in the Southwest Missouri Ozarks were similar across prey types and did not reflect the strong ontogenetic shift reflected in the diet of wild snakes. Unlike rattlesnakes with ontogenetic shifts involving relatively similar diets across their geographic range, cottonmouths feed on a wide range of prey, some of which (e.g. fish, amphibians and reptiles) are variable enough in size to be appropriate prey for snakes of all body sizes. We propose that cottonmouth diet breadth facilitates exploitation of whatever prey are most abundant in different locations. This generalist dietary strategy may promote selection for similar sensory responses to all prey types across snake body sizes instead of favoring a shift in prey types with age and size.

BEHAVIORAL VARIATION IN PREY HANDLING WITH RESPECT TO PREY SPECIES AND BODY TEMPERATURE EFFECTS ON POST-STRIKE TRAILING IN COTTONMOUTHS (*Agkistrodon piscivorus*)

Bryce F. Jarrett and Brian Greene

Department of Biology, Missouri State University, Springfield, MO

The foraging strategy of vipers is typically characterized by a sequence of behaviors known as strike-induced chemosensory searching (SICS), where prey are struck and envenomated, released, trailed and consumed. An increase in the post-strike tongue flicking rate (TFR) of vipers facilitates the location and trailing of prey chemical cues. Although snakes typically release envenomated rodents – presumably to avoid retaliatory injuries – harmless prey (e.g. frogs and small lizards), or those that may not deposit a scent trail (e.g. birds) are likely to be held post-strike. Additionally, while it is known that body temperature greatly impacts the performance of reptiles, no studies examining the efficacy of post-strike scent trailing in relation to body temperature have been performed. I conducted two foraging experiments on cottonmouth snakes (*Agkistrodon piscivorus*) to determine if prey capture behavior varied across three ecologically relevant live prey types: fish (*Pimephales* spp.), frogs (*Acris blanchardi*), and mice (*Mus musculus*). I measured whether prey were held post-strike, pre- and post-strike tongue flick rates, and whether prey were consumed alive or dead. I also conducted an experiment in which I

measured the post-strike scent trailing efficacy of seven cottonmouth snakes after striking mice at three different ecologically relevant body temperatures. Harmless and un-trailable prey types were held post-strike and consumed alive while mice tended to be released post-strike and were consumed dead. Post-strike TFRs were lower at lower body temperatures, but body temperature did not significantly impact trailing efficacy during SICS. Snakes exhibited significantly more exploratory behavior at lower body temperatures and significantly less exploratory behavior at higher body temperatures during SICS. These findings provide insight into the dynamic foraging behaviors of pit vipers and offer a greater understanding about how body temperature impacts their foraging ecology.

AQUATIC TURTLE DIETS IN AN AGRICULTURAL STREAM: A STABLE ISOTOPE AND FECAL APPROACH

Jeff B. Kimmons and Anastasia Bair

Park University, Parkville, MO

Aquatic turtle diets were evaluated to determine biodiversity in an agricultural stream, a Missouri River tributary, north of Kansas City. Common snapping turtles (*Chelydra serpentina*), eastern spiny softshell (*Apalone spinifera*), red-eared sliders (*Trachemys scripta*), and western painted turtle (*Chrysemys picta*) were trapped in Summer 2021-2023. Diets were estimated by fecal analysis and using carbon and nitrogen stable isotopes within hind limb nails. Fecal observations for all turtle species showed a consistent amount of plant material with few invertebrates, and even less vertebrates. Stable isotope analysis showed no significant difference in $\delta^{13}C$ and $\delta^{15}N$, supporting a similar diet among turtle species. Similar diets with higher amounts of vegetation insinuate a low diversity of prey items are available in this agricultural stream.

LONG-TERM STUDIES OF URBAN TURTLE METAPOPOPULATIONS.

Emily Sweet and Mark Mills

Department of Biology, Missouri Western State University, St. Joseph, MO

Long-term studies of turtle populations that live in ponds or wetlands often fit a metapopulation model, with turtles moving among ponds and recolonizing ponds or wetlands after drying events. However, few studies have examined turtle metapopulation dynamics in urban environments, and we are unaware of any long-term studies of urban turtle metapopulations. Faculty and students at Missouri Western State University have studied turtle populations on campus since 2009 with over 850 captures of five native species and three non-native subspecies. Missouri Western State University is located in Saint Joseph, Missouri and is surrounded by urban areas (e.g., residential, retail, and industry). This long-term study consisted of capturing and marking turtles and recording their movements among nine ponds on campus and three ponds adjacent to campus. This presentation will focus on the movements of the most common species on campus: *Chelydra serpentina*, *Trachemys scripta*, and *Chrysemys picta*. Over the past 15 years we have documented 77 turtles moving among the campus ponds and two turtles moving on or off campus. A male painted turtle moved off campus to a pond near Mosaic Hospital, covering a straight-line distance of 1,430 meters over two years. Another painted turtle moved from an off-campus pond to a campus pond, traveling 1,493 meters over 20 days. Overall, we found no

significant differences among distance traveled among the three species; however, male painted turtles traveled significantly longer distances (mean±SE, 428±98m, N=15) than females (172±19 m, N=19; P=0.003). The results of this long-term study are important in the context of documenting the movement patterns of animals within an area, but also in and out of that area, particularly in an urban habitat.

TOUGH CRAP: THE DIET OF THE NORTHERN GIANT MUSK TURTLE (*Staurotypus triporcatus*), A DUROPHAGOUS TURTLE

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Belize is home to nine species of freshwater and terrestrial turtles, many of which are listed as Critically Endangered, Vulnerable, or Near Threatened, chiefly due to overharvesting for consumption. The Northern Giant Musk Turtle (*Staurotypus triporcatus*) is an unusually charismatic species that has nonetheless reserved scant recent study. In comparison to the more widely recognized Central American River Turtle, this species is primarily carnivorous, inhabits a wider range of wetland types, and resides in terrestrial habitats for part of the year. The published literature concerning this species' diet is limited, both in the range of studies conducted and geographic scope. To better understand this species ecological role and trophic position, we elected to conduct parallel studies of diet and strike kinematics. To investigate variation in these traits we intend to work in six populations – three that inhabit systems with typically turbid water and three occupying systems with relatively better water clarity. Turtles are captured via active pursuit with dip nets, free-diving or passively using baited hoop traps. After capture, turtles are immediately stomach flushed to obtain a pre-digested diet sample and transported back to the Savana Field Station. Turtles are then held for 48 hours in tubs of water to collect fecal samples (post-digested diet samples) Stomach and fecal samples are sifted using 'flushing water' or 'tub water' through a fine mesh filter to avoid loss of material and stored in 70% isopropyl alcohol. Preliminary data suggests that The Northern Giant Musk Turtle diet largely consists of Bivalves, Gastropods, and seeds from plants in the palm family.

POPULATION SURVEYS OF ALLIGATOR SNAPPING TURTLES IN OKLAHOMA

Tessa N. Irvine, Derek Bateman, Kevin Babbitt, Alexander Edmond, Day B. Ligon

Department of Biology, Missouri State University, Springfield, Missouri

Alligator Snapping Turtles (*Macrochelys temminckii*) are of acute conservation concern following decades of declines, chiefly fueled by hunting and a proliferation of dams that fragment most of the rivers within its range. To assess the species' status, Oklahoma has conducted several population surveys, including a state-wide survey in the late 1990s and a survey of rivers in the northeastern part of the state in 2018–19. Here, we report results from the first two seasons of a survey chiefly focused in southeastern Oklahoma. In May–June 2023, we conducted surveys of the aquatic turtle communities at nine sites, including multiple subsites at Lake Eufaula and the

Verdigris, Neosho, Arkansas, Little, and Illinois rivers. Subsequently, in August–October 2023 we conducted surveys at Hugo Lake and the associated Kiamichi River, the Blue River, and resampled a subset of sites at Lake Eufaula and Neosho River. In May–June 2024, we conducted surveys in several tributaries of the Red River, an additional subsite within the Verdigris River system, and follow-up surveys at Lake Eufaula. Using 0.9-m diameter hoop nets baited with fish or chicken, we captured a total of 3,131 turtles 3,208 times. We captured 0, 0, 1, 2, 3, 3, 5, 20, 29, and 111 *M. temminckii* (total = 174 captures of 148 unique individuals) across the ten sites we surveyed, indicating that the species is likely thriving in some water bodies but are rare or have been extirpated from others. Because *M. temminckii* were deemed to be rare in the Neosho River based on previous survey efforts, 100 captive-bred and head-started individuals were released in 2021; interestingly, of the 29 *M. temminckii* we captured at that site, only 20 were introduced head-starts and the remaining nine captures were of wild animals. Across all captures, the majority of *M. temminckii* were immature or young adults, a pattern that suggests that populations may be in recovery from past harvest pressure and that highlights the persistent impacts that harvesting adults a long-living species with delayed maturity can have on a population.

INFLUENCE OF HABITAT CHARACTERISTICS ON WETLAND OCCUPANCY AND MOVEMENT PATTERNS OF WESTERN CHICKEN TURTLES IN SOUTHEASTERN OKLAHOMA

Ethan C. Hollender, and J. D. Willson

Department of Biological Sciences, University of Arkansas, Fayetteville, AR

Western Chicken Turtles (*Deirochelys reticularia miaria*) are an endemic species of the southern United States that are of conservation concern in nearly every state where they occur and have only begun to receive serious research attention in the last 15 years. They inhabit shallow wetlands and move among these regularly, but the specific environmental factors that drive wetland occupancy and patterns of interwetland movement are not well understood. In order to better create and manage suitable habitat for this species, we used a multi-species occupancy modeling approach in a Bayesian framework using the R package *spOccupancy* to examine Chicken Turtle wetland use patterns and evaluate factors that may affect detection and occupancy probability of Chicken Turtles and ten other co-occurring freshwater turtle species (five of which are also of local conservation concern) that comprise the local turtle community. These models were informed with extensive sampling of a set of wetlands surrounding the only two known extant Western Chicken Turtle populations in the US state of Oklahoma. Between 2020 and 2024, we performed effort-standardized occupancy surveys at 52 wetlands spanning gradients of depth, area, degree of isolation, aquatic vegetation coverage, and surrounding upland land use by humans. Here, we report our preliminary findings on the impacts of these factors in determining Western Chicken Turtle wetland usage and movement patterns in Oklahoma, US.

ROAD SALT INTRUSION AND INVASIVE HONEYSUCKLE ARE INCREASING ECOLOGICAL CONCERNS IN FRESHWATER HABITATS

Amanda Montgomery and Tom Anderson

Department of Biological Sciences, Southern Illinois University-Edwardsville, Edwardsville, IL

Amphibians are sensitive to these stressors due to their permeable skin. Salinization can lead to increased mortality, behavioral changes, and reduced growth. Invasive honeysuckle (*Lonicera maackii*) has been found to cause mass mortality in amphibians. Road salt and honeysuckle are likely to overlap in habitat, such as disturbed and edge habitats, which are both utilized by amphibians. If these stressors were to synergistically interact, it could lead to a higher increase in mortality and behavioral changes. These negative impacts could ultimately lead to a shift in amphibian community dynamics. We investigated the synergistic effects of road salt and honeysuckle on the predator-prey interactions of small-mouthed salamanders (*Ambystoma texanum*) and gray treefrogs (*Hyla versicolor/chrysozelis*). Larval *A. texanum* (predator) and *H. versicolor/chrysozelis* tadpoles (prey) were placed in cattle tanks with a control, honeysuckle, salt, or combined treatment. Half of the cattle tanks contained only *A. texanum* larvae and the other half contained both *A. texanum* larvae and *H. versicolor/chrysozelis* tadpoles. Survivorship of tadpoles and *A. texanum* larvae were monitored along with larvae body size and mass. The results are pending, but we expect that *A. texanum* in individual honeysuckle and salt treatments will experience reduced predation success, increased mortality, decreased growth, and decreased mass. Additionally, we expect that *A. texanum* in combined treatments (honeysuckle and salt) will experience the same effects as individual treatments but to a greater extent due to synergistic effects.

IMPACTS OF PHYSICAL STRESS AND RESIDENCY STATUS ON THE TERRESTRIAL BEHAVIOR OF TWO SPECIES OF TERRESTRIAL SALAMANDER

Abigail Nagl, Todd Watson, Alicia Mathis

Department of Biology, Missouri State University, Springfield, MO

Following exposure to increased predation risk, prey individuals often take measures to decrease their visibility to predators. For territorial species, such measures include decreasing high-visibility behaviors involved in territorial defense. The costs and benefits of contests over territories are typically affected by whether the contestants are territory owners (residents) or intruders into the territory of other individuals. We tested the hypothesis that status as a resident or intruder influences behavior following simulated predator attacks for two species of terrestrial salamanders, *Plethodon angusticlavius* and *P. serratus*.

We simulated snake attacks in the laboratory by grasping focal individuals (resident or intruder in each trial) with forceps for a 2-min period and an allowed subsequent 20-min recovery period. Aggressive, submissive, and chemosensory behaviors were recorded for both residents and intruders. The data for residents and intruders were analyzed separately, and statistical comparisons were between stressed and nonstressed individuals. For both species, stress did not affect behaviors of residents, but intruders decreased aggressive posturing after being stressed, which is consistent with different costs and benefits of territorial contests for residents and intruders. For *P. angusticlavius*, residents had generally high levels of aggression regardless of stress treatments, indicating that residents show strong territorial defense even in the face of high

predation risk. In contrast, *P. serratus* residents had generally low levels of aggression regardless of stress treatment, which is consistent with lower overall activity (in the current study as well as others) for this species.

**NEST-SITE SELECTIONS AND NEST-SEARCHING CUES FOR THE OZARK
HELLBENDER (*Cryptobranchus alleganiensis bishopi*) AND EASTERN HELLBENDER
(*Cryptobranchus alleganiensis alleganiensis*) IN MISSOURI.**

Jeffrey T. Briggler

Missouri Department of Conservation, Jefferson City, MO

Hellbenders have experienced severe population declines in Missouri with limited evidence of recruitment. With the multitude of threats for this aquatic salamander, as well as the decline, considerable resources have been devoted to propagation efforts to sustain and restore populations in Missouri. Part of these efforts is to collect eggs from the wild to hatch and head-start resulting larvae and juveniles at propagation facilities. Therefore, considerable effort was deployed to locate natural nests in Missouri's rivers and streams. Information, such as nest site dimensions, water conditions, attending male behavior, and breeding timeframes, collected from 2006 to present by searching and locating natural nests will be summarized. Experience gained by decades of searching has greatly advanced the knowledge and understanding of breeding behavior and phenology that has provided a vital role in the conservation of the hellbenders in Missouri.

NEW AND PREVIOUSLY UNREPORTED HERPETOLOGICAL DISTRIBUTION RECORDS FOR MISSOURI IN 2024

Richard E. Daniel¹, Brian S. Edmond² and Jeffrey T. Briggler³

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The following list represents new county records accumulated or brought to our attention since the publication of Briggler and Johnson (2021) and Daniel and Edmond (2024). Publication of these records extends our knowledge of the amphibians and reptiles found within the state of Missouri. In addition, recipients of this list have an opportunity to update checklists and distribution maps. Finally, the publication of this list allows us to acknowledge the contributions of the many individuals who have contributed information or specimens.

The records listed below represent the first report of the species within a given county and are based on catalogued voucher specimens or photographs deposited in a public institution. Distribution records are presented in the standardized format of Collins (1989): common and scientific name, county, specific locality (unless withheld for species of special concern), legal description of locality, date of collection, collector(s), catalogue number and institution where the specimen is deposited. Beginning in 2020 the published legal description of the locality was restricted to township and range. Nomenclature and common names follow Crother (2017) and updates from the *SSAR North American Species Names Database*.

Specimens reported in this note have been deposited in the Dean E. Metter Memorial Collection, University of Missouri, Columbia, MO (UMC). Unless otherwise indicated, all distribution records are documented by post-metamorphic/hatchling fluid preserved specimens.

We would like to extend our appreciation to E. Cain, C. Decoske, S. Foley, D. Hoisington, H. Locke, M. Ormsby, A. Rost, M. Smith, R. Thies, and N. Woodland for contributing photographs that were used in this note.

AMPHIBIA: ANURA (FROGS)

AMERICAN TOAD

Anaxyrus americanus

Saline Co.: Van Meter State Park (T52N R22W); 31 August 2019; M. Smith (digital image, UMC 5054P).

PICKEREL FROG

Lithobates palustris

St. Francois Co.: St. Francois State Park (T38N R5E); 1 April 2024; H. Locke (digital image, 5058P).

WOOD FROG

Lithobates sylvaticus

Randolph Co.: 3.27 km NW Cairo (T55N R14W); 5 March 2024; C. Decoske (digital image, UMC 5052P).

AMPHIBIA: CAUDATA (SALAMANDERS)

EASTERN TIGER SALAMANDER

Ambystoma tigrinum

Scotland Co.: Indian Hills Conservation Area (T64N R12W); 6 June 2024; D. Freiburger, S. Colatskie (larva) (digital image, UMC 5081P).

MUDPUPPY

Necturus maculosus

Lincoln Co.: Mississippi River Lock & Dam #25 (T49N R3E); 1 March 2024; M. Ormsby, S. Peper, M. Engel (digital image, UMC 5070P).

WESTERN SLIMY SALAMANDER

Plethodon albagula

Hickory Co.: Mule Shoe Conservation Area (T37N R20W); 24 April 2024; J. Briggler, R. Rimer, S. Hollabaugh, A. Schnake (digital image, UMC 5068P).

REPTILIA: SQUAMATA (LIZARDS)

BROAD-HEADED SKINK

Plestiodon laticeps

Bates Co.: Butler, MO (T40N R31W); 15 May 2024; S. Foley (digital image, UMC 5061P).

REPTILIA: SQUAMATA (SNAKES)

PRAIRIE KINGSNAKE

Lampropeltis calligaster

Wayne Co.: Mark Twain National Forest (T28N R4E); 10 August 2024; R. Thies, K. Thies, E. Prezier (digital image, UMC 5074P).

NORTHERN ROUGH GREENSNAKE

Opheodrys aestivus

Platte Co.: Parma Woods Conservation Area (T51N R34W); 7 April 2024; N. Woodland, A. Lanter, C. Phillips, M. Stucker (digital image, UMC 5055P).

WESTERN MASSASAUGA

Sistrurus tergeminus

Carroll Co.: (T54N R24W); 3 November 2024; E. Cain, D. Cain, D. Isaacs (digital image, UMC 5083P).

RED-BELLIED SNAKE

Storeria occipitomaculata

Hickory Co.: Mule Shoe Conservation Area (T37N R20W); 24 April 2024; J. Briggler, R. Rimer, S. Hollabaugh, A. Schnake (digital image, UMC 5069P).

REPTILIA: TESTUDINES (TURTLES)

WESTERN ALLIGATOR SNAPPING TURTLE

Macrochelys temminckii

Cole Co.: (T44N R11W); 10 June 2024; A. Rost (digital image, UMC 5076P).

EASTERN RIVER COOTER

Pseudemys concinna

Barton Co.: Prairie State Park (T32N R33W); 10 April 2024; D. Hoisington (digital image, UMC 5057P).

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NATURAL HISTORY NOTES

CLIMBING BEHAVIOR IN ADULT RINGED SALAMANDERS (*Ambystoma annulatum*)

Leslie Gittlemeier, Kayla Kapral, Bruce Schuette, and Rick Edwards

Cuivre River State Park, Missouri Department of Natural Resources, Troy, MO

Here we report an unusual climbing behavior observed for adult Ringed Salamanders (*Ambystoma annulatum*) at Cuivre River State Park (CRSP) in Lincoln County, MO.

On 23 September 2024, a mass movement of Ringed Salamanders to a natural upland sinkhole pond in CRSP was observed. The park is the northern most site known for Ringed Salamanders, an Interior Highlands endemic, and Ringed Salamanders have been known to use this sinkhole pond as a breeding site since 1989.

August and September 2024 had been particularly dry with only 30.5 mm (1.2 inches) of rain recorded between 1 August and 21 September at CRSP. On 22 September there was 32.3 mm (1.27 inches) of rainfall. The morning of 23 September CRSP staff scouted the sinkhole pond for signs of Ringed Salamander movement, and three adult Ringed Salamanders were found (two alive under log and one found deceased on road). On 23 September the temperature was a low of 63 F (17.2 C) and a high of 69 F (20.6 C) with an evening temperature of 64 F (17.8 C). Periods of light rain throughout the day totaled 33.0 mm (1.3 inches).

Three CRSP staff members and one retired staff member arrived on a road near the pond at 19:20 to begin surveying for salamanders. On the walk to the pond from the road through a degraded woodland, adult Ringed Salamanders were observed moving toward the pond, and thus, began the survey. Then, in a gridded fashion around the perimeter of the 0.25 ha (0.61 acre) pond, staff visually surveyed the shallow water margin of the pond and a terrestrial corridor around the outside of the pond. The total surveyed area was approximately 0.65 ha (1.6 acres).

The survey lasted around 2.5 hours, and 325 adult Ringed Salamanders were observed (191 males, 79 females, and 55 unknown). On land there were a total of 222 (155 males, 49 females, and 18 unknown), while in the water there were 103 (36 males, 30 females and 37 unknown). The salamanders on land appeared to all be heading to the pond and were moving on bare ground, leaf litter, atop logs (some large logs up to 32 cm (12.6 inches) in diameter), and most unexpectedly, some salamanders were observed in or climbing vertically up trees. At least nine adult salamanders were 61.0-152.4 cm (2-5 feet) above the ground surface. They were ascending tree trunks, inside hollow trees, on saplings, and on top of hollow stumps in the woodland, and one was approximately 30.4 cm (12 inches) above the water surface on a branch within emergent vegetation in the pond (see photos).

References (Petranka 1998, Trauth 2004) describe Ringed Salamanders as being highly fossorial and living in subterranean retreats making no mention of the climbing behavior observed here. The Amphibians and Reptiles of Missouri (Briggler and Johnson 2021) states that Ringed Salamanders, especially juveniles, have been observed climbing grass clumps, stumps and tree trunks to 152 cm (59.8 inches). One of their sources, Osbourn (2012) reported a previously undescribed behavior of juvenile Ringed Salamanders and Spotted Salamanders (*Ambystoma maculatum*) climbing on objects like drift fences, grass clumps, logs and tree trunks to a height of 152 cm (59.8 inches). Osbourn, however, did not report adult Ringed Salamanders exhibiting this

climbing behavior. Here we report 9 of the 222 adult salamanders (4%) we observed exhibiting this climbing behavior. We are not speculating why the salamanders exhibited this behavior but we would like to note that all the salamanders observed climbing were within 25 meters of the pond and one was in the pond on emergent vegetation.

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- Petranka, J. W. 1998. Salamanders of the United States and Canada. Smithsonian Institution. 587pp.
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ADDITIONS TO THE BIBLIOGRAPHY OF HERPETOFAUNAL REFERENCES FOR MISSOURI

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The following is a list of publications dealing with the biology of amphibians and reptiles from Missouri that have been brought to the attention of the author since the publication of Daniel (2023). Readers are requested to notify the author of any additional references that should be included in future compilations.

Anderson, T.L. 2024. *Ambystoma annulatum*: Diet. *Herpetological Review* 55(2): 229-230.

Bodinof Jachowski, C.M., J.T. Briggler, W.A. Hopkins. 2024. Artificial Hellbender shelters: tools for conservation, monitoring and research. Pages 292–305 in S.C. Walls and K.M. O'Donnell, editors. *Strategies for Conservation Success in Herpetology*. Society for the Study of Amphibians and Reptiles, University Heights, OH, USA.

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Hime, P.M. 2017. Genomic Perspectives on Amphibian Evolution Across Multiple Phylogenetic Scales. Theses and Dissertations--Biology. 45. https://uknowledge.uky.edu/biology_etds/45

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Macklem, D.C., L. Augustine, M.D. Wanner, J.A. Ettling, T. Crabill, A.S. Pedigo, C. Schuette, P.L. Ihrig-Bueckendorf, A.J. Martin, K.R. Noble, J.M. Elden, J.T. Briggler. 2024. Egg production, egg development, and mortality of Zoo-bred Ozark Hellbenders (*Cryptobranchus alleganiensis bishopi*). *Zoo Biology*: 1-15 <https://doi.org/10.1002/zoo.21869>

Macklem, D.C., L. Augustine, M.D. Wanner, J.A. Ettling, T. Crabill, A.S. Pedigo, C. Schuette, P.L. Ihrig-Bueckendorf, A.J. Martin, K.R. Noble, J.M. Elden, J.T. Briggler. 2024. Growth and Mortality of Zoo-Reared Ozark Hellbenders, *Cryptobranchus alleganiensis bishopi* (Grobman 1943). Zoo Biology: 1-15 <https://doi.org/10.1002/zoo.21870>

Pitt, A.L., C.C. Killian and E. Eldermire. 2024. Geographic distribution: USA: Missouri: *Trachemys scripta scripta*. *Herpetological Review* 55(4): 518.

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Daniel, R.E. 2023. Additions to the bibliography of herpetofaunal references for Missouri. *Missouri Herpetological Association Newsletter*. (36): 10.