Missouri Herpetological Association

Newsletter

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MISSOURI HERPETOLOGICAL ASSOCIATION NEWSLETTER NO. 24

Contents

Natural History Notes

Cover: Amelanistic Prairie Kingsnake (*Lampropeltis calligaster*) from Lincoln County, Missouri. Prairie Kingsnakes are found statewide in Missouri. While common in the pet trade, wild albinos are very rare. There have been at least five other documented cases of wild albinos in this species, one from Missouri. Photograph submitted by Bruce Schuette. See related note on page 26.

INTRODUCTION

The Twenty-fourth Annual Meeting of the **Missouri Herpetological Association** was held 24-25 September 2011 at **Reis Biological Station**, Crawford County, Missouri. 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 inaugural meeting to provide a means of publicly acknowledging papers presented at the 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 on the natural history of Missouri amphibians and reptiles.

ANNOUNCEMENTS

25th Annual Meeting of the Missouri Herpetological Association

The Twenty-fifth Annual Meeting of the **Missouri Herpetological Association** will be held on September 29-30, 2012 at **Lincoln University Busby Reservation**, Cole County, Missouri. A "call for papers" and registration materials will be sent electronically in mid-July. For more information please contact **Jeff Briggler** at:

Missouri Department of Conservation
P.O.Box 180
Jefferson City, MO 65102-0180
(573) 751-4115
E-mail: briggj@mdc.mo.gov

MHA on the Net

The Association has an official site on the Internet. Point your browser to http://www.moherp.org/ for copies of current and past publications and to view photos and information from past field trips and meetings. Send ideas, suggestions, comments, and content to the Webmaster (webmaster@moherp.org).

Abstracts of Papers and Poster Presented at the 24th Annual Meeting of the Missouri Herpetological Association

Reis Biological Station
24-25 September 2011

SPERMATOGENIC CYCLES OF SNAKES AND LIZARDS

Robert Aldridge[1] and Dustin S. Siegel[1,2]
[1]Department of Biology, Saint Louis University, St Louis, MO
[2]Department of Biology, Southeast Missouri State University, Cape Girardeau, MO

Within the Squamata, sperm production may occur immediately prior to mating (prenuptial spermatogenesis) or following mating (postnuptial spermatogenesis). In postnuptial spermatogenesis mating occurs when the seminiferous tubules are regressed. We examined the frequency of pre- and postnuptial spermatogenesis in snakes and lizards to determine if the frequency of these patterns is related to phylogeny. We concluded that, although these groups may superficially appear to have similar reproductive adaptations, they differ in fundamental ways. The major difference between snake and lizard is the absence of postnuptial spermatogenesis in lizards. Our interpretation of lizard spermatogenic cycles indicate that all lizards have prenuptial spermatogenesis (i.e. sperm are produced prior to mating) and the female then stores the sperm for months until spring ovulation. In contrast, many species of snakes have true postnuptial spermatogenesis (i.e. sperm are produced during the summer totally independent of when mating occurs). We suggest that the evolutionary origin of snakes may account for the differences observed in snake versus lizard reproductive cycles. We suggest that the evolutionary origin of snakes may account for these differences between snake and lizard reproductive cycles. If the earliest snakes evolved from lizards as burrowing forms perhaps the early snakes lost their reliance on heliothermy and in turn relied on thigmothermy. This adaptation for thigmothermy may have selected for individuals that could store sperm in the male ducts and female ducts for extended periods. The ability to store sperm for extended periods permitted the independent evolution of spermatogenic and vitellogenic cycles in snakes.

FRESHWATER TURTLE COMMUNITY COMPOSITION IN THREE RIVERS IN NORTHEASTERN OKLAHOMA

Travis L. Anthony and Day B. Ligon
Department of Biology, Missouri State University, Springfield, MO

We surveyed aquatic turtle communities on the Caney, Verdigris, and Spring Rivers in northeastern Oklahoma. Sampling was conducted using baited hoop traps, and sampling effort was rotated among the three rivers on one-week intervals from May through July 2011. However, the results presented will omit July data. At the Caney and Verdigris Rivers, sampling effort was divided between the main river channel and a tributary. No similar tributary occurs on the Spring River in Oklahoma. Sampling effort equated to 365 net-nights, and across species and watersheds the catch per unit effort was 3.08. However, catch rates varied among sites. Red-eared sliders (*Trachemys scripta*) consistently dominated the catch totals at all locations. However, few community-level patterns remained consistent among the three rivers sampled. Ouachita map turtles were evenly distributed between the Verdigris River and its tributary, but were found in lower numbers in the Caney River than they were in its tributary. Alligator snapping turtles were caught where they have been reintroduced in the Caney River and Pond Creek, but no naturally-

occurring individuals were captured there or in any other system that we sampled. This result supports a previous study that concluded the species had been extirpated in this part of its range.

THERMAL SENSITIVITY OF ENERGY CONSUMPTION IN MONTANE AND LOWLAND SALAMANDERS

Cody L. Barnes and Matthew E. Gifford
Department of Biology, University of Arkansas at Little Rock, Little Rock, AR

Salamanders in the genus *Plethodon* often show narrowly-overlapping distributions along mountain slopes. The montane species appear to be largely restricted by physiological constraints associated with thermal gradients. Here we test whether energetic constraints might play a role in limiting the distributions of these high elevation salamanders. For this talk we focus on preliminary data collected for two montane endemic salamanders from the Ouachita Mountains of Arkansas, *Plethodon caddoensis* and *P. ouachitae*. We examined the thermal sensitivity of foraging and energy processing at 10, 15, and 20°C. Following a fasting period, salamanders were fed a known quantity of fruit flies (*Drosophila hydei*), at daily intervals over the course of 7 days. The number of flies consumed and feces produced during each temperature trial was recorded. We expect that consumption and passage rates will increase with increasing temperature. The procedures used in this experiment will be later expanded to include explicit quantification of energy using bomb calorimetry and metabolic rate measurements. We expect that the results of these experiments will be used to illustrate a physiological mechanism for the elevational replacement of salamanders in the Ouachita Mountains. The study will also contribute critical data for building predictive models of *Plethodon* species distributions under possible future climate change scenarios.

AGGRESSIVE BEHAVIOR IN SYMPATRIC *Plethodon cylindraceus* AND *P. montanus*

Timothy A. Clay and Matthew E. Gifford
Department of Biology, University of Arkansas at Little Rock, Little Rock, AR

A common theme observed in the distributions among *Plethodon* species is elevational replacement, where a montane endemic is replaced at lower elevations by an ecologically similar congener. Interspecific aggression is common in plethodontids and appears to largely determine the upper elevation range limit of the low-elevation species. *Plethodon cylindraceus* and *P. montanus* occur in the southern Appalachians and exhibit elevational replacement, with *P. montanus* occurring at higher elevations. As part of a larger project, we conducted aggression trials to determine if this species pair follows the pattern of competitive interactions documented in other *Plethodon*. Sixteen males of each species were tested as both intruders and residents in inter- and intraspecific trials. We conducted aggression trials in darkness and video recorded them with infrared cameras. *P. cylindraceus* delivered more bites and displayed more aggression than did *P. montanus*. To our knowledge, this is the first documented case of the lowland congener being more aggressive than the montane endemic in *Plethodon*.

SOCIALLY FACILITATED ANTIPREDATOR BEHAVIOR BY RINGED SALAMANDERS (*Ambystoma annulatum*)

Adam Crane and Alicia Mathis
Department of Biology, Missouri State University, Springfield, MO

Many aspects of animal behavior can be socially facilitated, including foraging behavior, exploration behavior, and antipredator behavior. Although they are not gregarious, larvae of the ringed salamander (*Ambystoma annulatum*) hatch from eggs in ponds where they can live in high densities, and they face intense predation pressure. In a predator-recognition experiment, we found that these salamanders responded to chemical cues from dragonfly nymphs (Family: Libellulidae) with appropriate antipredator behavior (reduced activity), and this response was absent when salamanders were exposed to chemical cues from nonpredatory mayfly nymphs (Family: Heptageniidae). In a second experiment, we tested whether antipredator behavior in response to dragonfly nymphs could be socially facilitated among larval ringed salamanders. We placed an 'observer' salamander into a central arena with four 'demonstrator' salamanders behind clear barriers around the arena. The barriers ensured that chemical cues would not be detected by the observer. When demonstrators were exposed to chemical cues from dragonfly nymphs, both demonstrators and observers reduced activity relative to a blank control. Our results provide evidence that social facilitation can occur in larval ringed salamanders, a nonsocial species.

DIET AND FEEDING BEHAVIOR OF JUVENILE ALLIGATOR SNAPPING TURTLES (*Macrochelys temminckii*) IN EASTERN OKLAHOMA

Mitchell B. East[1], Day B. Ligon[1] and Brian Fillmore[2]
[1] Department of Biology, Missouri State University, Springfield, MO
[2]U.S. Fish and Wildlife Service, Tishomingo National Fish Hatchery, Tishomingo, OK

Alligator snapping turtle diet has been the subject of two studies. Both studies examined the contents of G.I. tracts harvested from butchered adult turtles. While both studies found some consistency in diet, both also reported surprising variety in the kinds of items consumed. These results provide important insight into alligator snapping turtle ecology and effects the species may have on the communities to which they belong. However, no studies have investigated the diet of juvenile alligator snapping turtles, so our present understanding of the species' role as a top predator is incomplete. In this study we used non-invasive techniques to compare the diet of juvenile alligator snapping turtles in a wild population to that in a recently reintroduced population. Additionally, we measured the degree of diet overlap between alligator snapping turtles and Ouachita map turtles (*Graptemys ouachitensis*), a species with which alligator snappers frequently co-occur. We determined the diet of turtles by collecting fecal samples from individuals of each population and compared differences in observed frequency of resource use. Additionally, we observed feeding behavior of naïve juveniles on representative fish species in a controlled system. Our preliminary results reveal that there are modest differences between diets of *M. temminckii* at the two study sites and identifies areas of potential resource overlap between juvenile alligator snappers and *G. ouachitensis*. It remains to be determined whether differences between snapping turtle populations are due to dissimilarity in life history or resource availability between the two systems. In controlled feeding trials, naïve juveniles exhibited patterns of prey selection that are likely explained by differences in catchability and variation in prey behavior.

EFFECTS OF TEMPERATURE ON FORAGING SUCCESS IN TWO SPECIES OF SEMI-AQUATIC SNAKES

Wendy Evans and Brian Greene
Department of Biology, Missouri State University, Springfield, MO

Temperature governs physiological processes in ectotherms, imposing proximate effects on movement functions that may ultimately have important fitness consequences. Previous studies on the thermal sensitivity of performance in reptiles have frequently attempted to identify thermal optima for various activities to understand how the thermal environment affects ecological function. We examined the effects of temperature on foraging success in two sympatric semi-aquatic snakes, the Northern Watersnake *(Nerodia sipedon)* and Cottonmouth *(Agkistrodon piscivorus)* feeding on fish at water temperatures of 15, 20, 25 and 30 ºC. Dietary data for both species from a cold Ozarks stream habitat revealed that *A. piscivorus* does not consume aquatic prey at this site while *N. sipedon* is primarily piscivorous. We hypothesized that this dietary difference may have been caused by species-specific thermal constraints on foraging performance. However, both snake species captured prey proficiently in laboratory trials at all water temperatures. The rate and efficiency of prey capture was optimal at 20 ºC for both species although *N. sipedon* completed foraging trials faster than *A. piscivorus* at all temperature treatments. It appears that the dietary differences observed for these species are caused by factors other than temperature constraints imposed by the aquatic habitat.

USE OF MANAGED WETLANDS BY SALAMANDERS AT MINGO NATIONAL WILDLIFE REFUGE IN SOUTHEASTERN MISSOURI

Andrew Hoffman and Brian Greene
Department of Biology, Missouri State University, Springfield, MO

Wetlands located on U.S Fish and Wildlife Service lands are managed primarily to improve habitat for waterfowl by manipulating flood cycles to promote certain types of vegetative growth. At Mingo National Wildlife Refuge in southeastern Missouri, extensive channelization and flood control mechanisms have resulted in an ecosystem with an altered hydrologic cycle. In order to determine whether these heavily managed wetlands provide adequate resources for native salamander species, I sampled fifteen wetlands (136 trap nights per site) using a combination of minnow traps, box traps, dip netting, and drift fencing. I also collected data on the diversity and abundance of reptiles, fish, and invertebrates at each site. The focal species of this study were *Siren intermedia* (N = 62), *Amphiuma tridactylum* (N = 2), *Ambystoma talpoideum* (N = 56), and *Notophthalmus viridescens* (N = 25). Permanent cypress/buttonbush wetlands yielded the most siren and amphiuma, had the lowest catch rates for invertebrates, and supported a diverse community of fish year round. Green Tree Reservoirs yielded the most Ambystomatid salamanders, but had relatively low catch rates for most other salamanders. Though moist soil units were the most intensely managed wetlands, *Ambystoma*, *Siren*, and *Notophthalmus* were captured in moderate numbers at various sites and invertebrate catch rates were very high. Fish were only captured regularly at moist soil units and green tree reservoirs after the heavy spring floods. After additional winter sampling targeting moist soil units, I will be using an occupancy analysis to evaluate detection probability of salamander types across habitat categories and attempt to determine which habitat variables influence species' presence. I hope that the results of my study will be useful for informing management of salamander populations at Mingo National Wildlife Refuge.

PREDATORY CHEMICAL CUES AFFECT GILL BLOOD FLOW IN LARVAL RINGED SALAMANDERS

Valerie Jones, Alicia Mathis and Adam Crane
Department of Biology, Missouri State University, Springfield, MO

The vertebrate fight-or-flight response in the presence of danger typically is characterized by both physiological and behavioral changes, which have been well-studied in humans. In nonhumans, many species have been shown to exhibit behavioral responses to perceived danger (predatory threat), but few studies have examined physiological responses. Larvae of ringed salamanders (*Ambystoma annulatum*) are aquatic and occupy woodland ponds where they are subject to heavy predation from various predators, including newts (*Notophthalmus viridescens*). Larvae respond to chemical stimuli from newts with appropriate antipredator behavior, and we predicted that larvae would also respond to newt stimuli with increased blood flow in their gills. In a laboratory experiment, we exposed newly-hatched larval salamanders to either stimuli from newts, stimuli from nonpredatory tadpoles (*Lithobates clamitans*), or to a blank control. We then placed each salamander under a dissecting microscope and recorded the frequency of discrete pulses of blood flow in the gills. Salamanders increased blood flow when exposed to newt cues relative to tadpole or blank cues; increased cardiovascular activity is predicted as part of the fight-or-flight response. The bioassay used in this study may be useful for answering additional questions about predator recognition and other types of stress by larval salamanders.

DETECTING DANGER FROM PREY-GUILD MEMBERS: BEHAVIORAL AND METABOLIC RESPONSES OF OZARK ZIGZAG SALAMANDERS TO STRESS SECRETIONS OF EARTHWORMS

Michael Lampe, Alicia Mathis and Adam Crane
Department of Biology, Missouri State University, Springfield, MO

When different species have common predators, selection should favor individuals that respond to alarm/stress cues of the other species. Ozark zigzag salamanders (*Plethodon angusticlavius*) are often found under rocks and logs during wet conditions, but they also use subterranean borrows during harsh environmental periods. By using the vomeronasal organ, these salamanders can assess chemical cues in their environment, including cues from predators and alarm/stress cues from conspecifics. Earthworms (*Lumbricus terrestris*) are abundant, syntopic with salamanders, and vulnerable to the same predators. We tested whether salamanders would respond to alarm/stress cues from earthworms in ways that are consistent with antipredator behavior. We obtained alarm/stress cues from earthworms by simulating a predatory attack (grasping them with forceps) and collecting the secretions in water. Salamanders significantly increased their time spent in escape behavior, decreased their chemosensory behavior, and increased oxygen consumption when exposed to stressed earthworm cues, whereas their responses to cues from unstressed earthworms were similar to responses to blank water. Our results suggest that salamanders can recognize alarm/stress cues from earthworms as dangerous.

USING COVERBOARDS TO EXAMINE HERPETOLOGICAL BIODIVERSITY IN THE LOESS HILLS AT SQUAW CREEK NATIONAL WILDLIFE REFUGE, MISSOURI

Mark S. Mills, Christopher Lanier, Joseph Streett, William Walker, and Teresa Ausberger
Department of Biology, Missouri Western State University, St. Joseph, MO, USA

In the fall of 2009, we began a research project in the Loess Hills at Squaw Creek National Wildlife Refuge, Missouri. We placed cover boards (2x4 feet) in prairie and forested areas in order to examine the biodiversity in the Loess Hills and determine species composition and abundance for reptiles and amphibians. Sampling began in the spring of 2010 and since that time period, a total of 140 individuals of six species have been captured: 94 *Diadophis punctatus*, 21 *Thamnophis sirtalis*, 13 *Lampropeltis triangulum,*6 *Coluber constrictor*, 2 *Carphophis vermis*, 1 *Aspidoscelis sexlineatus*, and 2 *Pseudacris maculata*. Of these six species, *Diadophis punctatus* was the most commonly captured. Throughout the course of the sampling season, most (91%) were captured in prairie versus forested habitat. Our goals for this project included: (1) determine reptile and amphibian biodiversity in the Loess Hills through long-term sampling, (2) obtain measurements for captured organisms, and (3) determine habitat associations of these species.

PREDATION IN THE STRAWBERRY POISON FROG *Oophaga pumilio*: ARE ADULTS AND JUVENILES EQUALLY PROTECTED FROM CTENID SPIDERS?

Erin M. Murray[1] and Ralph A. Saporito[2]
[1]*Department of Biology, Missouri State University, Springfield, Missouri*
[2]*Biology Department, John Carroll University, University Heights, Ohio*

Many organisms possess defensive mechanisms to protect themselves from predation. Dendrobatid frogs, such as *Oophaga pumilio*, contain alkaloid chemical defenses and advertise their toxicity to predators with warning coloration. However, color signals are not useful for deterring color-blind predators, and little is known about how *O. pumilio* advertise their chemical defenses to these potential predators. The neotropical ant *Paraponera clavata* and ctenid spider *Cupiennius coccineus* are two invertebrate, color-blind predators that avoid adult *O. pumilio* but readily consume non-toxic frogs.

Juvenile *O. pumilio* possess the same warning coloration as adult *O. pumilio*, despite being less toxic than adults. This may give juvenile *O. pumilio* protection from color-visioned predators, while leaving them susceptible to predation by color-blind predators. To test this hypothesis, we presented adults and juveniles of both *Craugastor bransfordii*, a non-toxic brown frog, and *O. pumilio* to *C. coccineus* while they were hunting in the field. *Cupiennius coccineus* did not consume any *O. pumilio* adults or juveniles, but consumed 90% of all juvenile and adult *C. bransfordii*. Therefore, species, but not age, was a significant predictor of predation. *Cupiennius coccineus* does not appear to be a natural predator of *O. pumilio*, as both juvenile and adult *O. pumilio* were equally defended from predation. This provides evidence for the use of alkaloids in *O. pumilio* as a strong chemical signal against some invertebrate, color-blind predators.

PATTERNS IN TIME AND SPACE: POPULATION CONNECTIVITY AND PERSISTENCE OF MISSOURI WOOD FROGS

Bill Peterman[1], Julia Earl[1], Tracy Rittenhouse[1,2] and Ray Semlitsch[1]
[1]*Division of Biological Sciences, University of Missouri, Columbia, MO*
[2]*Department of Natural Resources and the Environment, University of Connecticut, Storrs, CT*

Metapopulation theory has commonly been used to address conservation questions, especially in view of increasing loss, alteration, and fragmentation of habitat due to climate and land use change that can jeopardize the persistence of species. Crucial to metapopulation dynamics and species persistence is connectivity among habitat patches on the landscape, which is necessary for rescue or recolonization of populations following local extinction. Graph theoretic approaches are increasingly being utilized to answer questions concerning connectivity and flow among habitat patches and populations. Metapopulations of amphibians are often viewed from a ponds-as-patches perspective. Taking this approach, we studied wood frogs in east-central Missouri where they are at the edge of their Midwest distribution, and are a species of conservation concern. Previous research has shown that Missouri wood frog populations are stochastic in time and space. Using 6 years of egg mass survey data, we assessed the demographic connectivity, spatial structure, and breeding pond persistence of wood frogs in detail at a conservation area in east-central Missouri using a combination of graph theory and occupancy modeling. We constructed a demographic network model for each season as well as an average model for all years. Of the 34 ponds used for breeding, 12 were designated as sources. Connectivity among ponds was generally high, but decreased drastically in drought years. Population persistence over the study period was significantly influenced by the average level of self-recruitment at a pond, while pond colonization was dependent upon self-recruitment and rain. Pond self-recruitment is a component of our population graph analysis, and is a function of average number of clutches per year and spatial proximity to other breeding ponds. Thus we have linked a spatially-explicit connectivity model with a temporal colonization-persistence model. Our results provide working models for interpreting patterns of occupancy and gene flow, and can serve as an initial guide for future habitat management and restoration for this vulnerable species in Missouri.

CAN AUTOMATED RADIO TELEMETRY QUANTIFY ORNATE BOX TURTLE ACTIVITY AND NESTING PATTERNS?

Thomas A. Radzio, Charles R. Tucker, Jeramie T. Strickland, Day B. Ligon, and David K. Delaney
Department of Biology, Missouri State University, Springfield, MO

Miniature data loggers and transmitters allow biologists to efficiently study wary or cryptic animals in their natural habitats with minimal disturbance. In the spring-summer of 2010 and 2011, we investigated whether automated radio telemetry and the signal change method could be used to quantify the activity and nesting patterns of ornate box turtles (*Terrapene ornata*) inhabiting a sand prairie in northwestern Illinois. The signal change method relies on the principle that any movement of a radio transmitter (including minor changes in orientation) can strongly affect the intensity of the transmitter's signal at a stationary receiving station. Using video recordings of radio-monitored turtles, we confirmed

that transmitter signal strength values can be analyzed to generate accurate indices of box turtle activity patterns. Notably, between late May and mid-June of both years, most of 19 monitored females exhibited substantial activity on 1 or more nights. Previous reports indicate that ornate box turtles nest at night, but are otherwise inactive after dark. Based upon this information, relatively little indication of night activity by males, and other patterns present within the radio signal recordings, we hypothesized that night activity corresponded to nesting. We visually confirmed nesting in 3 night-active females in 2010, and also used the method to locate 13 nests in 2011. The night activity recordings and visual observations suggest that females may require multiple nights to successfully nest. In conclusion, we demonstrate that the signal change method can be used to generate accurate indices of box turtle activity and nesting patterns.

SPERMATOGENIC CYCLE OF *Sceloporus consobrinus* AND INSIGHTS INTO LIZARD SPERMATOGENIC CYCLES

Justin L. Rheubert and Robert D. Aldridge
Department of Biology, St. Louis University, St. Louis, MO

Lizard reproductive cycles have long been studied in both field and laboratory scenarios. However, a review of spermatogenic cycles in different species across a large geographic range has yet to be explored. The purpose of this study was to determine the spermatogenic cycle of a southern population of *Sceloporus consobrinus* in comparison with more northern populations as well as investigate reproductive cycles of the genus *Sceloporus* from various geographic locations. Specimens were collected from southeastern Louisiana monthly (excluding December and January) and the testes were examined histologically. For reproductive cycles data was gathered from the literature in which complete spermatogenic cycles were available. *Sceloporus consobrinus* from southeastern LA exhibits a prenuptial spermatogenic pattern with a short quiescent period in the late summer (August). Recrudescence begins in the fall (Oct-Nov) and the peak of spermatogenesis is reached during the early summer (May, June, July). This spermatogenic cycle resembles that of the more northern population of *Sceloporus consobrinus* from Missouri. However, due to individual variation, annual variation, and inability to delineate differences between the beginning of the month and the end of the preceding month no variation was examined. This same phenomenon can be observed in various reproductive cycles of the genus *Sceloporus*. However, the *Sceloporus* genus exhibits both a fall and a spring pattern of testicular recrudescence. No differences were observed within the two patterns of variation themselves. Testicular patterns (fall vs spring) showed no correlation to viviparity mode, elevation, latitude, or number of clutches produced. Evolutionarily it appears as if the spermatogenic cycle is an extremely plastic trait that has evolved multiple times throughout the lineage. With the rapid radiation of *Sceloporus* and lack of reproductive pattern data (especially within females) we are unable to determine what factor, or suite of factors, may be contributing to the evolution of spermatogenic cycles. Although, *Sceloporus* still remains an exemplary study genus for its substantial success, large geographic range (both tropical and temperate), and niche diversification, much more data are needed in terms of reproductive biology.

CONSERVATION OF ALLIGATOR SNAPPING TURTLES IN THE MISSISSIPPI RIVER DRAINAGE, AND A REVIEW OF THE SPECIES' STATUS IN MISSOURI

J. Daren Riedle[1] and Day B. Ligon[2]
[1]*Department of Agriculture and Environmental Science, Lincoln University, Jefferson City, MO*
[2]*Department of Biology, Missouri State University, Springfield, MO*

Symposia on the biology and conservation of the alligator snapping turtle were held at the 2006 and 2007 Turtle Survival Alliance Annual Meetings, with papers focusing on the species' status west of the Mississippi River. Panel discussions were held concerning development and implementation of a multi-state management plan for the species. Recent research in several states has focused on distribution and current status, population structure and survivorship, nesting and hatchling ecology, micro- and macro-

scale habitat use, movements, and experimental reintroductions. In this presentation, the authors will review recent developments in research and conservation actions in Louisiana, Oklahoma, Kansas, and Illinois, and will also discuss the current state of knowledge for the species in Missouri.

SPATIAL PATTERNS AND MULTI-SCALE HABITAT SELECTION OF THE WESTERN MUD SNAKE (*Farancia abacura reinwardtii)* AT THE NORTHERN LIMITS OF ITS RANGE

Daniel Schepis and Brian Greene
Department of Biology, Missouri State University, Springfield, MO

From mid-June 2010 through August 2011 sixteen (16) Western Mud snakes (*Farancia abacura reinwardtii*) were surgically implanted with radio transmitters and tracked at Mingo National Wildlife Refuge in southeastern Missouri. Prior to this study no in depth investigation into Mud snake spatial ecology and/or habitat selection had been conducted. Mud snakes have been shown to be highly aquatic, favoring shallow vegetated marshes and stagnant swamps and sloughs. Males were found submerged among leaf litter and vegetation for 76% of the relocations. Females were found in similar situations during 51% of the relocations. Both sexes were more commonly found in terrestrial situations during shedding. Data strongly support previous notions that this species requires well-established swamps and marshes. This study emphasizes the species' dependency on large areas of swamp-like habitats and that Missouri's few remaining bottomland hardwood forests and cypress swamps are crucial to the species persistence in the state.

THE REPRODUCTIVE BIOLOGY OF NEWTS FROM REIS BIOLOGICAL STATION

Dustin S. Siegel[1] and Robert D. Aldridge[2]
[1]*Department of Biology, Southeast Missouri State University, Cape Girardeau, MO*
[2]*Department of Biology, Saint Louis University, St. Louis, MO*

A working model for the reproductive biology of newts (*Notophthalmus viridescens*) is presented. This model was created from our own novel research on newt sperm physiology and from the great works of previous investigators on newt reproductive biology. The secondary sexual characteristics of male newts are hypertrophied in the fall, winter, and spring, indicating the possible time of mating. Spermatogenesis, spermiogenesis, and spermiation occur before the mating season in the summer months. Quiescent sperm in the Wolffian ducts of males are partially activated by hypoosmotic shock in the cloaca during spermatophore formation. This hypoosmotic shock not only facilitates movement of the undulating membrane through activation of the marginal filament, but also is necessary for activation of the axial filament by collecting duct secretions that mix with sperm during spermatophore formation (Siegel et al., 2010). Sperm in the spermatophore are motile. After a host of mating behaviors and spermatophore deposition, the spermatophore is consumed by the female cloaca, at which time sperm swim to the spermathecae and remain docile. Sperm are then evacuated from spermathecae by the spermathecal myoepithelium at the time of ovulation, and their undulating membranes are reactivated by components of the jelly covering passing ova. The amount of motility at this phase is adequate for the fertilization of passing ova.

ROCKY RACCOON MUST DIE: NEST PREDATION PATTERNS IN A REINTRODUCED POPULATION OF ALLIGATOR SNAPPING TURTLES

Denise M. Thompson and Day B. Ligon
Department of Biology, Missouri State University, Springfield, MO

Predation of turtle nests is the primary cause of egg mortality and can be as high as 100% in some populations. In North America, raccoons (*Procyon lotor*) are significant predators of turtle nests; however, the importance of different sensory cues to nest detection and predation by raccoons has not been investigated. We experimentally tested the importance of visual and olfactory cues by measuring raccoons' response to artificially constructed nests composed of: a) visual cues alone; b) olfactory cues alone; c) both visual and olfactory cues; and d) controls with no sensory cues. Research was conducted in southern Oklahoma at Tishomingo National Wildlife Refuge at ponds containing reintroduced alligator snapping turtles (*Macrochelys temminckii*). Artificial alligator snapping turtle nests were created to represent the three aforementioned nest treatments. A total of 16 trials were run between 2–27 June, 2011 and monitored with time-lapse, infrared game cameras. Initial raccoon detection of nests in each trial resulted in 9 (56%) of the 16 visitations occurring at the visual treatment, 7 (44%) at the simulated treatment, and none occurring at the olfactory or control treatments. Similarly, predation events were evenly distributed between visual and simulated treatments, with each being the first to be predated 7 times, while olfactory nests were the first nest predated only once. In 85% of trials the olfactory nest was the last nest to be predated, and on one occasion was not predated at all for an entire 3-day trial. We conclude that visual cues play a far more important role in raccoon detection and predation of alligator snapping turtle nests than do olfactory cues.

POPULATION ECOLOGY OF TURTLES ON THE CAMPUS OF MISSOURI WESTERN STATE UNIVERSITY

Leah Voltmer, Mitchell Bembrick, Brittany Bremer, Heather McMillian, and Mark S. Mills
Department of Biology, Missouri Western State University, St. Joseph, MO

We are in the third year of a long-term study surveying the turtle populations on the campus of Missouri Western State University. There are nine ponds located on campus and each was surveyed using baited hoop nets. Turtles were marked, weighed and measured, then released. In three years we have documented 4 species of turtles in the 9 ponds. Otoe Creek, also located on campus, produced two turtles. The species surveyed were *Chelydra serpentina, Chrysemys picta, Trachemys scripta* and *Apalone spinifera*. Population size estimates ranged from 6-22 turtles per pond, with at least 129 turtles on campus. Based on captures and population estimates, *Chelydra serpentina* and *Chrysemys picta* were the most common species on campus. We have documented movement of turtles among the ponds: a painted turtle moved a straight-line distance of approximately 200 m between two ponds, and a snapper moved from Otoe Creek to Pond 8, a straight line distance of 730 meters. In addition to collecting data on the turtles, leeches were counted and collected, with results indicating that *Chelydra serpentina* had the highest average infestation of the species surveyed and pond 7 had the highest infestation of the ponds surveyed. Additional results will be discussed.

ESTABLISHMENT OF LONG-TERM HERPETOLOGICAL RESEARCH ON THE LINCOLN UNIVERSITY CAMPUS, JEFFERSON CITY, MO.

Troy Wieberg and J. Daren Riedle
Department of Agriculture and Environmental Science, Lincoln University, Jefferson City, MO

Lincoln University (LU) is a small (~3,000 students) state university located near the center of Jefferson City, MO. The LU Department of Agriculture and Environmental Science maintains a 2-ha Living Laboratory adjacent to campus that contains woodland and grassland/vacant lot habitat, in addition to an abandoned rock quarry. LU also owns a second, undeveloped 4-ha woodland plot. In order to provide LU students with hands on field sampling experience, and provide real world data for use in wildlife classes, a biological inventory was initiated on both plots during the spring 2011 Semester. Initial inventories have focused on amphibians and reptiles, and to date 4 species of amphibians and 6 species of reptiles have been documented on site. All captured species have been weighed and measured, and all reptiles are individually marked. The most frequently captured reptile species to date has been the ringneck snake (*Diadophis punctatus*), and we have marked 45 individuals (15M:29F) to date. Future projects at this

urban site include population structure, survivorship and recruitment of bullfrogs within the quarry, radio telemetry of box turtles, and non-herp vertebrate inventories.

ACCLIMATION OF LOCOMOTION TO CONSTANT AND VARIABLE ENVIRONMENTS IN DUSKY SALAMANDERS, *Desmognathus brimleyorum*

Vanessa K.H. Young and Matthew E. Gifford
Department of Biology, University of Arkansas at Little Rock, Little Rock, AR

Temperature is arguably one of the most critical factors impacting fitness of ectotherms. Previous studies have indicated that many organisms have the ability to adjust their physiological capabilities to cope with variation in their thermal environment. Acclimation theory predicts that individuals experiencing thermal conditions that fluctuate widely will experience physiological traits that are less sensitive to temperature than those individuals experiencing stable thermal conditions. Therefore, we are testing this prediction by studying acclimation of multiple physiological traits in the salamander species *Desmognathus brimleyorum*, although only locomotor data are presented here. We haphazardly assigned salamanders from each of five populations to either a constant or variable temperature treatment in the lab. Following a two-month period of acclimation, we subjected each salamander to five swimming speed trials at each of six temperatures between 5 and 30°C and recorded each trial using a high-speed camera. In this talk, we will present preliminary data testing a key prediction of the theory of optimal acclimation.

NATURAL HISTORY NOTES

NEW HERPETOLOGICAL DISTRIBUTION RECORDS FOR MISSOURI IN 2011

Richard E. Daniel[1], Brian S. Edmond[2] and Jeffrey T. Briggler[3]
[1]Division of Biological Sciences, University of Missouri, Columbia, MO 65211
[2]Computer Services, Missouri State University, Springfield, MO 65897
[3]Missouri Department of Conservation, P.O. Box 180, Jefferson City, MO 65102

The following list represents new county records accumulated or brought to our attention since the publication of Johnson (2000), Daniel and Edmond (2000, 2001) and Daniel *et al*. (2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010). Publication of these records extends our knowledge of the amphibians and reptiles native to Missouri. In addition, recipients of this list have the 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 provided information or specimens.

The specimens listed below represent the first reported occurrence 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), institution and catalogue number where the specimen is deposited.

The following abbreviations indicate the institutional collections where specimens reported in this note have been deposited: LACM- Natural History Museum of Los Angeles County, Los Angeles, CA; UMC-Dean E. Metter Memorial Collection, University of Missouri, Columbia, MO. Unless otherwise indicated, all distribution records are documented by post-metamorphic/hatchling fluid preserved specimens.

We would like to extend our appreciation to D. Drake, T. Gerard, M. Jeppson, K. Korthas, N. Mitchell, B. Peterman and E. Schott for contributing photographs that were used in this note.

AMPHIBIA: CAUDATA (SALAMANDERS)
DARK-SIDED SALAMANDER
Eurycea longicauda
Callaway Co.: Earthquake Hollow Conservation Area (T45N R10W Sec 4); 15 September 2011; B. Peterman (digital image, UMC 2103P).

CENTRAL NEWT
Notophthalmus viridescens
Cooper Co.: Lamine River Conservation Area (T46N R19W Sec 21); 22 February 2011; K. Korthas (digital images, UMC 2095P-2096P).

AMPHIBIA: ANURA (FROGS AND TOADS)
COPE'S GRAY TREEFROG
Hyla chrysoscelis
Cape Girardeau Co: Rt. Y, ca. 6.3 air km ESE Fruitland (T32N R13E Sec 26); 21 May 2011; R. Daniel, B. Edmond (UMC 8781) (verified by call).
Scott Co.: Co. Rd. 307, ca. 6.9 air km ENE Scott City (T30N R14E); 20 May 2011; R. Daniel, B. Edmond (UMC 8779) (verified by call).

GREEN TREEFROG

Hyla cinerea

Jasper Co.: Oronogo ca. 5.3 air km SSE Purcell (T29N R32W Sec 30); 4 September 2010; N. Mitchell (digital image, UMC 1841P) (This record, so far from the documented range, undoubtedly represents an anthropogenic introduction; however, a large breeding chorus observed nearby on 12 June 2011 indicates that the species is now established in Jasper Co.)

SPRING PEEPER

Pseudacris crucifer

Jackson Co.: Blue Springs (T48N R31W Sec 13); 28 September 2011; S.R. Parmerlee (digital image, UMC 2165P).

EASTERN NARROW-MOUTHED TOAD

Gastrophryne carolinensis

Perry Co.: Red Rock Landing Conservation Area (T35N R12E Sec 13); 4 May 2011; J. Briggler, M. Bowyer, K. Cordell, B. Heatherly, J. Ettling (digital image, UMC 2168P).

REPTILIA: SQUAMATA (LIZARDS)

WESTERN SLENDER GLASS LIZARD

Ophisaurus attenuates

Ste. Genevieve Co.: Hawn State Park (T36N R7E Sec 11); 11 April 2011; E. Schott, S. Schell (digital image, UMC 2101P).

REPTILIA: SQUAMATA (SNAKES)

PRAIRIE KINGSNAKE

Lampropeltis calligaster

New Madrid Co.: MO 80, ca. 7.16 air km E East Prairie (T25N R15E Sec 30); 18 March 2011; J. Briggler, T. Johnson (digital image, UMC 2166P).

Perry Co.: Rt. H, 1.55 km W Jct. MO 51 (T36N R11E); 28 September 2011; T. Gerard (digital photo, UMC 2172P).

RED MILKSNAKE

Lampropeltis triangulum

Livingston Co.: Rt. Y, ca. 8.53 km NW Chillicothe (T58N R24W Sec 9); 5 June 1983; B. Hubbs (color photo, LACM PC 1523).

Scotland Co.: Rainbow Rd., 2.09 km SW Jct. Rt. A (T64N R10W Sec 33); 29 May 2011; R. Daniel (digital image, UMC 2055P).

NORTHERN WATERSNAKE

Nerodia sipedon

Scott Co.: General Watkins Conservation Area (T28N R13E Sec 27); 21 May 2011; R. Daniel, B. Edmond (UMC 8793); Rt. N Jct. Rt. D (T28N R15E Sec 33); 21 May 2011; B. Edmond, R. Daniel (UMC 8794). Roth Rd. (T29N R14E Sec 11); 21 May 2011; R. Daniel, B. Edmond (digital image, UMC 2138P).

WESTERN PIGMY RATTLESNAKE

Sistrurus miliarius

McDonald Co.: MO 90 (T22N R29W Sec 31); 26 June 2011; M. Jeppson (digital image, UMC 2159P).

NORTHERN RED-BELLIED SNAKE

Storeria occipitomaculata

Knox Co.: Rt. K, 3.54 km W Jct. Rt. M (T63N R11W Sec 28); 9 October 2011; R. Daniel (digital image, UMC 2084P).

LINED SNAKE

Tropidoclonion lineatum

Putnam Co.: US 136; 4.03 km W Blackbird Creek (T65N R18W Sec 3); 9 October 2011; R. Daniel (digital image, UMC 2088P).

WESTERN SMOOTH EARTHSNAKE

Virginia valeriae

Dent Co.: Sinkin Experimental Forest, Mark Twain National Forest (T32N R3W Sec 16); 5 May 2011; D. Drake, M. Osbourn (digital image, UMC 2097P).

Perry Co.: Rt. A Jct. Co. Rd. 460 (T34N R14E); 22 May 2011; R. Daniel, B. Edmond (UMC 8785).

REPTILIA: TESTUDINES (TURTLES)

SPINY SOFTSHELL

Apalone spinifera

Perry Co.: Indian Creek at Rt. A (T34N R12E Sec 25); 22 May 2011; B. Edmond, R. Daniel (digital image, UMC 2154P).

WESTERN PAINTED TURTLE

Chrysemys picta

Mercer Co.: Rt. P Jct. Elliot Rd. (T65N R24W Sec 7); 18 June 2011; R. Daniel (digital image, UMC 2067P).

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UPDATED MAXIMUM SIZE RECORDS FOR AMPHIBIANS AND REPTILES FROM MISSOURI

Richard E. Daniel
Division of Biological Sciences, University of Missouri, Columbia, MO 65211

A number of new records have been accumulated since the most recent compilation of maximum size records for Missouri amphibians and reptiles (Edmond and Daniel 2001). Size maxima may provide important life history information for a species both within the state of Missouri and across its entire range and often generates considerable interest among the general public (Powell *et al*. 1982). The following list is an updated summary of size maxima for each species taken from Missouri. Previous summaries appear in Powell *et al*. (1982), Powell (1994) and Edmond and Daniel (2001).

Inclusion in this list requires a catalogued voucher specimen housed in an institutional collection. Notable literature records, particularly those of Anderson (1965), are mentioned where appropriate but are not considered valid unless supported by a voucher specimen. Furthermore, some species are not represented by a qualifying adult voucher specimen and are listed without a measurement.

Each entry consists of the species name (listed in alphabetical order within each group), the county from which the specimen was taken, measurement (to the nearest 0.1 cm), the collection abbreviation and catalogue number of the specimen are in parentheses. Asterisks indicate species that are considered extirpated within the state by the Missouri Department of Conservation (MDC). Any comments on the record appear after the entry. Records marked by "†" equal or exceed the record sizes reported in Conant and Collins (1998).

Measurements differ for each group. Snout-vent length (SVL) and total length (TL) are reported for salamanders, lizards and snakes, SVL for anurans and carapace length (CL) is reported for turtles.

The following abbreviations indicate the institutional collections where specimens are deposited: BWMC-Bobby Witcher Memorial Collection, Avila College, Kansas City, MO; CA-Chicago Academy of Science, Chicago, IL; CMSU-University of Central Missouri, Warrensburg, MO; KU-Museum of Natural History, University of Kansas, Lawrence, KS; NWMSU-Northwest Missouri State University, Maryville, MO; SEMSU-Southeast Missouri State University, Cape Girardeau, MO; UMC-Dean E. Metter Memorial Collection, University of Missouri, Columbia, MO; USNM-National Museum of Natural History, Smithsonian Institute, Washington, DC. The Avila College collection was recently transferred to the Museum of Natural History, University of Kansas where new catalogue numbers will be assigned.

CAUDATA (SVL/TL)

†*Ambystoma annulatum* Stone Co: 11.3/23.8 (KU 88905).

Ambystoma maculatum Boone Co: 10.0/21.3 (BWMC 1609)

†*Ambystoma opacum* Montgomery Co: 7.5/13.2 (UMC 2114).

†*Ambystoma talpoideum* Butler Co: 6.9/13.2 (UMC 2806).

†*Ambystoma texanum* Cass Co: 10.2/18.3 (BWMC 4955).

Ambystoma tigrinum Camden Co: 12.7/23.8 (UMC 117).

Amphiuma tridactylum Stoddard Co: 65.0/81.1 (UMC 1571).

Cryptobranchus alleganiensis Dallas Co: 41.0/60.1 (UMC 1547).

Eurycea longicauda Carter Co: 5.7/15.0 (UMC 538).

Eurycea lucifuga McDonald Co: 6.5/17.7 (KU 28059).

Eurycea spelaea Stone Co: 5.9/10.9 (KU 60779).

Eurycea tynerensis Taney Co: 5.1/10.2 (UMC 1982).

Hemidactylum scutatum Phelps Co: 4.2/9.1 (UMC 7662).

Necturus louisianensis Stone Co: 18.5/26.9 (UMC 454).

Necturus maculosus Morgan Co: 22.2/31.2 (KU 89900).

†*Notophthalmus viridescens* Callaway Co: 6.1/12.5 (UMC 348).

Plethodon albagula Butler Co: 8.1/16.9 (KU 89732).

Plethodon angusticlavius Ozark Co: 4.2/8.1 (KU 89681).

Plethodon serratus Cape Girardeau Co: 5.5/10.7 (SEMSU 289).

Siren intermedia Bollinger Co: 28.0/41.9 (UMC 1541).

ANURA (SVL)

Acris crepitans Taney Co: 4.1 (CMSU 106).

Anaxyrus americanus Jackson Co: 10.5 (KU 90238).

Anaxyrus cognatus Jackson Co: 7.4 (KU 90107).

†*Anaxyrus fowleri* Boone Co: 9.7 (UMC 7725).

Anaxyrus woodhousii No record available.

†*Gastrophryne carolinensis* Dallas Co: 3.9 (KU 220524).

Gastrophryne olivacea Ray Co: 3.7 (BWMC 754).

Hyla chrysoscelis Ozark Co: 5.7 (KU 223375).

Hyla cinerea Stoddard Co: 5.8 (KU 176195).

†*Hyla versicolor* Boone Co: 6.2 (UMC 7709).

Lithobates areolatus Bates Co: 11.2 (KU 220022).

Lithobates blairi Johnson Co: 10.0 (CMSU 226).

Lithobates catesbeianus Montgomery Co: 17.0 (KU 218604).

Lithobates clamitans Miller Co: 9.1 (KU 910903).

Lithobates palustris Dade Co: 6.6 (BWMC 1879).

Lithobates pipiens Atchison Co: 7.0 (KU 204084).

Lithobates sphenocephalus Callaway Co: 9.4 (UMC 7135).

Lithobates sylvaticus Stone Co: 6.3 (USNM 58028).

Pseudacris crucifer Wayne Co: 3.2 (KU 176204).

Pseudacris feriarum No record available.

Pseudacris fouquettei No record available.

Pseudacris illinoensis Dunklin Co: 3.8 (KU 90705).

Pseudacris maculata Jackson Co: 3.8 (BWMC 357).

Scaphiopus holbrookii Dunklin Co: 6.9 (KU 90080).

Spea bombifrons Jackson Co: 5.2 (KU 90043).

SQUAMATA (LIZARDS) (SVL/TL)

Aspidoscelis sexlineata Barry Co: 8.4/26.7 (KU 218611).

Crotaphytus collaris Boone Co: 10.5/29.6 (UMC 3475). Anderson (1965) reported a maximum size of 32.2 cm, but no voucher could be located to corroborate the record.

Ophisaurus attenuatus Franklin Co: -/71.3 (KU 222320).

Phrynosoma cornutum No record available.

Plestiodon anthracinus Stone Co: 6.0/17.0 (CMSU 835).

Plestiodon fasciatus Bollinger Co: 7.3/19.9 (CMSU 832).

Plestiodon laticeps Boone Co: 10.8/26.8 (KU 185893).

Plestiodon obsoletus Vernon Co: 9.9/26.8 (KU 88556).

Plestiodon obtusirostris Barton Co: 6.6/17.7 (KU 219997).

Plestiodon septentrionalis Harrison Co: 7.5/20.3 (NWMSU 4015); Worth Co: 8.6/15.0 (incomplete tail) (NWMSU 4020).

Sceloporus consobrinus Cedar Co: 8.1/18.5 (BWMC 4267).

Scincella lateralis Barton Co: 5.4/13.8 (BWMC 4708).

SQUAMATA (SNAKES) (SVL/TL)

Agkistrodon contortrix Wayne Co: 80.9/93.0 (UMC 6688). Anderson (1965) reported a maximum size of 99.2 cm, but no voucher could be located to corroborate the record.

Agkistrodon piscivorus Stoddard Co: 87.7/110.5 (CMSU 98). Anderson (1965) reported a maximum size of 111.7cm, but no voucher could be located to corroborate the record.

Carphophis vermis Scotland Co: 33.3/37.6 (BWMC 2590).

Cemophora coccinea Camden Co: 31.0/36.4 (UMC 4167).

Clonophis kirtlandii Marion Co: 34.9/42.6 (UMC 7979).

Coluber constrictor Chariton Co: 105.3/135.2 (UMC 8799).

Coluber (=Masticophis) flagellum Texas Co: 162.5/193.0 (CMSU 505).

Crotalus horridus Ray Co: 116.4/125.7 (KU 84437). Anderson (1965) reported a maximum size of 182.6 cm, but no voucher could be located to corroborate the record.

Diadophis punctatus Holt Co: 39.5/47.7 (KU 217202).

Farancia abacura Stoddard Co: 96.2/112.4 (UMC 4673).

Heterodon gloydi Scott Co: -/47.0 (CA 8142). Anderson (1965) reported a maximum size of 47.3 cm, but no voucher could be located to corroborate the record. Only two specimens of *H. gloydi* from Missouri are known to exist in museum collections and the species was classified as extirpated by the MDC. Briggler (2004) reported that the species was rediscovered in southeast Missouri and it is currently classified as critically imperiled. The largest specimen captured during an intensive population survey had a total length of 48.0 cm. It was measured by two MDC Natural History Biologists, marked and released.

**Heterodon nasicus* Holt Co: 42.5/52.1 (KU 82089). Anderson (1965) reported a maximum size of 53.7 cm, but no voucher could be located to corroborate the record.

Heterodon platirhinos Pulaski Co: 72.8/86.7 (UMC 8738).

Lampropeltis calligaster Maries Co: 115.1/133.2 (UMC 7977).

Lampropeltis getula Maries Co: 103.6/119.9 (UMC 6890). Anderson (1965) reported a maximum size of 152.2 cm, but no voucher could be located to corroborate the record.

Lampropeltis triangulum Jackson Co: 71.1/83.5 (KU 82237). Anderson (1965) reported a maximum size of 91.4 cm, but no voucher could be located to corroborate the record.

**Nerodia cyclopion* Dunklin Co: 69.3.91.1 (KU 82394).

Nerodia erythrogaster Howell Co: 109.9/131.9 (UMC 7965).

Nerodia fasciata Dunklin Co: 79.6/101.4 (KU 82978).

Nerodia rhombifer St. Clair Co: 118.5/129.5 (CMSU 544). Anderson (1965) reported a maximum size of 137.7 cm, but no voucher could be located to corroborate the record.

Nerodia sipedon Lewis Co: 94.1/119.8 (KU 223910).

Opheodrys aestivus Randolph Co: 50.2/78.3 (UMC 6701).

**Opheodrys vernalis* Harrison Co: 36.5/51.6 (NWMSU, catalogue number unavailable).

Pantherophis emoryi McDonald Co: 102.9/122.0 (KU 81981). Anderson (1965) reported a maximum size of 152.4 cm, but no voucher could be located to corroborate the record.

Pantherophis obsoletus Johnson Co: 164.6/194.1 (UMC 8097)

Pantherophis vulpinus Holt Co: 97.0/115.5 (KU 82077). Anderson (1965) reported a maximum size of 152.4 cm, but no voucher could be located to corroborate the record.

Pituophis catenifer Vernon Co: 156.4/178.2 (KU 83136). Anderson (1965) reported a maximum size of 197.8 cm, but no voucher could be located to corroborate the record.

Regina grahamii Jackson Co: 70.0/85.5 (KU 82597).

Sistrurus catenatus Holt Co: 68.1/76.4 (KU 84563).

Sistrurus miliarius Christian Co: 49.1/55.5 (UMC 8114).

Sonora semiannulata Taney Co: 28.7/34.3 (UMC 4674).

Storeria dekayi Macon Co: 30.0/36.8 (KU 223913).

Storeria occipitomaculata Boone Co: 25.0/30.3 (KU 185933).

†*Tantilla gracilis* Benton Co: 19.9/24.9 (KU 51707).

Thamnophis proximus Montgomery Co: 68.8/95.2 (UMC 8121).

Thamnophis radix Holt Co: 62.0/78.7 (KU 83895). Anderson (1965) reported a maximum size of 84.5 cm, but no voucher could be located to corroborate the record.

Thamnophis sirtalis Boone Co: 81.2/102.7 (UMC 8122).

Tropidoclonion lineatum Jackson Co: 38.0/43.8 (BWMC 4250).

Virginia striatula Moniteau Co: 26.2/31.4 (KU 218665).

†*Virginia valeriae* Jackson Co: 34.2/39.3 (BWMC 1714).

TESTUDINES (CL)

Apalone mutica Benton Co: 30.5 (BWMC 4281).

Apalone spinifera Jefferson/St. Louis Cos: 44.3 (UMC 7968).

Chelydra serpentina Jackson Co: 35.8 (BWMC 4275).

Chrysemys picta Grundy Co: 20.3 (BWMC 1821).

Deirochelys reticularia Stoddard Co: 20.2 (UMC 4106).

Emydoidea blandingii Clark Co: 19.0 (UMC 8749). The specimen given by Powell *et al*. (1982) and Powell (1994) as the size record for this species (KU 91330) is actually a G. geographica.

Graptemys geographica Miller Co: 23.6 (KU 91330).

Graptemys ouachitensis No record available.

Graptemys pseudogeographica Boone Co: 25.0 (UMC 8771).

Kinosternon flavescens Clark Co: 13.2 (UMC 8603).

Kinosternon subrubrum Wayne Co: 11.7 (BWMC 3703).

Macrochelys temminckii Wayne Co: 42.5 (UMC 4109).

Pseudemys concinna Camden Co: 33.6 (UMC 1787P)

Sternotherus odoratus Texas Co: 12.6 (UMC 8098).

†*Terrapene carolina* Jefferson Co: 18.9 (UMC 812P).

Terrapene ornata Jackson Co: 14.0 (BWMC 4368).

†*Trachemys scripta* Platte Co: 29.6 (UMC 7826).

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AQUATIC TURTLES FEASTING ON PERIODICAL CICADAS

Michael A. Powell[1] and Robert Powell[2]
[1]University of Missouri School of Law, Columbia, MO 65211
[2]Department of Biology, Avila University, Kansas City, MO 64145

In 2011, northern and central Missouri experienced a major eruption of 13-year Periodical Cicadas (*Magicicada* sp.), triggering feeding frenzies in birds, fish, and turtles. From 1–7 June at the Lake of the Ozarks (Camden County), we observed at least four species of birds, eight species of fish, and three species of turtles eating cicadas floating on the water's surface. Mixed-species congregations of Red-eared Sliders (*Trachemys scripta*), Eastern River Cooters (*Pseudemys concinna*), and False Map Turtles (*Graptemys pseudogeographica*) (in order of abundance) were evident at numerous locations, but concentrations were greatest at sites under overhanging vegetation, where we saw as many as 15 turtles within 5 m of one another. Individual turtles at the surface would elevate their heads, apparently searching for the nearest cicada, and race up to 3+ m when one was sighted. Regardless of species or size, turtles would grab a cicada and immediately try to consume it, presumably to prevent loss of all or part of the meal to another turtle or fish. We twice observed fish taking cicadas immediately prior to the arrival of a turtle and once observed two turtles (both Sliders) striking simultaneously at the same cicada.

Predation on Periodical Cicadas by birds, fish, and reptiles has been amply documented (e.g., Marlatt, 1907; Allard, 1937; Dybas and Davis, 1962; Reid and Nichols, 1970; Williams and Simon, 1995), with most authors noting that predators frequently concentrate on temporally abundant cicadas to the exclusion of other prey.

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SUMMER BREEDING OF THE SOUTHERN LEOPARD FROG, *Rana sphenocephala* (=*Lithobates sphenocephalus*), IN SOUTHERN MISSOURI

Dana L. Drake and Brittany H. Ousterhout
Division of Biological Sciences, University of Missouri, Columbia, MO 65211

Southern Leopard Frogs have the potential for year-round breeding in the southern regions of their range (Dundee and Rossman 1989), and as having a bimodal breeding periods, in the spring and fall, farther north (see review in Johnson 2004). Southern Leopard Frogs in Missouri had been reported to have one primary breeding period in the spring (Johnson 2000). In the early 2000s, Johnson (2004) encountered fall breeding of Southern Leopard Frogs in central Missouri, with the earliest fall eggs found on 13 August. While conducting pond surveys for larval salamanders on 13 July 2011, we discovered a fresh egg mass of Southern Leopard Frogs in a fishless, semi-permanent water site on Fort Leonard Wood, Pulaski County, MO. A portion of the eggs was hatched and resulting tadpoles were reared to metamorphosis to verify their identification. To our knowledge, this is the only report of summer breeding for this species in the state.

McCallum *et al*. (1994) suggested that fall breeding of Southern Leopard Frogs in northern Arkansas may be inspired by the heavy late summer rains. This was not an applicable explanation in our case, as no precipitation had fallen in the area for weeks prior to the encounter of the fresh egg mass, and diurnal temperatures were in the mid-30°s C, not temperatures that might provide autumnal cues for the breeding leopard frogs. Johnson (2004) suggested that "fall breeding may be a much more common occurrence in more permanent fishless ponds irrespective of rainfall". Our finding supports the idea that breeding in Southern Leopard Frogs is not inspired solely by season, rain events or cooler temperatures often associated with their breeding events.

We do not know whether tadpoles from eggs we encountered in the middle of summer, assuming they survived, metamorphosed out of the ponds in the fall or overwintered in the pond in their larval state. Given that tadpoles of Southern Leopard Frogs that hatched in ponds during the spring metamorphosed out in the summer (Johnson 2000), and that the tadpoles retained for identification purposes in this observation metamorphosed by the end of August, it was certainly possible that tadpoles from eggs laid in July could have metamorphosed out this fall. It may have also afforded some of the tadpoles the opportunity to overwinter as larger tadpoles, and therefore metamorphose in the spring at a larger size, increasing their chances for survival in the terrestrial environment.

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SUCCESSFUL HATCHING FROM AN UNUSUALLY LARGE RACER (*Coluber constrictor*) CLUTCH

Brian S. Edmond

Computer Services, Missouri State University, Springfield, MO 65897

On 21 June 2011 in Greene County Missouri, I encountered a disturbed North American Racer (*Coluber constrictor*) nest in the corner of a vegetable garden. The eggs were apparently originally deposited within an abandoned mammal burrow, but most were lying exposed on the ground or visible without further excavation.

A total of 29 eggs were collected from the site. At least one of the eggs was punctured. Most appeared traumatized *(i.e.,* partially or wholly crushed) and were probably no longer viable (Figure 1). It is not clear whether the nest disturbance was the result of predation or benign mammalian burrowing activity. Eastern Moles (*Scalopus aquaticus*) and a variety of potential nest predators (*e.g*., raccoons, opossums, skunks, armadillos, *etc*.) are common in the area.

Figure 1. Eggs from a large North American Racer clutch.

All of the eggs were oval in shape and exhibited a roughened appearance described by Ditmars (1907) as having been "sprinkled with coarse grains of salt" (Figure 2). Those eggs that appeared whole and undamaged (n=9) were weighed (4.34 ± 0.42g) and measured (29.0 ± 1.3mm x 20.8 ± 1.1mm). All eggs were divided and placed into two covered vessels containing moistened vermiculite. The vessels were placed in a warm area out of the sun and allowed to incubate

On 31 July 2011, four hatchlings were found in and moved to a separate container (Figure 3). Eggs were allowed to incubate for several more days but no additional hatching occurred. A minimum incubation period of 42 days is noted, but the development stage was unknown when the nest was discovered. Hatchlings were weighed (3.22 ± 0.22g) and measured (201.8 ± 10.6mm SVL, 256.3 ± 9.5mm TL).

Ernst and Barbour (1989) reported a typical clutch size for *Coluber constrictor* to be between 9 and 12. Other reported clutch size ranges are 8 to 29 (Trauth *et al*. 2004), 8 to 21 (Johnson 2000), and 1 to 28 (Wright and Wright 1957). Fitch (1963) reported clutch size variance between 2 and 31 (mean 13.6 ± 3.8, n=11) in a Kansas population. Some communal nesting has occurred in *Coluber*, probably due to a lack of suitable nesting areas as described in Brodie *et al*. (1969), Foley (1971), and Swain and Smith (1978). Given the ephemeral nature of the garden location, it seems likely that a single female chose the nest site opportunistically, making this clutch larger than normal for the species.

This encounter marks the second known published account of a North American Racer clutch in Missouri. Smith and Powell (1993) reported a clutch of 16 eggs from a Lincoln County female, with a mean egg size of 30.4 x 20.4mm and mean hatchling TL of 253.9mm (n=9).

Photographs were deposited in the Dean E. Metter Memorial Collection, University of Missouri, Columbia (UMC 2176-2177P).

Figure 2. A single egg, showing the roughened shell characteristic of North American Racer eggs.

Figure 3. Four North American Racer hatchlings.

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A SECOND EXAMPLE OF ALBINISM IN *Lampropeltis calligaster* FROM MISSOURI

Bruce Schuette[1] and Richard E. Daniel[2]

[1]Cuivre River State Park, Troy, MO 63379

[2]Division of Biological Sciences, University of Missouri, Columbia, MO 65211

Partial or complete albinos are rarely encountered in the wild. Dyrkacz (1981), in the most comprehensive review of albinism in North American amphibians and reptiles to date, listed a single specimen of *Lampropeltis calligaster* from Georgia (Collins 1960) and four specimens from the Dallas, Texas area (reported by J.B. Murphy). More recently, Clark *et al*. (1983) reported an amelanistic partial albino from Wyandotte County, Kansas and Pisani (2003) reported a leucistic individual from Lawrence, Douglas County, Kansas.

Hogan and Smith (1998) reported the first amelanistic individual from Missouri. The subadult male was a partial albino with xanthophores and pink eyes collected from a mulch pile in Independence, Jackson County, Missouri. The snake was displayed for a period of time at the Lakeside Nature Center and is currently housed in the herpetology collection at the Museum of Natural History, University of Kansas in Lawrence.

On 24 October 2011, Mr. Roy Reynolds collected a second amelanistic prairie kingsnake as it was crossing MO 47 ca. 11.3 km E of Troy in Lincoln County, Missouri. The snake measured ~68.0 cm in total length and had a snout-vent length of ~59.0 cm. It is a partial albino with xanthophores and pink eyes similar to the specimen from Jackson County. The snake was donated to the Cuivre River State Park where it is currently on display. Photographs were deposited in the Dean E. Metter Memorial Collection, University of Missouri, Columbia, MO (UMC 2178P).

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ADDITIONS TO THE BIBLIOGRAPHY OF REFERENCES ON THE HERPETOFAUNA OF MISSOURI

Compiled by
Richard E. Daniel
Division of Biological Sciences, University of Missouri, Columbia, MO 65211

The following is a list of references dealing with the biology of amphibians and reptiles from Missouri that have been brought to my attention since the publication of Johnson (2000), Powell and Daniel (2000), and Daniel (2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010). Readers are requested to notify the author of any additional references that should be included in future compilations.

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