

2022 SCPARC Annual Meeting

Presentation and Poster Information

Title, presenter, and abstract/description of presentations and posters are listed below. Presentations are listed in order of how they appear on the SCPARC 2022 Annual Meeting Page:

<http://scparc.org/2022-annual-meeting/>

Title: Evidence of determinate growth in American alligators (*Alligator mississippiensis*) in coastal South Carolina

Presenter: Thomas Rainwater

Abstract: Growth patterns of vertebrates are broadly divided into two categories: 1) determinate growth, in which an organism reaches a maximum size after which growth ceases and 2) indeterminate growth, in which growth continues throughout the life of an organism such that body size and age are correlated. The perception that crocodilians exhibit indeterminate growth is common in the general reptilian literature. However, this assumption is frequently based on observations of immature and young adult animals and therefore lacks a complete understanding of adult growth patterns. From 1979-2015, we conducted a mark-capture study of an American Alligator (*Alligator mississippiensis*) population on the Tom Yawkey Wildlife Center (YWC) in coastal South Carolina to examine long-term growth patterns. We found no discernible linear growth in 19 of 31 adult female and 7 of 19 adult male alligators over periods of 5-33 years. Discernible growth occurred in the remaining 24 alligators examined, but these animals were all well below asymptotic size when initially captured. More recently (2018), we had the unique opportunity to examine skeletal growth in an additional adult alligator at YWC based on change in body length measurements over time and confirm these findings using osteohistological analyses (presence/absence of an external fundamental system [EFS]) of long bones. This alligator was captured and measured five times over seven years and exhibited no discernable growth during that period, suggesting skeletal maturity had been attained at or prior to its first capture. Our field assessment of determinate growth in this alligator was osteohistologically confirmed by the presence of an EFS in the animal's humerus, femur, tibia, and fibula. Collectively, these observations provide evidence that both male and female American alligators in a population in coastal South Carolina exhibit determinate growth and add to a growing list of studies suggesting crocodilians as a group exhibit this growth pattern.

Title: A Guide to South Carolina Tadpoles: a work in progress

Presenter: Stephen H. Bennett | SCDNR-Retired

Description: Anurans are important components of many ecosystems, in particular those of the southeastern United States. Global amphibian declines, linked to habitat loss, pathogens/disease, introduced exotics and exploitation are increasing the need for cost-effective survey and monitoring and an increased focus on research.

The most common survey method for frogs has been to focus on vocalizing males during breeding season. This is a widely used method, with a lot of literature to support it and with a little training it can be very accurate. Historically vocalization surveys have relied on skilled participants visiting anuran

breeding sites during a species breeding season. Such surveys can be limited due to a lack of skilled participants and are extremely weather dependent.

Recent development of automated recording devices has greatly improved the efficiency of vocalization surveys. Recording devices can be deployed at known or potential breeding sites, programmed to record, at intervals, for extended periods of time and the data can be analyzed by use of automated software or by researchers themselves. While these recorders represent a very important advancement for anuran surveys they can be very expensive. One automated recorder can cost \$1,000.00 and the software can cost \$500, which can limit the amount of survey effort possible.

One possible solution to the inherent problems of surveying adult anurans is to focus on their larvae ... tadpoles. Tadpoles are relatively easy to collect and many species are present at breeding sites for extended periods of time, allowing for greater flexibility in a sampling schedule.

The problem with tadpole surveys is in identification, and, for some species it can be very problematic. In this presentation the author discusses the possibility of developing a visual guide to South Carolina tadpoles that could be used by field biologists surveying for anurans.

Poster Title: Eastern Newt (*Notophthalmus viridescens*) Localities and Notes From 10 Years of Sampling Across the Southeastern United States

Presenter: Eran S. Kilpatrick | USC Salkehatchie

Abstract: The eastern newt, *Notophthalmus viridescens*, is a semiaquatic salamander ranging throughout most of the eastern United States. Four different eastern newt subspecies are recognized: *N. v. dorsalis* (broken-striped newt), *N. v. louisianensis* (central newt), *N. v. piaropicola* (peninsula newt), and *N. v. viridescens* (red-spotted newt). From 2009 - 2019, we sampled eastern newts in eight states to collect tissue for a genetics study exploring hybridization in *N. v. dorsalis*, *N. v. louisianensis*, and *N. v. viridescens*. Sampling began in South Carolina, the state where the three focal subspecies come into contact. Over time, sampling gradually progressed west to Mississippi and north to Pennsylvania. We captured eastern newts at 102 localities from 86 counties across the eight-state study region. Seventy of the localities represent new, undocumented sites. *N. v. viridescens* composed 63% of detections, followed by *N. v. louisianensis* (23%), *N. v. dorsalis* (12%), and *N. v. viridescens* x *dorsalis* (2%). Adults (n = 675) and larvae (n = 676) composed 98% of the captures with efts (n = 28) representing the remaining portion. Knowledge of documented localities, drought severity, season, and land use history influenced capture success, particularly in the Sandhills and Coastal Plain where detection rates were low despite intensive sample effort. We captured newts in the Coastal Plain most frequently in short hydroperiod wetlands whereas Piedmont and Blue Ridge newts were captured in wetlands spanning the hydroperiod spectrum. The localities we report for *N. v. louisianensis* and *N. v. dorsalis* are significant and should further conservation attention for eastern newt populations in the Atlantic and Gulf Coastal Plain.

Poster Title: Effects of land use type on movement, habitat use, and health state of woodland box turtles

Presenter: Sydney Grant | Winthrop University

Abstract: Anthropogenic land use changes are a major threat to reptiles. To determine the impact of different land use types on the movement and individual fitness of the woodland box turtle (*Terrapene*

carolina carolina), I am tracking turtle movement, measuring body conditions, and collecting microbial samples by swabbing cloacal. Understanding how the woodland box turtle responds to different land use will aid in developing more effective land management strategies.

Poster Title: Influence of Complete Egg Removal During Early Incubation on Maternal Female Alligator Nest Attendance

Presenter: Clarissa Tuten

Abstract: While many studies have examined alligator nesting ecology, little is known about the female's ability to sense egg removal and subsequently alter her maternal behavior. We predicted that maternal females would be able to detect egg removal and reduce nest attendance. The study focused on 18 separate nest sites, removing eggs from 8 nests, and leaving eggs in 10 nests. Nest activity was recorded using game cameras set at each nest site. Images were manually analyzed from each SD card and instances of female nest attendance were recorded in a spreadsheet. "Nest attendance" includes crawling, laying, and digging into the nest as well as laying in the guard hole. Statistical analysis showed that there was no significant change in nest attendance due to egg removal. In fact, three of the nests with the highest nest attendance were nests without eggs. Research on maternal female nesting habits as it relates to complete egg removal would need to be repeated with a larger sample size over a longer time frame to ensure adequate results. Our results were not statistically significant, therefore more data would be needed to fully reject our hypothesis. However, based on the data collected, we concluded that variability of nest attendance was due to individual differences in both maternal instincts as well as behavior, possibly influenced by age, size, and amount of past nesting experience.

Title: Kinship and Breeding Site Philopatry Drive Fine-Scale Genetic Structure in Fragmented Populations of the Gopher Frog (*Rana capito*) in North Carolina

Presenter: Brian S. Arbogast, PhD | UNC Wilmington

Abstract: The Gopher Frog (*Rana capito*) is a threatened species native to the southeastern longleaf pine ecosystem. Although once much more widespread across the southeastern United States, they now occur in North Carolina at only a handful of disjunct sites in the Coastal Plain and Sandhills regions of the state. The long-term persistence of these populations is thus a concern, as is a loss of genetic variation over time. We used mitochondrial and microsatellite markers to better understand the spatial structure of genetic variation and levels of genetic variability across these remaining populations in order to inform conservation and management decisions. Eight unique mitochondrial haplotypes were found, but these were all genetically similar to one another. Levels of genetic diversity based on the microsatellite analyses were similar across populations, but inbreeding coefficients in two populations were significant, suggesting a potential vulnerability to inbreeding depression. All disjunct populations showed significant genetic differentiation, which was not related to geographic distance. Conversely, within populations, the genetic relatedness of individuals between ponds decreased as distance between ponds increased. This kinship pattern is likely driven by strong breeding philopatry (individuals returning to the same ponds across years) and indicates that conservation actions at the scale of <1 km would primarily affect kin groups of Gopher Frogs, whereas conservation actions at scales ≥ 1.5 km would be needed to capture more distantly related individuals. Management efforts should thus focus on local metapopulation dynamics by maintaining multiple breeding ponds at each location, and by enhancing connectivity between these breeding ponds.

Title: StumpCams: Using Trail Cameras to Detect Herps

Presenter: Jeff Hall | NC Wildlife Resources Commission

Abstract: Trail cameras, also called camera traps, have been used to survey and monitor many different types of wildlife. However, these types of cameras have been primarily used with mammals and birds. I will discuss the use of these systems for work with amphibians and reptiles. Deployed in several different sites in eastern North Carolina, I have used trail cameras to “capture” several different herp species, including species of conservation concern such as Eastern Coachwhip and Eastern Diamondback Rattlesnake. There are challenges to using trail cameras with amphibians and reptiles, and I will explore these during the presentation. As methods are further improved, this survey tool offers significant added value to the toolbox for herp conservation.

Title: Salleyland: Discovering South Carolina’s Hidden Biodiversity

Presenter: Whit Gibbons | UGA Savannah River Ecology Lab

Abstract: Salleyland is a 100-acre tract of land in rural South Carolina where discoveries were made serendipitously that reptiles and amphibians might be more abundant than predicted. Bioblitzes during field trips by SCPARC (previously known as SC Herp Society), SCAN, and wildlife classes from colleges and universities, coupled with consistent efforts by friends and family have confirmed the presence of more than 50 species of herps on the site. Experiences at Salleyland offer insights into prospects of inventorying herps on private lands and how citizen science could affect herpetofaunal conservation.

Title: Effects of invasive nonnative plants on the movement of Eastern Box Turtles (*Terrapene carolina carolina*)

Presenters: Hazel Crago and Kiyoshi Sasaki, Ph.D. | Winthrop University

Abstract: Globalized trade has contributed to the dispersal of plant species beyond their natural range. Hundreds of these species have been identified as invasive in their new habitats, thus raising concern for their impacts on native resident animals. Studies on invasive plant impacts on animals have primarily focused on population or community responses. Behavioral responses of individuals remain understudied but are critical in developing an understanding of the processes and mechanisms underlying the population and community level change. To determine how the movement of the Eastern Box Turtles are affected by invasive plants, we mapped the distribution of major invasive plants in an urban forest (Winthrop Woods, Rock Hill, SC) and examined the effects of invasive plants on box turtle habitat selection based on the movements of 16 individual, which were tracked with radiotelemetry from May to October 2021. Generalized linear mixed effect models showed that the probability of home range occurrence (second-order selection) declined with increasing densities of *Elaeagnus umbellata* (autumn olive), *Vinca major* (bigleaf periwinkle), woody species (all woody species pooled), and herbaceous species (all herbaceous species pooled), but not with *Ligustrum sinense* (Chinese privet), *Microstegium vimineum* (Japanese stiltgrass), or *Wisteria sinensis* (Chinese wisteria). Within home ranges (third-order selection), the probability of individual occurrence declined with increasing densities of *E. umbellata*, *L. sinense*, *M. vimineum*, *V. major*, woody species, and herbaceous species, but not with *W. sinensis*. These results suggest that Eastern Box Turtles avoid areas that are densely covered by

invasive plants regardless of their growth forms (woody or herbaceous). The avoidance of invaded patches implies that plant invasion can diminish available habitat for resident animals, thus plant invasion can have long-term impacts on population persistence.

Title: Venom Complexity within Garter Snakes and the Role of Diet in Toxin Diversification

Presenter: Tucker Heptinstall | Parkinson Lab, Clemson University

Abstract: Numerous studies have been conducted on snake venoms to better understand venom complexity, diversity of proteins, and the evolution of toxicity. However, these studies often focus on medically relevant front-fanged species, such as vipers and cobras, which only account for approximately 15% of known snake species. Recent studies have discovered toxins in many species historically considered non-venomous, like the garter snakes. Garter snakes (*Thamnophis*) are a relatively diverse (35 currently recognized species), widespread, and common genus found throughout North America. Because of their diversity, this genus has been used as a model in many ecological and evolutionary studies. However, one area of garter snake natural history that has not been studied in detail is their “venome”. To explore venom evolution in these non-front fanged snakes, we performed assembly and analysis of the Duvernoy’s gland (venom gland) transcriptome from multiple species of the genus *Thamnophis*. Venom gland transcriptomes from *T. chrysocephalus*, *T. conanti*, *T. cyrtopsis*, *T. marcianus*, *T. proximus*, *T. pulchrilatus*, *T. sauritas*, *T. scalaris*, *T. sirtalis*, and *T. sumichrasti* have been completed and show variation between species in toxin gene presence, toxin gene expression, and total toxin expression. These results show venom evolution occurs even between closely related species, and, potentially, at the population level within species. We hypothesize phylogenetic dietary breadth is the primary driver of this venom variation, and future directions of this project will address these questions by comparing phylogenetic dietary breadth to venom complexity. This research will help uncover the selection pressures facilitating the evolution of venom and understand how ecology and natural history shape trait evolution. Our transcriptomic results provide the most complete venom characterization of *Thamnophis* to date, which will allow for comparison with dietary records, and significantly increase our knowledge of venom throughout the Serpentes suborder.

Title: Does small space use area in urban populations of Woodland Box Turtles (*Terrapene carolina carolina*) have fitness and population consequences?

Presenter: Ashley Graham | Winthrop University

Abstract: Human activities now cover more than a third of the Earth’s ice-free land and disrupt the movements of a wide variety of wildlife taxa. Altered movement behavior potentially has detrimental effects on the fitness of individual animals and may contribute to population declines. However, the fitness and population costs of movement change are often unknown. To determine fitness and population costs of altered movement in urban dwelling woodland box turtles (*Terrapene carolina carolina*), we assessed whether body condition and abundance varied with the amount of space the turtles used in 11 forest patches along a gradient of urban land use. Body condition did not vary with space use in either males or females. However, in females, abundance decreased with decreasing space use area along the urban gradient. The apparent lack of decline in body condition with decreased space use suggests that reduced space use does not compromise the health or energetic state in individuals (e.g., through reduced foraging success). We propose that the observed decline in space use area with increasing urban land use is a consequence of selective loss of individuals with large space use area to

human-caused mortality or emigration. Loss of individuals with large space use area may have long-term repercussions on urban populations.

Title: Population Abundance and Movement Patterns of South Carolina Spotted Turtles (*Clemmys guttata*)

Presenter: Parker Gibbons

Abstract: Spotted turtles are a declining species now protected in most states, including South Carolina. Because of their restricted habitat requirements, populations are sparsely distributed across their geographic range. Consequently, field studies have been limited, especially in the southern part of their range. A one-year study conducted in Georgetown County, SC, provides new insight into habitat preferences, movement patterns, and population densities of this unusual turtle.

Title: Using epigenetic age estimation to aid in herpetological conservation

Presenter: Ethan Shealy

Abstract: Knowledge of a population's age distribution is critical when attempting to develop and implement conservation strategies. Age structure can inform susceptibility to spreading disease, provide evidence for fluctuations in mortality over time, and give an idea of the general health of a population. However, many organisms, including most reptiles and amphibians, lack reliable and minimally invasive methods for the estimation of an individual's age when sampled from the wild. Although size is often used to estimate age, there are many genetic and environmental factors which may impact the correlation between these variables, rendering this approach unreliable. However, recent advances in the field of epigenetics have yielded tools which can predict an organism's age from only a small tissue/blood sample. These 'epigenetic clocks' utilize measurements of DNA methylation, a epigenetic modifier nearly ubiquitous in vertebrates, as predictors by modeling the frequency of base modifications at a handful of sites. Here, we show that 'epigenetic clocks' are able to predict age in a squamate reptile by training a model on blood samples from captive, known-age brown anoles (*Anolis sagrei*). Once developed, these tools may also be used to study the drivers of life history traits such as age at first reproduction and maximum lifespan, which can vary greatly both among and within species. One especially significant predictor of maximum lifespan, as well as the rate of epigenetic aging, is sex. Studying differences across the sexes represents a strong approach for assessing the drivers of maximum lifespan due to the nearly identical genetic background and overall increased similarity compared to looking across species. Using our recently generated DNA methylomes, we will assess differences in age-associated methylation patterns between male and female *sagrei*, and use epigenetic clocks to investigate aging trajectories across the sexes.