

SE PARC 2019 Poster Abstracts

Abstracts are organized by first author *last name

RECOVERY OF THE RETICULATED FLATWOODS SALAMANDER ON ESCRIBANO POINT WILDLIFE MANAGEMENT AREA, FL. Timothy C. Abeles*, Emma A. Browning*, Jessica L. Sandoval*, and Vernon S. Compton, The Longleaf Alliance, charlie@longleafalliance.org; Kelly C. Jones, Virginia Tech; Mark A. Winland, Florida Fish and Wildlife Commission.

The Reticulated Flatwoods Salamander (*Ambystoma bishopi*), a federally endangered species, has been reduced to a few isolated sites and two known areas with multiple occupied breeding sites in the Florida Panhandle - Eglin Air Force Base (Eglin) and more recently, Escribano Point Wildlife Management Area (EPWMA). Through the use of the Department of Defense's (DOD) Readiness and Environmental Protection Integration (REPI) program, Eglin's natural resources leadership saw an opportunity for a win-win through greatly accelerating salamander conservation and recovery goals on already existing conservation lands by funding a five-year large-scale recovery effort on EPWMA to help relieve DOD's regulatory burden in marginal habitat and provide a stronger protected area for species recovery. The Longleaf Alliance, Virginia Tech, Georgia Southern, Florida Fish and Wildlife Conservation Commission, and Eglin have dedicated significant existing resources, as well as hiring a new Wildlife Biologist and two biological technicians to execute project objectives on EPWMA. Methods will include large-scale habitat restoration through prescribed burns, manual and chemical treatments to breeding habitat, headstarting of larval salamanders to metamorphosis in cattle tanks, and monitoring through larval sampling and collection of genetic data to determine N_e , diversity, and success of headstarting efforts. During this first year, our goals are to use prescribed fire and mechanical treatment to restore four historical breeding ponds, and to headstart 264 larvae. Based on previous headstarting efforts, 70 – 80% survival is expected, meaning an anticipated 185 to 211 larvae will successfully reach metamorphosis and be released on Escribano Point WMA.

EFFECTS OF SALINITY ON GROWTH, STRESS, AND BEHAVIOR OF HATCHLING *MALACLEMYS TERRAPIN CENTRATA*. Elizabeth A. Ashley*, lizzyashley97@gmail.com, Connor Lake, Cady Carden, Lauren Head, Rebacca Choe, Vanessa K. Terrell, and John C. Maerz, Warnell School of Forestry and Natural Resources, University of Georgia.

Carolina Diamond-backed terrapins reside in southeastern U.S. coastal salt marshes, ecosystems characterized by the competing influences of inland freshwater and marine environments. Terrapins are adapted to intermediate salinities yet frequently face saltwater-inundated marsh habitat with salinities greater than 25 ppt. We investigated how terrapin hatchlings cope with high salinities by examining compensatory behavioral strategies and physiological effects of osmotic stress. We acquired 30 terrapin hatchlings from

Skidaway Island, Georgia and randomly assigned each to one of five salinity treatments: 1, 5, 10, 20, 35 ppt. For 75 days, we monitored behavior, growth, and appetite. We drew blood from hatchlings on day 60 and prepared films to determine heterophil:lymphocyte (H:L) ratios. We found that H:L ratios increased with salinity, indicating high salinity exposure is associated with chronic stress, which may affect wild terrapin health and disease susceptibility. Hatchlings held in high salinities showed saltwater avoidance and freshwater-seeking behaviors. Consistent with previous studies, we found high salinity to be associated with reduced feeding and slowed growth. Growth retardation from chronic high salinity exposure could increase hatchling mortality and alter terrapin spatial demography. However, employing compensatory behaviors may offset severe growth effects in the wild, provided freshwater is accessible. Little is known about hatchling behavior and microhabitat use, and our findings suggest hatchling distribution and survival may be partially dependent on freshwater access. As sea levels and coastal salinities rise, alterations to freshwater sources may have implications for terrapin hatchling survival and population persistence.

BATRACHOCHYTRIUM SALAMADRIVORANS (BSAL) COULD DECIMATE GREEN SALAMANDERS (ANEIDES AENEUS). Bailee Augustino*, E. Davis Carter, Markese Bohanon, Brittany Bajo, Pattarawan Watcharaanantapong, Daniel Malagon, Rajeev Kumar, Debra L. Miller and Matthew J. Gray. University of Tennessee Center for Wildlife Health, baugust3@vols.utk.edu

Green salamanders (*Aneides aeneus*) are declining throughout their Appalachian range and are listed as an IUCN Near Threatened species and are endangered in North Carolina. Habitat loss has been identified as a driver; however, other factors such as pathogens could play a role as individuals become confined to fewer habitat fragments. *Batrachochytrium salamadrivorans* (Bsal) is an emerging fungal pathogen that is causing declines in European fire salamanders (*Salamandra salamandra*), and could be introduced into the United States through international trade. Understanding the threat of Bsal to native species is key to understanding invasion risk and organizing disease intervention strategies if the fungus is introduced. We tested the susceptibility of green salamanders to infection and development of Bsal chytridiomycosis by exposing individuals housed at 15C to one of four Bsal zoospore doses ($5 \times 10^{3-6}$). Nearly all animals exposed to Bsal became infected, developed necrotic ulcers through the epidermis, and died in <2 months post-exposure. Salamanders exposed to the highest two zoospore doses died in <2 weeks and there was a trend for individuals to stop using cover objects as chytridiomycosis developed. These results demonstrate that Bsal is a significant threat to green salamanders, and precautions should be taken to ensure introduction does not occur in North America.

PLETHODON MERIDIANUS: LOOKING OUTSIDE THE PARK. Alan M. Babineau*, East Carolina University, babineau14@ecualumni.ecu.edu, David A. Beamer, Nash Community College, dabeamer973@nashcc.edu

The South Mountain Gray-Cheeked salamander (*Plethodon meridianus*) is historically known from 3-4 localities within South Mountain State Park. With much of the surrounding area owned by private landowners, there has been little sampling conducted outside of the State Park limits. In order to better delineate the range of *P. meridianus*, we sampled gray-cheeked salamander populations in the surrounding area between the Blue Ridge escarpment and Bakers Mountain (an isolated peak south of Hickory, NC). We sequenced a ~1200bp fragment of the ND2 mitochondrial gene to serve as our species identifier since *P. meridianus* share similar morphological characteristics as the other three members of the gray-cheeked salamander complex. We analyzed our sequence datasets in a Bayesian phylogenetic framework and compared our sequence to known sequence of *P. meridianus*. Our data identified localities of *P. meridianus* extending further North, South, East, and West than previously recognized as well as a potential contact zone between *P. meridianus* and a second gray-cheeked salamander, *P. amplius*.

CHANGES IN EASTERN NEWT BEHAVIOR ASSOCIATED WITH *BATRACHOCHYTRIUM SALAMANDRIVORANS* (BSAL) CHYTRIDIOMYCOSIS

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Batrachochytrium salamandrivorans (Bsal) is an emerging fungal pathogen linked to population declines of salamanders in Europe. While research concerning Bsal is expanding, little is known about how infection influences behavior. Understanding changes in behavior could lead to early detection of the pathogen in the wild during population monitoring of hosts. There may also be ecological implications if behavioral shifts lead to changes in fitness. To better understand if Bsal influences behavior, we exposed adult eastern newts (*Notophthalmus viridescens*) to one of four Bsal zoospore doses (5×10^3 - 6×10^6) and monitored food consumption and movements. After exposure, the newts were held at 14C for 45 days in 300mL of water with a PVC cover object. Each newt was fed bloodworms according to their body mass, and percent consumption was measured. We estimated newt movements by assigning a habitat-use score: newt submerged and under the cover object, submerged but not using the cover object, partially submerged, or newt out of the water. We found that as Bsal chytridiomycosis progressed newts became less likely to be under the cover object, more likely to be out of the water, and they consumed fewer bloodworms. These results suggest that salamander behavior and possibly energetics could be influenced by Bsal infection, which could play a role in the detection of infected hosts and contribute to the epidemiology of Bsal.

HERPETOFAUNAL INVENTORY, NATIVE AND NON-NATIVE, AT TWO NURSERIES IN NORTH GEORGIA. Paul-Erik M. Bakland*, The University of Tennessee at Chattanooga, Paul-Erik-Bakland@utc.edu; Joshua R. Baker, Hartsock's Horticulture Inc.

As part of a long term study evaluating the impact of horticultural business activities on local amphibian and reptile communities, this pilot study seeks to gain preliminary data and establish a baseline on diversity and abundance of native herps in and around two nurseries in North Georgia. The transport and introduction of non-native/invasive species is a commonly noted feature of this type of industry and as such, a primary goal of this study is to monitor and mitigate appropriately. Both nurseries (HHS1 and HHS2) are owned and operated by Hartsock's Horticulture Inc. and are located in Gordon County, Georgia. HHS1 is located in the northeast quadrant of the county and HHS2 in the southwest quadrant. These sites are separated from one another by approximately 13.5 km. In addition to several native amphibians and reptiles documented at each site via incidental encounter, two invasive species have also been detected, a Cuban Treefrog (*Osteopilus serpentrionalis*) and a Brown Anole (*Anolis sagrei*) at HHS1 and HHS2 respectively. To our knowledge, these are the northernmost records for these two species within the state of Georgia.

INTERSPECIFIC COMPARISONS OF MERCURY BIOACCUMULATION IN *NERODIA FLORIDANA* AND *NERODIA FASCIATA* FROM THE SAVANNAH RIVER SITE, SC.

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University of Georgia, University of Georgia Savannah River Ecology Laboratory; Melissa A. Pilgrim, Univ. of South Carolina Upstate; Tracey D. Tuberville, University of Georgia, and University of Georgia Savannah River Ecology Laboratory.

Mercury (Hg) is a ubiquitous environmental contaminant known to bioaccumulate in biota and biomagnify up trophic webs. Watersnakes (*Nerodia* spp.) are high trophic predators with attributes (e.g., abundant, small home range, carnivorous) that make them ideal candidates for studying contaminant uptake and accumulation. At the Department of Energy's Savannah River Site in South Carolina, the Florida green watersnake (*N. floridana*) and the banded watersnake (*N. fasciata*) occur sympatrically in certain aquatic habitats, including former nuclear cooling reservoir systems and isolated wetlands. Although diet may overlap between species, adult *N. floridana* more commonly consume fish, while *N. fasciata* primarily consume amphibians. Habitat type may determine prey sources for either species, while also impacting the bioavailability of Hg. Thus, we compared Hg accumulation between species and aquatic habitats. We also investigated the relationships between body size (SVL) and Hg burdens in each species. We used snake tail tips to approximate total Hg (THg) burden. Our results indicate a significant, positive relationship between SVL and THg in *N. floridana* and *N. fasciata* in both habitats. Average THg was significantly higher for *N. fasciata* compared to *N. floridana* in wetlands (0.24 ± 0.02 & 0.07 ± 0.0006 ppm, respectively; <0.01), but not in reservoirs (0.16 ± 0.01 & 0.18 ± 0.03 ppm, respectively; $p=0.29$). Based on preliminary results, watersnakes appear to be reliable bioindicators of THg, but accumulation may differ between

species and habitats. In this presentation, we will further compare results obtained from isolated wetlands with snakes from former nuclear cooling reservoirs.

DISTRIBUTION OF RANAVIRUSES IN WILD POPULATIONS OF AMPHIBIANS AND REPTILES THE USA. Annastacya K. Carey, Dana E. Brue, Tiffany M. Ward, and Amanda L.J. Duffus* (aduffus@gordonstate.edu), Gordon State College.

Ranaviruses (family: *Iridoviridae*) are a group of globally emerging infections that affect amphibians, reptiles, and fish. They are responsible for many morbidity and mortality events in herpetofauna across the USA every year. Infection with a ranavirus can result in no signs of disease in some individuals, but cause morbidity and mortality in others of the same species. In some species, an outbreak of *Ranavirus* can cause mortality in upwards of 90% of individuals (e.g. Wood Frogs *Rana sylvatica*/*Lithobates sylvaticus*). Currently, ranavirus infections are known to have occurred in over a dozen species of amphibians, three species of reptiles, across most of the United States. However, this is probably an underestimate because many morbidity and mortality events are likely not found and/or investigated thoroughly. Ranavirosis may occur in multiple life history stages of amphibians, however in the USA, it appears to predominantly affect the larval stages. It is important to note that ranaviruses are considered to be a reportable infection in amphibians by the OIE (World Health Organization for Animals) and if a morbidity/mortality event is suspected to be caused by a ranavirus, it should be reported to the appropriate state authorities.

PLETHODON DORSALIS: MICROHABITAT ANALYSIS AND INDIVIDUAL IDENTIFICATION. Tegan Childers*, Team Salamander, and Thomas P. Wilson, University of Tennessee at Chattanooga.

Sampling of *Plethodon dorsalis* (Zig Zag salamander) is being conducted at select sites in the Tennessee River Gorge. Microhabitat is assessed within one square meter of each *P. dorsalis* located along an elevation gradient. This assessment attempts to identify differences in microhabitat preference based on selected versus available habitat. Acquisition of data on microhabitat preference for *P. dorsalis* is ongoing at this time. We are also exploring tracking salamanders with the most minimally invasive method in an effort to maximize recapture, and minimize stress. This makes choosing the best tracking method for identification of unique individuals paramount. We are applying image analysis to identify unique individual *P. dorsalis*. There is a paucity of research on image analysis with Caudates and few of the studies have occurred in situ.

REGIONAL CHARACTERIZATION OF GOPHER FROG BREEDING PONDS IN FLORIDA. Kevin M. Enge* (Kevin.Enge@MyFWC.com) and Anna L. Farmer, Florida Fish and Wildlife Conservation Commission.

Dipnet surveys during the past 10 years detected Gopher Frog (*Lithobates capito*) tadpoles in

329 unique ponds in Florida. Mean pond size is 1.03 ± 1.86 ha (SD) in the Panhandle, 1.55 ± 2.70 ha in the North region, and 1.40 ± 2.39 ha in the South region but does not differ statistically among regions. Median pond size ranges from 0.47 ha in the Panhandle to 0.87 ha in the South region. Most breeding ponds are depression (59.1%) or basin (17.1%) marshes. Sandhill habitat predominates around breeding ponds in the Panhandle and North regions, whereas scrubby flatwoods and scrub predominate in the South region. Wetland and upland habitat types are most diverse in the North region. Presence of fish and crayfish increases from the Panhandle to the South region, where sheet flow across the flatter landscape facilitates colonization of isolated wetlands. Panhandle ponds with Gopher Frog tadpoles did not contain fish, whereas 40.3% of South region ponds had fish, including one pond that had six fish species. Tadpoles of the Southern Leopard Frog (*L. sphenoccephalus*), Barking Treefrog (*Hyla gratiosa*), Southern Cricket Frog (*Acris gryllus*), and Pine Woods Treefrog (*H. femoralis*) are the amphibian species most often associated with Gopher Frog tadpoles; the Mole Salamander (*Ambystoma talpoideum*) and Eastern Newt (*Notophthalmus viridescens*) are mostly restricted to Panhandle ponds. Although Gopher Frog tadpoles were detected every month of the year, November–May is the most productive period to conduct dipnet surveys in Florida.

ALLIGATOR SNAPPING TURTLES (MACROCHELYS TEMMINCKII): WHERE ARE THEY NOW IN WESTERN TENNESSEE? Joshua R. Ennen, Tennessee Aquarium Conservation Institute; Kristen K. Cecala, University of the South; Dustin F. Garig II, Southeast Missouri State University; Saidee J. Hyder, Southeast Missouri State University; Rob L. Colvin, Tennessee Wildlife Resources Agency; Jeremy S. Dennison, Tennessee Wildlife Resources Agency; Andrew J. Feltmann, Southeast Missouri State University; Taylor R. Simmonds, Southeast Missouri State University; Madison A. Herrboldt, Southeast Missouri State University; Caitlin M. Weible, Southeast Missouri State University; Lewis H. Recker, Southeast Missouri State University; and Jon M. Davenport, Southeast Missouri State University and Appalachian State University.

The Alligator Snapping Turtle (*Macrochelys temminckii*) is the largest freshwater turtle in the United States and is distributed within the Mississippi and Gulf Coast river drainages reaching as far north as Iowa. Alligator Snapping Turtles are apex predators in these drainages but have experienced dramatic declines throughout their range due to overexploitation. Despite the type locality from West TN, very little distribution and demographic information is available from this part of their range. From 1992 to 2005, Tennessee Wildlife Resources Agency (TWRA) released 444 Alligator Snapping Turtles into West and Middle Tennessee river drainages. Unfortunately, no data is available determining the success of those introductions. From 2016-2017, we surveyed four West TN drainages to assess the abundance and distribution of AST. A total of approximately 45 sites were trapped with baited hoop nets of various sizes. During the two years of sampling Alligator Snapping Turtles were only detected in 2 of the 45 sites. Preliminary analyses of occupancy for Alligator Snapping Turtles suggests that detection probability may be affected by trap size. In

addition, the occupancy rates of other turtle species appear to be affected by trap size. In the future, we plan to analyze habitat variables that may also affect occupancy rates and detection probabilities along with additional years of trapping data.

MULTISTATE WETLANDS ECOLOGICAL RESTORATION PROJECT: FLORIDA & GEORGIA. Anna Farmer and Kent Williges, Florida Fish and Wildlife Conservation Commission; John Jensen, Georgia Department of Natural Resources; John Maerz, University of Georgia; Jana Mott, The Nature Conservancy; Megan Keserauskis Kunzer, Pierson Hill, Aubrey Greene*, Emily Milbauer, and Barbara Garrow, Florida Fish and Wildlife Conservation Commission, aubrey.greene@myfwc.com.

Geographically isolated wetland habitats are identified as priorities for conservation action in the State Wildlife Action Plans of Florida and Georgia and are home to 73 wildlife species identified as Species of Greatest Conservation Need. Despite their importance for wildlife, isolated wetlands throughout the Southeast are overgrown and hydrologically altered due to fire exclusion and incompatible fire regimes, greatly reducing their ability to support native wildlife. As part of a multistate wetlands ecological restoration project aimed to address these concerns, we will restore a minimum of 45 wetlands across the Florida panhandle and southern Georgia using prescribed fire and a variety of shrub and tree removal methods. The wetland vegetation response and the adult and larval occupancy of five species of rare and imperiled amphibians will be monitored at restoration sites pre- and post-treatment to determine effectiveness. In Florida, we will complete a study comparing the amphibian and plant response to light and heavy mechanical wetland restoration techniques to guide future restoration efforts.

A PHYLOGEOGRAPHIC EVALUATION OF THE SIREN OF FLORIDA AND RESULTING TAXONOMIC IMPLICATIONS. Matthew T. Fedler*, Florida Fish and Wildlife Conservation Commission (FWC) and Florida Museum of Natural History, mfedler@ufl.edu; Paul E. Moler and Kevin M. Enge, FWC.

For the last thirty years the genus *Siren* has been rumored to contain several unrecognized species, most under the guise of geographic variability of the Lesser Siren (*Siren intermedia*). Utilizing modern genetic sequencing and analysis, we are creating a comprehensive genetic and morphological dataset for Florida members of the genus, providing a concrete framework for future research into *Siren*. Preliminary genetic analyses indicate that a subset of animals currently recognized as Eastern Lesser Siren (*S. i. intermedia*) in Florida and Georgia are nested with the *Siren lacertina* complex in a clade distinct from all other *Siren*. A second set of genetic lineages form another distinct clade nested between the previously mentioned “lacertina-intermedia” clade and a clade that contains *S. i. texana* and some animals designated *S. i. nettingi*. This second clade’s members are currently unclearly recognized as *S. i. intermedia* or *S. i. nettingi*. It contains several undescribed species including two distinct forms we outline in our poster. Finally, *Siren reticulata* falls sister to the three previously

mentioned clades of *Siren*. In addition to the paraphyly of *S. intermedia*, the high amount of genetic divergence among the four identified *Siren* clades and growing number of species present within each clade indicate that analysis should be expanded to include samples at a finer geographic resolution across the range of the genus.

BEHAVIORAL AND CHEMICAL RESPONSE OF MALE *DESMOGNATHUS FUSCUS* TO POTENTIAL FEMALE PHEROMONE WATER. Rachael Feeney*, Mississippi State University, rzf3@msstate.edu; Allison R. Julien, Mariana Santos-Rivera, Andrew J. Kouba and Carrie K. Vance, Mississippi State University.

Male plethodontid salamanders release pheromones to increase female receptivity during courtship, and in response to female pheromones left in the environment. In some species of plethodontid salamanders, males exhibit strong sexual behaviors like dancing and butterfly walking and produce courtship pheromones in their mental glands. The northern dusky salamander (*Desmognathus fuscus*) is found in the United States and Canada, where the Canadian Carolinian population is endangered. This study measured male behavior in response to female-cloacal-water (FCW). Males were also examined for glandular chemical changes indicating pheromone expression using Near Infrared Reflectance Spectroscopy (NIRS). Female *D. fuscus* (n=4) were soaked in 12.5 ml water for 15 hours to create FCW. Males (n=4) were exposed to FCW and control water (CW). NIRS spectra of the chin, cloaca, and dorsal-tail-base, were collected before and after exposure to FCW to measure possible pheromone expression. On average males interacted more frequently with FCW (63%) than with CW (37%), presumably due to female reproductive pheromones deposited from the cloaca. Males touched the FCW sample significantly ($p < 0.001$) more than the CW sample. Principal Component Analysis (PCA) showed that five factors explained 88-98% of the NIRS spectral variation, meaning that the chemical changes are significant enough to be described by very few eigenvectors. Linear Discriminant Analysis (LDA) yielded >80% accuracy in detecting pheromone expression by males exposed to FCW. These data demonstrate that male *D. fuscus* have a preference for FCW over CW, both in behavior and chemical signatures.

DEVELOPMENT OF A MOLECULAR GENETIC METHOD FOR CHARACTERIZING AMPHIBIAN DIETS. Alexander Funk and Todd W. Pierson, University of Tennessee Knoxville, afunk4@vols.utk.edu.

Dietary studies can provide key insights into the ecology and behavior of animals. Methods common in dietary studies of amphibians (e.g., gastric lavage, fecal analysis, dissection) often fail to identify prey beyond the level of Order, are time intensive, and can be biased against soft-bodied prey. Here, we are developing a DNA metabarcoding assay to characterize amphibian diets from non-invasive fecal samples. In DNA metabarcoding, barcoding loci from mixed community samples (e.g., feces) are sequenced on a next-generation sequencing

platform, and resulting reads are used to identify members of that community (e.g., diet composition). To validate this method, we will prepare COI amplicon libraries from 27 fecal samples collected from wild Blue Ridge two-lined salamander (*Eurycea wilderae*) during the breeding season. We will sequence these reads on an Illumina MiSeq and compare resulting reads against a reference library of sequences of known identity to characterize invertebrate diet composition. Some of our samples are derived from male *E. wilderae* with two alternative reproductive tactics—“searching” and “guarding”. Because the latter is more likely to be found in aquatic habitats in the breeding season, we expect to find a great representation of aquatic invertebrates in its diet. We hope that this method will prove to be more accurate and efficient than previous methods, providing a new, versatile tool with which amphibian diets can be characterized and compared.

SNAKE MOVEMENT IN RESPONSE TO SUPPLEMENTAL FEEDING OF PREY.

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Supplemental feeding is a technique used by land managers in an effort to increase the survival rates of certain target species; however, the use of supplemental feed can elevate small vertebrate populations and potentially concentrate them in smaller areas which may subsequently attract predators. Snakes prefer to hunt in areas with higher prey abundance and diversity and would presumably benefit from hunting near supplementally fed areas. There is little known about how the presence of supplemental feed may indirectly affect snake movement or the potential resulting changes in opportunities for predator-prey interaction. We used radio-telemetry to track Timber rattlesnakes (*Crotalus horridus*), Black rat snakes (*Pantherophis obsoleta*), as well as Northern Bobwhite (*Colinus virginianus*), a commonly managed prey species, over the course of five months within a fed treatment area containing filled stationary feeders and an unfed control area containing empty stationary feeders. We analyzed the data using movement and home range models to test the hypotheses that our study species' home ranges would be smaller and their movements more concentrated around stationary feeders in the fed treatment area in comparison to the unfed control area and result in greater potential for overlap of predator and prey. The results from this study will provide new insight into predator behavior and the potential interactions between predator and prey brought about by the tradeoffs involved in utilizing resources with different spatial distributions.

IMPERVIOUS SURFACE COVER IN URBANIZED AREAS MAY CONTRIBUTE TO BOX TURTLE DECLINE.

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Urbanization has contributed to rapid biodiversity declines on local and global scales. Eastern box turtle declines are widely attributed to urbanization, but quantitative evidence for this claim is lacking. To determine the effects of urbanization on eastern box turtles and underlying mechanisms of population change, we measured the abundance and body condition of turtles along a gradient of impervious surface cover among 11 sites in the South Carolina Piedmont. The data from the first field season showed that females declined significantly as impervious surface cover increased. The body condition of both sexes appeared to decrease with increasing impervious surface cover, but the relationship was not significant. These results suggest that box turtle declines may be partially driven by impervious surface cover and associated changes in resource availability. This study provides preliminary evidence of the urbanized landscape as a mechanism of box turtle decline.

CONSERVATION VALUE OF UNIQUE ECOLOGICAL COMMUNITIES WITHIN PRIVATE, WORKING FORESTS.

Daniel U. Greene*, Weyerhaeuser Company, Daniel.Greene@weyerhaeuser.com; Darren A. Miller, National Council for Air and Stream Improvement; Scott A. Rush, Mississippi State University

Maintaining biodiversity across the landscape is a primary goal of sustainable forestry. In the southern United States, approximately 19% of forests are managed pine (*Pinus* spp.) stands that contribute to biodiversity through maintenance of forested areas, diverse plant communities, successional stages interspersed with mature natural forests, unique ecological communities, and reduced pressure on other forests for wood products. Forest certification systems can also provide a formalized vehicle for achieving biodiversity goals. In addition to production sites, an often-overlooked element of biodiversity conservation that occurs in tandem with many working forests are these unique ecological communities. Several examples of these unique sites include sites defined as “Special Areas” or “Forests with Exceptional Conservation Value” which serve important roles in maintaining landscape-level biodiversity. As an example of this, recent surveys of two sites owned by Weyerhaeuser Company: Old Cove in Webster Co., MS, and Buttahatchee Bluffs in Lamar Co., AL, have yielded numerous rare and at-risk species undocumented elsewhere within the adjoining geography that persist in these landscapes. Both mature hardwood-dominated sites have species typically found elsewhere (e.g., Appalachian Mountains) and are proving to be important sites for many locally unique species of plants, reptiles, and amphibians. Here, we discuss contributions of these sites to biological diversity within private, working forests and opportunities to explore how these special areas help promote and sustain genetic, geographic, and other lifelines of vitality to biodiversity through landscape ecology and conservation.

UPDATE ON LONG TERM HERPETOFAUNAL COMMUNITY RESPONSE TO SILVICULTURE TREATMENTS AT WILLIAM B BANKHEAD NATIONAL FOREST, ALABAMA. TJ Haltigan*, Alabama A&M University, (tjhaltigan@gmail.com), Yong Wang, Alabama A&M University, and William Sutton, Tennessee State University.

Understanding the impacts of forest management techniques on wildlife habitat and community composition is essential for long-term biological conservation. As part of an ongoing long-term research project evaluating the effects of prescribed fire and thinning regimes on herpetofaunal communities using a field experiment consisting of control impact and factorial complete block design from 2005 to 2018, we sampled herpetofauna from May to October. Throughout the sampling period, we collected 2041 individuals representing 41 species (16 amphibians and 25 reptiles) during 2136 trap nights. One-Way UNOVA tests were conducted in order to compare both average species richness and average species diversity across each treatment. Neither Species richness nor species diversity were found to be significantly different among silviculture treatments. The impact of these treatments must be continuously studied in order to understand the long term effects of forest management. Tissue samples from all captured animals are being collected for future analysis of the potential impacts of altered microhabitat characteristics on genetic variation among silviculture treatments.

PREVALENCE OF *OPHIDIOMYCES OPHIODIICOLA* IN TENNESSEE SNAKE POPULATIONS. Cullen T. Harris*, The University of Tennessee at Chattanooga, zyz671@mocs.utc.edu; Team Salamander and Dr. Thomas P. Wilson, The University of Tennessee at Chattanooga.

In recent times it has been well documented that disease has played a major role in population collapse of certain taxa. Amphibian populations have been decimated by chytrid fungus and bats have been heavily impacted by white nose syndrome. In just the past few years a new pathogen, *Ophidiomyces ophiodiicola* or snake fungal disease (SFD), has emerged and has been proven to cause death and declines in North American-endemic snakes. Snakes are extremely important for ecosystem function and play key roles in complex predator-prey relationships. To proactively engage this issue in Tennessee we have begun sampling a variety of suitable serpentes habitat across the state. Non-destructive systematic sampling has been utilized to locate free-ranging snakes throughout a variety of landscapes. Habitat types that have been monitored include wetland, forest, riverine and UTC biological field stations. Utilizing visual encounter surveys, randomized walks and road cruising to locate animals. Once an individual is located it is photographed, assessed for symptoms of SFD and is then subjected to a thorough body swab (using lab grade aseptic cotton swabs) for a period of 45 seconds. Once a sample is collected the animal is released and the sample is placed on ice packs until it can be transferred to a -80-degree Celsius freezer. The goal of this study is to determine where SFD occurs in TN and what species can be considered at risk. This project

will then lead to more specialized research into a potential high magnitude conservation issue.

CONSERVATION OF THE FROSTED FLATWOODS SALAMANDER (AMBYSTOMA CINGULATUM) IN THE APALACHICOLA NATIONAL FOREST, FL. E. Pierson Hill* (Pierson.Hill@myfwc.com), Kevin M. Enge, and Anna L. Farmer, Florida Fish and Wildlife Conservation Commission.

The Apalachicola National Forest (ANF) is one of only two remaining population strongholds for the federally threatened frosted flatwoods salamander (*Ambystoma cingulatum*). Recent larval surveys have indicated precipitous declines and extirpations, mostly attributed to the ecological succession of wetlands due to incompatible prescribed fire practices. Wetland restoration is underway, but populations are unlikely to recover without additional conservation measures. Headstarting has been identified by stakeholders as a potentially effective tool for boosting recruitment and survival while habitats recover. Here we report on the implementation of this strategy in the ANF from 2016-2018. Nearly 2000 eggs were located and rescued from multi-year winter droughts. Rescued eggs were either hatched into “cattle tank” mesocosms or donated to a captive assurance colony. Larvae were raised to metamorphosis before re-release in their natal ponds. Our methods have produced high larval survival rates (80-85%) and the release of nearly 1400 metamorphs back to the wild. Headstarting is paired with mark-recapture at two focal populations and will determine the fate of headstarted populations over time. Return rates have been low in years 1 and 2, but the effort is still in its early stages. Continued monitoring will be necessary to fully evaluate headstarting as an effective conservation strategy.

UNDERSTANDING THE INTERACTIONS BETWEEN DEVELOPMENT AND NEST DEPREDATION IN BOG TURTLES. Michael T. Holden*, Virginia Tech, Michaelholden@vt.edu. Joseph C. Barron II, Jeffery R. Feaga, Emmanuel A. Frimpong, Carola A. Haas, Virginia Tech.

Animals such as raccoons, skunks, and opossums are documented to depredate a wide variety of terrestrial nests. These mesocarnivores are also known to persist in artificially inflated densities in relation to human activity, subsidized by anthropogenic food sources and refuse material. While studies show that these animals both depredate terrestrial nests, and persist at augmented population densities along an urban gradient, there is a lack of understanding on how these factors interact. While numerous species face these depredation pressures, I plan to conduct this research within the context of bog turtle (*Glyptemys muhlenbergii*) conservation. This species is a prime candidate for this research for a number of reasons. *G. muhlenbergii* is declining across much of its range, requiring a thorough understanding of the primary drivers of decline for this species. Additionally, they lay terrestrial nests, with documented depredation by mesocarnivores. These nests are easily replicated, as they are non-randomly placed, small in clutch size, and shallowly laid. To investigate these interactions, I plan to

construct artificial nests in conjunction with camera traps during the 2019 field season. These nests will be placed at varying distances to human developments such as residential structures and roads. Furthermore, by mid-February I plan to conduct a GIS analysis assessing the potential anthropogenic impact on *G. muhlenbergii* wetlands. I will use available spatial data and a previously developed GIS-based habitat model to identify what proportion of wetlands predicted to be suitable for bog turtles in southwest Virginia occur in close proximity to established human infrastructure.

IN SITU USE OF ULTRASONOGRAPHY TO VALIDATE SEX IN WILD

CAUDATES. Addison A. Hoven*, Mississippi State University, aah396@msstate.edu; Allison R. Julien and Carrie Vance, Mississippi State University; Meaghan Gade, Ohio State University.

Caudates exhibit visible sexual dimorphic physiology in expression of nuptial pads, pheromone glands and differing cloacal structure. However, these traits are not only species-specific and seasonal, but also fluctuate throughout the reproductive cycle, thus limiting their use as definitive sexual indicators in wild populations in differential climates. Ultrasonography (US) provides a window into the gonadal structure in males and follicular development in females, thus potentially validating sex as well as providing information about gamete development and fertility. In this study, six species of wild salamanders, *Plethodon shermani*, *Desmognathus ocoee*, *Desmognathus quadramaculatus*, *Desmognathus wrighti*, *Eurycea wilderae*, and *Gyrinophilus porphyriticus* were examined by ultrasound to catalog salamander reproductive anatomy and fertility status; US images were referenced to established images obtained from captive salamanders. A Titan Sonosite Micromaxx with 33-mm linear array transducer 6-13MHz probe was used to collect US images from captive salamanders to validate ovarian and testicular structure, and to develop an egg grading system for breeding status. Egg grades of captive salamanders were established based off long term US data. US images on 252 wild individuals were obtained alongside traditional physiological parameters collected during an on-going mark recapture study in the Nantahala National Forest. Visual sexual dimorphism was not evident in 17% of the wild caudates, but of these, 72% were successfully sexed using US. Ultimately, US could provide an efficient method of evaluating sex and follicular development in wild caudates in-situ, lending another dimension to understanding biotic and abiotic changes in population demographics of native salamanders.

USING CITIZEN SCIENCE TO MONITOR THE NON-NATIVE MEDITERRANEAN

HOUSE GECKO IN CHATTANOOGA, TN. Nyssa Hunt*, University of Tennessee at Chattanooga, nyssa-hunt@utc.edu; Kelly Daniels, University of Tennessee at Chattanooga, kelly-daniels@utc.edu.

Throughout the southeastern United States, Mediterranean House Gecko (*Hemidactylus turcicus*) presence has been documented primarily in urban areas. Given that *H. turcicus* is exotic/non-native and from the Mediterranean region, rapid spreads of populations have become a concern and ecological interactions have yet to be fully understood. The species is known to be nocturnal, take refuge in or near man-made structures, and consume insects around light fixtures; breeding habitat preferences and specifications in diet, however, are not well documented. While regional scale distribution has been mapped, fine scale distribution analysis at the city-level may provide further insight to urban presence and habits. To gain a preliminary understanding of finer distribution, we plan to conduct a rapid assessment using citizen science. Using GIS and spatial data gained from citizen science, we investigate sections of Chattanooga, TN that have been documented with *H. turcicus* presence from 2015 to the present. A preliminary assessment of the reports reveals higher presence documentation throughout sections of downtown Chattanooga, though reports were also documented in suburban areas. This research yields the potential to understand how widespread *H. turcicus* may be in an urbanized environment and may lead into future research regarding its urban ecology.

GROWTH RATES OF TWO NATRICINE SNAKE SPECIES: DIFFERENCES BETWEEN SEXES, AGE CLASSES, AND SITES. Andrew J. Ibach* and Steven J. Price, University of Kentucky.

Growth rates are an important metric from which we can gain significant knowledge regarding reptile ecology and population dynamics. Common species, such as the Common Watersnake (*Nerodia sipedon*) and the Queensnake (*Regina septemvittata*), offer opportunities to investigate differences in growth rates between sites, sexes, and size classes. Our study attempted to assess these differences by surveying seven riparian sites, in central Kentucky over six years (2013-present). These surveys were conducted using a combination of capture mark recapture and passive integrated transponder (PIT) tag telemetry methods. Once captured, Common Watersnakes and Queensnakes were weighed, measured (SVL and TL), and PIT tagged. This not only provided us with the morphometric data we require to calculate growth rates but also allowed for easier recapture using a PIT tag scanner. From these efforts, we examined growth rates in 442 unique individuals that have been captured between 2 and 10 times. We found that males possess higher average growth rates (*N. sipedon* = 0.54mm/day; *R. septemvittata* = 0.35mm/day) than females (*N. sipedon* = 0.48mm/day; *R. septemvittata* = 0.31mm/day) and that juveniles possess higher average growth rates (*N. sipedon* = 0.46mm/day; *R. septemvittata* = 0.43mm/day) than adults (*N. sipedon* = 0.08mm/day; *R. septemvittata* = 0.23mm/day). Our preliminary findings support the idea that male growth rates exceed those of females (particularly at the juvenile stage), provide a framework for future growth modeling within these species, and serve as a valuable reminder of the many environmental and demographic factors to consider when attempting to model reptile growth.

POTENTIAL TRANSMISSION OF SNAKE FUNGAL DISEASE THROUGH WOODEN BOX TRAPS IN BIODIVERSITY STUDY.

Brandon Jack*,
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Snake Fungal Disease (SFD) is caused by an emerging fungal pathogen, *Ophidiomyces ophiodiicola*. Since 2006, massive declines in snake populations have been documented across the eastern United States. *O. ophiodiicola* is a keratinophilic pathogen that can cause open wounds or scar tissue along the body, head, or tail, though not all cases of infection have visible symptoms. One study saw a 40% mortality rate in five Cottonmouths inoculated with the pathogen, however, little has been done to determine the potential human involvement in the transmission of *O. ophiodiicola*. A common method for sampling snake populations is drift fences with wooden funnel traps. This method was used for the first time to survey the snake populations in Northwest Georgia. The purpose of this research was to test if these traps are potential reservoirs for the fungal pathogen. Six drift fences with two wooden box

funnel traps were used to sample the snake populations. Sterile swabbing was performed on three occasions inside the boxes while the traps were actively being used to trap snakes. The swabs will be tested using PCR and qPCR methods to determine presence or absence of *O. ophiodiicola*. We predict that the traps will not act as reservoirs for *O. ophiodiicola* because the traps' materials do not contain keratin; therefore, wooden box traps typically used in drift fence arrays to catch snake species will not further transmit SFD. We anticipate that this study will help establish protocols to prevent human caused transmission of SFD.

DETERMINING A 100-YEAR TIMELINE FOR THREE DEADLY ANURAN PATHOGENS IN FLORIDA, USA.

Emily Karwacki*, Katherine Martin, Anna Savage
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Anuran populations have been documented declining and experiencing mass mortality events since at least the 1970s. Pathogens have played major roles in these declines, in particular the fungus *Batrachochytrium dendrobatidis* (Bd), the iridovirus *Ranavirus* (Rv), and the protist *Perkinsea* (Pr) have been implicated as affecting anurans the worst globally. Despite the extensive bodies of research on Bd and Rv, and the growing body of research on Pr, in many cases it remains unknown how long these pathogens have been in regions, which species are more susceptible, and whether or not they have significantly evolved over time. One way to move these studies forward is by using museum specimens. Museums have numerous specimens, sometimes hundreds of years old, which can be used to detect and analyze pathogen DNA. In this study we used anuran specimens from the Florida Museum of Natural History to study three deadly pathogens. We swabbed specimens, extracted the DNA, and tested presence and intensity via qPCR for each pathogen. We found that Bd and Pr have been infecting Florida frogs since at least 1928, and Rv since at least 1922, and that all

three pathogens are present throughout the state. We were also able to sequence Bd and Pr samples and found multiple SNPs when comparing them to modern sequences. Our analyses also found the first case of tri-infection. Our results show that all three pathogens have been infecting Florida frogs for much longer than previously thought, and that their dynamics may be different than previously thought.

THE ROLE OF REPRODUCTIVE INTERFERENCE AND ENDOCRINE STRESS IN THE DECLINE OF NATIVE GREEN TREEFROGS FOLLOWING CUBAN TREEFROG INVASIONS. Joseph G.C. Kennedy* (jgkenned@go.olemiss.edu) and Christopher J. Leary, The University of Mississippi

Invasive species are a leading cause of global declines in amphibians. In many cases, the ways invasive species negatively affect native amphibians are well known, but in some cases these processes remain enigmatic. For example, invasive Cuban treefrogs (*Osteopilus septentrionalis*) are linked to the decline of several anuran species in Florida but there is little evidence that direct predation, competitive exclusion, and/or transmission of pathogens are contributing factors. Green treefrogs (*Hyla cinerea*) are one species in particular that seem to be highly susceptible to Cuban treefrog invasions. I examined the role of reproductive interference and stress physiology in the decline of green treefrogs following Cuban treefrog invasions. An intriguing aspect of these green treefrog declines is that the advertisement calls of male Cuban treefrogs possess similar spectral and temporal features as the aggressive calls of male green treefrogs. These similarities are important because the production of aggressive calls during intraspecific contests in male green treefrogs elicit an endocrine stress response in contest losers, which suppresses androgen production and reproductive behavior. I will present data from audio playback experiments examining whether courtship signaling by Cuban treefrogs elicits an endocrine stress response and suppression of reproductive behavior in native green treefrogs.

MANAGING HUMAN-ALLIGATOR INTERACTIONS WITH NEGATIVE CONDITIONING: A PILOT STUDY. Anjelika Kidd-Weaver*, Clemson University, anjelic@g.clemson.edu; Tom Murphy, Spring Island Institute; Catherine M. Bodinof Jachowski, Clemson University.

Urban wildlife management requires considering the needs of wildlife and humans in a shared environment. The American Alligator (*Alligator mississippiensis*) is a large predator common to coastal residential landscapes. Alligators may become overly habituated to people, particularly when humans provision supplemental resources (e.g., food). In the worst-case scenarios, over habituation can lead to injurious human-alligator interactions, typically resulting in lethal removal. Negative conditioning has been used to curb over habituation in other large predators and may be useful as a proactive management strategy for alligators. However, the efficacy of negative conditioning for alligators has not been investigated. We conducted flight initiation distance (FID) surveys of naive and previously

captured alligators in two South Carolina golf course communities to investigate whether standard capture-mark-release events could be used to increase FID in alligators. We recorded 4950 FID values from 2009-2018 and used a generalized linear mixed model approach to investigate factors associated with FID. After accounting for season, study site, and size/age class, average FID for previously captured alligators was 52% larger than that of naive alligators. Our results suggest that capture-mark-release events can reduce alligators' tolerance of humans in some habitats. However, additional work is needed to determine whether alligators respond similarly to negative conditioning in a broad range of residential landscapes. Ongoing research will expand upon this study by investigating alligator behavior across a urban-wild habitat gradient, incorporating additional factors such as behavioral phenotypes and an experimental approach to more thoroughly understand alligators' response to negative conditioning.

MORE THAN SKIN DEEP: BLOOD SERUM PROTEIN CHANGES IN RESPONSE TO *BATRACHOCHYTRIUM SALAMANDRIVORANS* CHYTRIDIOMYCOSIS.

Rajeev Kumar*, Agata Grzelak, E. Davis Carter, Markese Bohanon, Matthew J. Gray, and Debra L. Miller, Center for Wildlife Health and College of Veterinary Medicine, University of Tennessee, Knoxville, TN

Recent extirpations of European salamanders by a novel chytrid fungus (Bsal) have been cause for alarm. With Bsal being detected on animals in the pet trade, it is highly probable that Bsal will find its way to the North American continent, which harbors the highest diversity of salamanders on the planet. Despite growing concerns and research, there is still much ambiguity regarding the host immunological responses to Bsal chytridiomycosis. We used serum protein electrophoresis (SPE) to analyze blood proteins (albumin, globulins alpha, beta, and gamma) in eastern newts (*Notophthalmus viridescens*, NOVI), and compared estimates between infected and uninfected individuals, and among the zoospore exposure doses. We found that albumin decreased and alpha globulin increased in infected animals, which is suggestive of an acute immune response (innate not adaptive). From our results, it seems infected NOVI may mount immune responses to Bsal infection, but because nearly all animals that were exposed to Bsal at 14 C in our experiment died, the immune response is likely either too slow or insufficient to prevent disease progression.

SUBLETHAL EFFECTS OF 137 CS AND HG CONTAMINATION IN FLORIDA GREEN WATERSNAKES (*NERODIA FLORIDANA*). Michaela M. Lambert*, University of Kentucky, michaela.lambert@uky.edu; M. Kyle Brown, University of South Carolina Upstate; David L. Haskins, University of Georgia; Amelia L. Russell, University of Georgia; Melissa A. Pilgrim, University of South Carolina Upstate; Tracey D. Tuberville, University of Georgia.

Due to relatively long lifespans and high trophic positions, many reptile species are susceptible to negative impacts from contaminants that bioaccumulate. Nuclear and industrial

activities on the Savannah River Site have resulted in areas with mercury (Hg) and radiocesium (^{137}Cs) contamination. Both contaminants are known to bioaccumulate in reptiles and may alter their physiology. From 10-30 June 2016, we captured *Nerodia floridana* from three former nuclear cooling reservoirs (PAR pond, Pond B and Pond 2). We quantified ^{137}Cs whole body burden and Hg concentration in tail tips of each snake. To estimate the effect of contaminant concentrations on snake metabolism, a SABLE flow-through respirometry system was used to quantify total oxygen consumed by each animal ($\dot{V}\text{O}_2$). Average $\dot{V}\text{O}_2$ for Pond 2 ($8.044\text{ mL/hr} \pm 0.796$) was significantly lower than that of Pond B ($16.678\text{ mL/hr} \pm 2.329$), and PAR pond ($19.694\text{ mL/hr} \pm 4.145$). Pond B and PAR pond snakes had the highest levels of contaminants (^{137}Cs highest at Pond B and Hg at PAR pond). Multiple regression revealed that snake $\dot{V}\text{O}_2$ was significantly associated with Hg and ^{137}Cs concentrations ($p < 0.001$; Hg coefficient = 10.24, ^{137}Cs coefficient = 12.27). One-quarter of the variation in $\dot{V}\text{O}_2$ was associated with contaminant concentrations ($r^2 = 0.26$), indicating higher energetic costs associated with contaminant exposure. However, size, sex, and reproductive condition could also impact among-site variation in oxygen consumption. Future analyses will include more complex models that will refine our interpretation of the magnitude of contaminant effects on *Nerodia floridana* metabolism.

VARIATIONS OF GROWTH WITHIN THE BREEDING AND NON-BREEDING SEASON OF THE RETICULATED FLATWOODS SALAMANDER (AMBYSTOMA BISHOPI). Allison E. Leipold*, lalli96@vt.edu, Nicholas M. Caruso, George C. Brooks and Carola A. Haas, Virginia Tech.

Body size is an important life history characteristic in amphibians where larger individuals typically have higher survival, fecundity, and larger territories. Yet, there is a paucity of data on how growth varies among seasons, sex or other factors. This is especially true for rare and endangered species and limits the development of conservation plans. Therefore, we determined how growth varies within the breeding and non-breeding seasons in the reticulated flatwoods salamander (*Ambystoma bishopi*). Adult salamanders were caught using drift fences surrounding breeding wetlands, and PIT tagged to uniquely identify individuals. Upon each capture, we measured the snout-to-vent length, total length, mass, and volume displaced for each individual. For the growth rate calculation, we analyzed individuals that were captured within a year at the beginning and end of the breeding season (fall to spring) and then at the end of one breeding season and the beginning of the next (spring to fall) and determined the change in each of the four responses between successive captures. We used an analysis of variance to compare the effects of sex and time period on the four different measures of growth rates. We found that between the spring and fall, salamanders decreased in size. In contrast, individuals gained mass during the breeding season, while at breeding wetlands. These results suggest that, in addition to functioning as breeding habitat, ephemeral longleaf pine wetlands provide an important food resource for migrating adults.

INTEGRATING SPATIAL AND TEMPORAL STUDIES TO MODEL SALAMANDER DEMOGRAPHIC RESPONSES TO CLIMATE. John C. Maerz*, Jillian S. Howard, and Kira D. McEntire, University of Georgia; jcmaerz@uga.edu.

In the face of shifting climates, management for biodiversity and associated ecological services requires mechanistic models of species' distributions and abundances. Such models require integration of long-term and spatially extensive demographic studies, and are, therefore, relatively uncommon for animals. Here we demonstrate the integration of a long-term robust capture-recapture study with a spatially extensive "unmarked" study to estimate the sensitivity of salamander vital rates and abundance to weather and climate, and to project salamander population growth across a portion of western North Carolina where rapid development may conflict with the capacity to support salamander population growth under future climate scenarios.

We studied salamanders in the genus *Plethodon*, which are abundant and ecologically influential in forested ecosystems of North America. We found that 28-day survival estimates varied positively through time with mean daily precipitation, and that sensitivity of survival to precipitation declined with increasing body size. Reproductive rate and abundance increased spatially with increasing mean annual precipitation, such that abundant populations in wetter areas had a higher proportion of juveniles compared to less abundant populations in drier areas. Drier habitats had estimates of mean instantaneous population growth <1 , suggesting those habitats may be population sinks sustained by episodic wet years with high recruitment or subsidized by small source habitats such as coves.

EVALUATING FINE-SCALE NEST SITE SELECTION PREFERENCES OF NEOPHYTE AND REMIGRANT LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*). *Sarah E. Martin, University of Georgia, Sem24883@uga.edu; Brian M. Shamblin, University of Georgia; Mark G. Dodd, Georgia Department of Natural Resources; Joseph B. Pfaller, Caretta Research Project; Kristina L. Williams, Caretta Research Project; Katherine Tweedy, Little Saint Simons Ecological Advisory Council; Campbell Joseph Nairn, University of Georgia.

Fine-scale nest site selection (NSS) affects hatching and emergence success in addition to potentially impacting hatchling sex ratios and fitness. Previous studies have demonstrated individual repeatability of NSS preferences, raising concerns about the potential for altering gene pools through relaxed selection on females that consistently nest in poor sites. Previous studies of loggerhead turtle (*Caretta caretta*) NSS suggested neophytes (newly recruited nesters) and remigrants (returning females) may exhibit different NSS preferences, with neophytes tending to nest lower on the beach profile. NSS variation attributable to previous nesting experience has implications for interpreting individual repeatability and clutch relocation practices. We conducted this study on four Georgia barrier islands: Wassaw, Ossabaw, Sapelo, and Little St. Simons Island during the 2018-nesting season. We collected body pit depths (from sand surface to the top of the clutch) as well as egg chamber depths to

incorporate these data into elevation measured using a real time kinematic (RTK) GPS unit. We will analyze these NSS metrics following assignment of clutches to individual females and these females to experience groups via genetic tagging using 16 microsatellite loci. The relative importance of each beach, individual female preferences, and previous nesting experience in determining variation in elevation and DSHTL will be examined. This study will provide further insight into repeatability of individual preferences in NSS and how these may vary between neophyte and remigrant nesters. Preliminary data on the repeatability of behavior among relatives may inform the potential for heritability of NSS preferences.

SIREN INTERMEDIA COLONIZATION OF A RECENTLY CONSTRUCTED WETLAND. C. Kabryn Mattison*, Appalachian State University, Kenzi M. Stemp, and Jon M. Davenport, Appalachian State University and Southeast Missouri State University.

The world has lost 87% of wetlands since 1700, which has undoubtedly affected many wetland-dependent species. While these effects are better understood in other taxa, many amphibian species are highly dependent on wetlands for breeding, foraging, and cover. In response to wetland loss, restoration and construction of wetlands has been increasing, though little is known about how recently constructed wetlands are colonized and used. *Siren intermedia* (Lesser Siren) is a top vertebrate predator in many wetland ecosystems, and can colonize newly constructed wetlands via drainages and channels. To better understand population parameters in a recently constructed (<5 years old) wetland in southeastern Missouri, we monitored a local population for 20 months. Each month, we set 19 minnow traps and checked them daily for 4 trap nights; all captured salamanders were marked and measured in the lab, then released.

In total, we captured 123 unique salamanders. Total biomass was greatest during March 2017 with a maximum of 1755.1g in a single trapping cycle. Peak biomass coincided with peak abundance during late winter. Recaptures were more common in the summer season relative to the other seasons. Preliminary estimates of the population are >500 unique individuals. Our results for peak wetland use by *Siren* are similar to other published studies. Overall, our study demonstrates that *Siren* will utilize newly constructed wetlands and populations have the potential to function similarly to natural wetland habitats. Further studies should investigate the usage of wetland-dependent species of constructed wetlands and best management practices.

HOME RANGE AND MOVEMENT DYNAMICS OF TWO POPULATIONS OF SPOTTED TURTLE (*CLEMMYS GUTTATA*) AT THE SOUTHERN EXTENT OF THEIR RANGE. Jonathan D. Mays*, Florida Fish and Wildlife Research Institute – Florida Fish and Wildlife Conservation Commission, jonathan.mays@myfwc.com.

The spotted turtle (*Clemmys guttata*) is a Species of Greatest Conservation Need in Florida, where it reaches the southern periphery of its range. This species was recently petitioned for listing under the U.S. Endangered Species Act, citing habitat fragmentation and population

declines. Spotted turtles have been documented from 15 counties in Florida, though most records are limited to single specimens found on roads between March and May. Little information exists on the habitat, abundance, distribution, and ecology of spotted turtles in the Southeast, with no previous studies for the species in Florida. Since 2014, we've used radio telemetry and mark-recapture techniques to investigate home range, movement, habitat, seasonal phenology, and population dynamics for two populations of spotted turtles in Florida. Adult home range size varies between sites and individuals, from very small (0.2 ha) to large (47 ha), with an overall mean of 4 ha. Both sexes remain active year-round, with males moving greater distances and utilizing larger areas. Shallow water and abundance of woody debris within wetlands are the most reliable habitat characteristics for predicting spotted turtle presence. Population size at occupied sites is small, with known sites scattered and isolated across the landscape. Spotted turtles in Florida are both uncommon and cryptic, favoring a highly aquatic lifestyle, rarely basking or spending time upland. Results from this study will provide information necessary for the long-term conservation and management of this rare and secretive species.

BOGBOY – A BOG TURTLE (*GLYPTEMYS MUHLENBERGII*) WITHOUT A BOG.

Samuel McCoy*, North Carolina Wildlife Resources Commission,
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Long distance movements by bog turtles (*Glyptemys muhlenbergii*) have rarely been observed. In May 2015 an injured, adult, male bog turtle was found in Alleghany County, North Carolina and reported to the North Carolina Wildlife Resources Commission. He recovered in captivity for two months. We found no wetlands near his site of capture, and the nearest known bog turtle site was 16.0 km away (straightline distance). Thus, we fit him with a radio transmitter in order to track his movement, and released him in a small patch of wetland near his site of capture. We located him once weekly to once biweekly during the active season (spring – autumn), and once monthly during winter. At each location we recorded GPS coordinates, macrohabitat vegetation, and aquatic habitat. He primarily moved in the downstream direction of Kings Creek, and during the active season his monthly movement rate ranged 140-298 m/mo. He preferred being in/near water, specifically streams. Sixtytwo of his 92 locations were in/near a stream, and mean distance to the nearest stream was 13.1 m. Tracking ceased when he was returned to captivity due to severe injuries from a predator. This turtle was tracked over a greater distance and length of time than other examples of long distance movement by bog turtles. He was likely searching for suitable habitat, using Kings Creek as an aquatic corridor. This type of movement was likely more common and possible before current habitat fragmentation, and underscores the importance of habitat connectivity for land managers today.

DO RELATIONSHIPS BETWEEN TEMPERATURE AND BEHAVIOR AFFECT INTRA-SPECIES INTERACTIONS? Ansley Murphy*, murphae0@sewanee.edu; Kristen Cecala, University of the South.

Species may respond to climate change by shifting distributions, changing behavior, or reducing body size. Mismatches in the manner or rate in which organisms respond to change could disrupt well-established ecological and evolutionary patterns. Behaviors of terrestrial, lungless salamanders are known to be closely related to microhabitat conditions including temperature, which is expected to increase in the future. We evaluated exploratory behaviors that could affect rates of interactions among individuals. Specifically, we evaluated the effects of temperature on (1) latency to emerge and area moved, and (2) intraspecific interactions while accounting for potential differences in acclimation to different thermal regimes. While latency to explore a novel habitat did not vary between temperatures, distance and time explored were greater at warmer temperatures. With increased movement, individuals may encounter one another more frequently, and behavior trials indicated higher aggression between individuals at warmer temperatures. As individuals respond to warming temperatures by moving more on the surface and intensifying aggressive interactions, it appears that they are placing themselves at greater risk of injury. Plasticity in behaviors associated with temperature could prove to be adaptive or maladaptive with large-scale temporal shifts in thermal regimes.

INVESTIGATING STUMP HOLES AS A VERTEBRATE REFUGIA IN THE LONGLEAF PINE ECOSYSTEM. Chris M. Murphy*, University of Georgia and Jones Center, chrismurphy618@gmail.com, Lora L. Smith, Jones Center, Steven B. Castleberry, University of Georgia, Joseph J. O'Brien, USDA Forest Service.

Underground refugia are of particular importance in the longleaf pine ecosystem; providing protection from fire in addition to extreme temperatures and predation. Although burrows of the gopher tortoise (*Gopherus polyphemus*) are well-studied and well-recognized as a valuable vertebrate refugium in this ecosystem, the value of pine stump holes as a refugium is under-studied. We conducted a pilot study monitoring vertebrate use of 10 stump holes with trail cameras over the course of one year (September 2016 – August 2017) on Ichauway in Baker County, GA. We documented at least 29 species at stump holes and recorded animals using these habitat features as both refugia and foraging sites. A similar trail camera study was conducted at Ichauway in 2014 investigating vertebrate gopher tortoise (*Gopherus polyphemus*) burrow commensals and documented 36 species. Only 15 of the species documented in that study overlap with those documented in our study. Currently we are investigating the differences between vertebrate use of stump holes of different decay stages and gopher tortoise burrows with a larger scale camera study. Additionally, we are investigating refugia selection by Eastern diamondback rattlesnakes (*Crotalus adamanteus*) through an overwinter telemetry study. As a species that has been documented using both gopher tortoise burrows and stump holes, we are interested in what Eastern diamondbacks are

selecting on our study site and if availability of these refugia within their home ranges influences this selection.

ARTIFICIAL BURROWS MITIGATE THE EFFECTS OF FIRE-SUPPRESSION ON THE GROWTH OF JUVENILE DUSKY GOPHER FROGS. Joseph P. Nacy*, Western Carolina University, nacyjody@hotmail.com; Joseph H. K. Pechmann, jpechmann@wcu.edu, Western Carolina University.

The dusky gopher frog occupies longleaf pine savannas periodically frequented by fire, where grasses and natural burrows are abundant. Gopher frogs avoid fire-suppressed habitat, where the understory is comprised of thick shrubs and there are fewer burrows. It is assumed that fire-suppression creates a suboptimal environment for the frog, but there are few data to support this. We examined growth rates of juvenile dusky gopher frogs in these two habitats and how burrow density affects these rates, using artificial burrows. We released newly metamorphosed frogs into outdoor enclosures in a longleaf pine forest assigned to one of four treatments: frequently-burned, frequently-burned with artificial burrows, fire-suppressed, and fire-suppressed with artificial burrows. We marked and recaptured frogs and recorded their mass and snout-vent length every two weeks from June 2 through August 12, 2018, and again in October 2018 and January 2019. Frogs in frequently-burned enclosures containing artificial burrows had the greatest growth rates. Frogs in fire-suppressed enclosures without artificial burrows had the lowest growth rates. Frogs in the frequently-burned enclosures without artificial burrows and frogs in fire-suppressed enclosures with artificial burrows had strikingly similar growth rates. This demonstrates that increasing burrow density could mitigate the effects of fire-suppression. The results of this research suggest that both controlled burns and artificially created burrows increase growth in these frogs. We recorded warmer temperatures in frequently-burned enclosures than in fire-suppressed, which may explain the higher growth rates in the former. Incorporating artificial burrows into management strategies will facilitate the recovery of this endangered species.

IT'S NOT EASY BEING GREEN? UPDATE ON THE GENETICS AND CONSERVATION STATUS OF THE GREEN SALAMANDER (*ANEIDES AENEUS*) IN TENNESSEE. Matthew L. Niemiller*, University of Alabama in Huntsville, cavemander17@gmail.com; K. Denise Kendall Niemiller*, University of Alabama in Huntsville; Katherine E. Dooley, University of Alabama in Huntsville; Daniel Istvanko, Tennessee Wildlife Resources Agency; Chris Ogle, Tennessee Wildlife Resources Agency; Dustin Thames, Tennessee Wildlife Resources Agency.

The Green Salamander (*Aneides aeneus*) is the only species of the North American genus *Aneides* endemic to the eastern United States. This species is cryptic and historically thought to be habitat specialists, and, therefore, can be difficult to detect and monitor. In Tennessee, Green Salamanders have primarily been found in association with forested, well-shaded sandstone rock outcrops with damp, deep crevices, but recent studies suggest that this species

may use other habitats, such as limestone outcrops and arboreal habitats, more frequently than previously believed. Most populations have been found in the Cumberland Plateau, Cumberland Mountains, and Eastern Highland Rim, but disjunct populations are known from the Central Basin and Short Mountain in central Tennessee and the Appalachian Ridge and Valley, Bays Mountains, Clinch Mountain, and the Great Smoky Mountains in eastern Tennessee. However, the ecology, life history, and genetics of Tennessee populations are poorly understood. Consequently, there is a great need to assess the current distribution of the species in addition to sizes, persistence, health, and genetic relationships of existing populations. Here, we present preliminary results on the status of historical occurrences, updated distribution, habitat use, abundance, life history, and genetics of *A. aeneus* in Tennessee.

SPATIAL ECOLOGY OF EASTERN HELLBENDERS PRIOR TO

TRANSLOCATION. Bradley D. Nissen*, bradnissen915@gmail.com; Emily Nolan, Tennessee State University; Michael Freake, Lee University; Rebecca Hardman, University of Tennessee Knoxville; William Sutton, Tennessee State University.

Successful translocation programs are dependent upon the quality of the habitats where animals are released, and a detailed knowledge of spatial ecology. Due to population declines throughout its range, the Eastern Hellbender salamander (*Cryptobranchus alleganiensis alleganiensis*) is a strong candidate for translocation in Tennessee. We used radio-telemetry to evaluate the spatial ecology (i.e. home range size and movements) and multi-scale habitat use of individual Eastern Hellbenders (N =27) in two sustainable populations to estimate suitable sites for translocations and to establish a baseline that can be used as a comparison after translocation. Our preliminary results of this on-going study show that most Hellbenders do not make frequent or large movements during summer months, and individuals spend most of their time under large (>30 cm) boulders. We found a median home range length of 133 m in Tumbling Creek and 79 m in Hiwassee River. We conclude that large boulders are a vital habitat requirement for translocation sites, and we predict that a successful translocation would involve hellbenders quickly locating suitable habitat and having similar sedentary movement patterns.

COMPARISON OF CHYTRID PREVALENCE IN EASTERN HELLBENDERS IN SOUTHEAST TENNESSEE STREAMS.

Emily Nolan*, Tennessee State University, enolan1@my.tnstate.edu; Brad Nissen, Tennessee State University; Bill Sutton, Tennessee State University; Rebecca Hardman, University of Tennessee; Michael Freake, Lee University.

Populations of Eastern Hellbenders have been declining across their historic ranges due to habitat loss, overcollection, and environmental degradation. The chytrid fungus *Batrachochytrium dendrobatidis* is a leading cause of amphibian species loss, and has been

recorded in hellbenders throughout their range. In this study, 27 hellbenders from two streams in southeast Tennessee were implanted with radio transmitters to track daily movements, determine home range size as part of a larger translocation project. Determining disease prevalence in these hellbenders is crucial as it will help us to monitor overall health of study animals. Hellbenders were swabbed for chytrid once before receiving transmitters and opportunistically throughout the summer. Samples will be tested for presence of *B. dendrobatidis* and *B. salamandrivorans* using qPCR. Chytrid prevalence will be compared between the two study sites, and any infection differences in size class will also be calculated. Summer seasonality of chytrid infection in hellbenders will also be tested as it will provide us with an ideal sampling month for the disease, and to observe any clearing of infection. We predict that approximately 25% of our samples will test positive for Bd based on previous studies, and all will test negative for Bsal as it has not yet been detected in the U.S. This study will provide insights to amphibian disease susceptibility before and after translocation. We will continue to monitor for chytrid in these populations after translocation in order to make informed conservation management decisions for this species.

A COMPARISON OF SALAMANDER COMMUNITIES IN A MANAGED SECTION VERSUS AN IMPACTED ON-CAMPUS SECTION OF A NORTHWEST GEORGIA FIRST ORDER STREAM. Mary K. Pepper*, Dalton State College, mpepper@daltonstate.edu; Brittany N. Flood*, Dalton State College, bflood2@daltonstate.edu; Dakota Smith, Jordan Talley, and Christopher Manis, Dalton State College.

Dalton State College sits at the base of Dug Gap Mountain in North Georgia and includes managed terrestrial and stream habitat within its campus borders. From 2017 to 2019, a community study was conducted in portions of stream reaches and associated terrestrial habitats to investigate salamander species diversity and habitat use. A comparison was made between sections of the stream that received little human impact with those that were directly impacted by human disturbance. We sampled 35-meter-long sections of stream and adjacent terrestrial habitat four days a week using traps, hand capture, and coverboard arrays. Meteorological and sound pollution data were collected daily and morphological data was documented for each specimen captured. The less impacted site had more total captures (N=132) and a similar diversity (N=5) in salamander community when compared to the developed site (N=88; 6). *Desmognathus fuscus* and *D. monticola* retained status as most abundant species detected, accounting for 80.3% of the community population in the protected site and 75.0% in the disturbed site. The additional detected species maintained similar capture rates at each site with *E. cirrigera* (11.7%; 10.2%), *P. glutinosus* (6.1%; 9.1%), *P. ruber* (2.3%; 4.5%), and *P. serratus* (0%; 1.1%) also being observed. Our results indicate that while species diversity has been retained thus far, disturbance from the college campus and supplementary drainage system could be negatively affecting the sustainability of the inhabiting salamander communities.

MONITORING RETICULATED FLATWOODS SALAMANDERS WITH PIT TAG ANTENNAS: OUR FIRST SEASON OF INSIGHTS. Brandon K. Rincon*, brandon6@vt.edu; Nicholas M. Caruso, George C. Brooks, Kelly C. Jones, Carola A. Haas, and Jennifer Smith, Virginia Tech.

Eglin Air Force Base, FL, contains the majority of the remaining known occupied breeding sites for the federally endangered Reticulated Flatwoods Salamander (*Ambystoma bishopi*). At two of these sites, we have been intensively monitoring salamander movements with drift fences and funnel traps, using VIE and PIT tags for mark-recapture, during the breeding seasons starting in Fall of 2010. More recently, we augmented our labor-intensive trap-based monitoring with the use of passive PIT tag antenna arrays. To date, the antennas detected unique individuals that were not captured in traps within a given breeding season, which provides valuable information on the status of marked individuals and will ultimately reduce uncertainty in our estimated survival rates. Additionally, we now have the ability to detect surface activity continuously throughout the year rather than only during discrete times at night during the breeding season, which would not have been logistically feasible with technicians. By spacing parallel antennas radiating out from the wetland edge, we also have our first glimpses of salamander movement from the uplands to the ponds and vice-versa. Finally, with variable timing of early breeding movements, these antennas can increase efficiency in staff time by allowing us to keep a remote finger on the pulse of breeding activity so we can begin actively running drift fences once the antennas detect animal movements. For those looking to explore use of PIT tag antennas for their projects, we will provide recommendations for common problems that may arise with setting up PIT tag antenna arrays.

INVESTIGATING THE RESPONSE OF SALAMANDERS TO RAINFALL VIBRATIONAL CUES. Stephanie Ruck and Adam Koenig, University of Missouri; Jacob Burkhart*, Appalachian State University, burkhartjj@appstate.edu; Sabrina Michael and Reginald Cocroft, University of Missouri.

Water balance is vital component of amphibian survival and fitness. Optimizing decisions to maintain water balance is therefore critical such that individuals can modulate desiccation risk throughout ontogeny. One possibility would be the ability to perceive and respond to rainfall events of varying magnitude that may initiate dispersal, foraging, or courtship movements. To this end, we investigated the response of spotted salamanders (*Ambystoma maculatum*) to the vibrational cues associated with rainfall events. Specifically, we tested whether spotted salamanders emerged from artificial burrows at a higher rate in response to (1) vibrational cues versus silence, (2) vibrational cues of varying intensity (high or low) versus silence, and (3) vibration cues of varying duration (1, 2, or 4 hours) versus silence. All trials were conducted in a controlled laboratory environment using 37 L aquaria containing an artificial burrow and 3 cm of soil at $30\% \pm 5\%$ moisture content. Rainfall vibrational cues were reproduced using surface transducers and digitally filtered to match the spectral and

temporal properties of natural rainfall recordings. We found that individuals emerged at a higher rate in response to a rainfall cue versus silence and at a higher rate in response to higher intensity vibrations. Similarly, individuals showed a slightly increased response to rainfalls of longer duration when compared to silence. Overall, these data suggest that spotted salamanders perceive and respond to the high frequency vibrations in the soil created by rain when initiating emergence from a burrow for dispersal and/or foraging movements.

REFINING HEAD-STARTING TECHNIQUES TO BETTER AUGMENT GOPHER TORTOISE POPULATIONS. Amelia L. Russell*, University of Georgia Warnell School of

Forestry & Natural Resources, University of Georgia Savannah River Ecology Laboratory, amelialr@uga.edu; Kurt A. Buhlmann, University of Georgia Savannah River Ecology Laboratory; Tracey D. Tuberville, University of Georgia Warnell School of Forestry & Natural Resources, University of Georgia Savannah River Ecology Laboratory.

Globally, over half of all extant turtle species are listed as threatened by extinction. Turtles and tortoises are not only a highly sought-after commodity for consumption, medicinal purposes and trade; their habitats are also regularly subjected to fragmentation, degradation, pollution and destruction. Mitigation of these threats require multi-faceted solutions – one of which is population augmentation. We aim to supplement a depleted population of gopher tortoises (*Gopherus polyphemus*) on the 1,894-ha Yuchi Wildlife Management Area (YWMA) in Burke County, Georgia by releasing head-started juveniles reared in captivity. As part of a previous study (2015-2016), 41 of 145 head-started tortoises from three donor populations in Georgia were released at YWMA and radio-tracked. After the 8-month head-starting period, yearlings were equivalent in size to 2-3-year-old wild juveniles. Site fidelity was high and tortoises traveled ≤ 122 m from their release location, never leaving the bounds of the protected area. Overall annual survival for the two cohorts was 70.0%, although survivorship varied dramatically over small spatial scales. Subsequent releases also revealed that head-started yearlings exhibited significantly higher survival until dormancy when compared to directly-released hatchlings (87.7 vs. 56.5%, respectively). Collectively, these results suggest head-starting could be a potentially useful tool for augmenting small populations. We will continue assessing effects of age and size on post-release site fidelity and survival of gopher tortoises head-started in captivity for 2 and 3 years. We will also compare growth and body condition during head-starting and collect a suite of stress metrics (e.g. fecal corticosterone, heterophil:lymphocyte ratios, lactate) as a measure of stress to potentially explain tortoise movement and survivorship post-release.

LONG-TERM MONITORING OF A TURTLE COMMUNITY IN A NORTHWEST GEORGIA LAKE AND WETLAND PRIOR TO, DURING, AND AFTER RESTORATION. Dare Schley*, jschley@daltonstate.edu, Tristan Henley*, jhenley3@daltonstate.edu, Chris Manis, and John Lugthart, Dalton State College.

Although habitat restoration efforts are intended to benefit wildlife populations, some projects may cause a significant short-term disturbance from which populations may take some time to recover. During our seven-year study (2012-2018), turtles have been sampled in a lake and wetland at a public park in Dalton, Georgia in order to assess the effect of habitat restoration on the community. In 2017, restoration of these habitats - including draining of the lake and reconfiguring, laying back, and revegetating its banks - was conducted. In anticipation of the restoration project, five years of monitoring was conducted before restoration. Monitoring was also conducted during the year of restoration and the year following its completion. Sampling was conducted during two-week periods during either June or July of each year. Baited hoop traps were used to collect the turtles. The turtles were weighed, measured, sexed, and marked before being released into the area that they were trapped in. In 2018, the first year post-restoration, the total number of captures and catch per unit effort either exceeded or was similar to values observed in three of the pre-restoration years, suggesting recovery of the turtle community. However, variation in species composition was noted, indicating recovery may have been uneven among species. For example, the relative abundance of *Chrysemys picta* was 2.5-4.4 times lower than previous years.

DO AGGREGATED POPULATIONS OF GOPHER TORTOISES (*GOPHERUS POLYPHEMUS*) REMAIN SOCIALLY ISOLATED FOLLOWING TRANSLOCATION? Philip A. Schulte* and Sharon M. Hermann, Auburn University, Department of Biological Sciences, pas0008@auburn.edu

For a wide range of species, translocation success is often measured in terms of site-fidelity following release of animals, and this aspect of the practice has been followed for gopher tortoises. However, Guyer et al. (2014) reported that a native, intact population of gopher tortoises may exhibit an extensive social network defined by interconnected subunits of the population the authors termed “cliques”. Behavioral responses to a disruption of the social network in gopher tortoise populations has not been reported previously. Because translocation of gopher tortoises is likely to continue in the face of urban development, it is important to determine if aggregated populations form novel social networks. To test that hypothesis, we tracked the movements of 61 gopher tortoises translocated to Nokuse Plantation in Walton Co., FL from June – September 2017. Tortoises from multiple populations were held within one pen. Movements were tracked via radio telemetry and burrow scoping 4-7 days/week and burrow use was recorded for each individual. Burrow shares (two individuals in a single burrow at the same time) and burrow chases (one tortoise occupying a previously occupied burrow) were recorded (Johnson et al., 2009). Burrow shares and chases were used to construct an individual x individual matrix, which was then analyzed using the methods of Girvan and Newman (2002) to determine social network structure. Preliminary analysis suggests that source populations do not remain socially isolated from one another within the same translocation pen.

IS 80 YEARS ENOUGH TIME TO DISPLAY CHARACTER DISPLACEMENT IN SALAMANDERS?: A CASE STUDY. Brittany Shearin*, bashearin961@st.nashcc.edu; Samantha Gaskins and David A. Beamer, Nash Community College.

In the early 1940's, Northern Gray-Cheeked salamanders (*Plethodon montanus*) native to Whitetop Mountain, Virginia, were introduced to the Mountain Lake Biological Station. At the source population, Northern Gray-Cheek salamanders occupy higher elevations, where no other large *Plethodon* species occur. However, at the introduction site, Gray-Cheek salamanders experience a novel contact with a similarly-sized, native *Plethodon* species, the Northern Slimy salamanders (*Plethodon glutinosus*). Previous research has revealed character displacement when two species of large *Plethodon* co-occur. We aimed to test the temporal aspects of character evolution provided by the unique circumstances surrounding the relocation of Northern Gray-Cheek salamanders and ask whether approximately eighty years is enough time to observe character displacement in this population. We collected Gray-Cheeked salamanders from Mountain Lake (n=31) and from Whitetop Mountain (n=34) for comparison using geometric morphometric techniques. We photographed the lateral aspects of each specimen's head and plotted twelve homologous landmarks. We then conducted a relative warps analysis in the Geomorph R software package. The preliminary analysis does not show substantial character displacement in our system.

DEVELOPMENT AND PROGRESSION OF *DERMOMYCOIDES* SP. IN THE CRITICALLY ENDANGERED DUSKY GOPHER FROG (*RANA SEVOSA*). Jaime E. Smith*, University of Southern Mississippi and Western Carolina University twig818@gmail.com; Robin Overstreet, University of Southern Mississippi; Joseph H.K. Pechmann, Western Carolina University.

With a current population of < 200 breeding adults, the dusky gopher frog (*Rana sevosa*) risks extinction if shortened hydroperiods or disease greatly reduce natural metamorphic recruitment. The protist parasite, *Dermomycoides* sp., can cause mass mortalities in ranid tadpoles and is thought to have caused several years of near-zero recruitment of *R. sevosa* at Glen's Pond in Mississippi. While prior work (Atkinson, 2016; Cook, 2008) has shown that at early Gosner stages, *R. sphenoccephala* is highly susceptible to mortality associated with infection of *Dermomycoides* sp., no study has described the susceptibility of *R. sevosa* to *Dermomycoides* sp. Using zoospores of *Dermomycoides* sp. extracted from the liver and intestine of dead, infected *R. sevosa*, we experimentally exposed *R. sevosa* tadpoles from two different egg masses to 0, 25, 75, 150, 200 or 250 zoospores/ μ L at Gosner Stage 25. We monitored tadpoles every other day through metamorphosis for morbidity and mortality associated with infection. Morbid tadpoles were removed and analyzed using qPCR to measure the average increase of infection of *Dermomycoides* sp. after initial exposure across experimental dose groups. Average larval survival in tadpoles exposed to 250 zoospores/ μ L was significantly lower over 87.05 days than the survival in the other experimental dose groups, with no other significant differences across non-zero dose groups. Comparing the

concentration of zoospores of *Dermomycoides* sp. that causes mortality in *R. sevosia* in the lab to concentrations of zoospores in the field will allow us to monitor the risk of potential mortality events in the *R. sevosia* population.

BEHAVIORAL RESPONSES OF HETERODON PLATYRHINOS AND PANTHEROPHIS GUTTATUS TO VISUAL AND CHEMICAL STIMULI. Chris Steinwachs, William McCoy*, James Stroup, and O. Thomas Lorenz, Georgia Southwestern State University, otto.lorenz@gsw.edu.

In this experiment, we examined the behavioral responses of the Eastern Hognose Snake *Heterodon platyrhinos* and *Pantherophis guttatus*, the Corn Snake, to both chemical (conspecific scented substrate) and visual (mirror) stimuli. Another snake specimen will provide both visual and chemical stimuli. Results indicated that hognose snakes were more visually oriented than corn snakes and that the chemical treatment had no significant effect on snake behavior or time spent on treated or untreated substrate. Hognose snakes spent most of their time on the side that had the mirror during mirror treatments, spending an average of 578.3 seconds on the mirror side. By contrast, hognose snakes spent an average of 309 seconds on the scented side during the chemical treatment trials, and corn snakes spent 362.6 seconds on the mirrored side. Hognose snakes performed dramatic defensive displays to the mirrors and eventually pushing behaviors that appeared to be efforts to move into the space occupied by the mirror. There were more of these pushing displays on the mirrored side than the non-mirrored side. By doing this experiment we hope to get a better understanding and appreciation for the diversity of snake behavior and intelligence and even potentially social behavior. We hope to apply this to outreach and future educational activities.

USING TRAIL CAMERAS TO MONITOR SEASONAL MIGRATIONS OF TWO POND-BREEDING SALAMANDER SPECIES. Kenzi M. Stemp*, Southeast Missouri State University, Appalachian State University; Thomas L. Anderson, Southeast Missouri State University, Appalachian State University; Brittany H. Ousterhout, National Great Rivers Research and Education Center; Jon M. Davenport, Southeast Missouri State University, Appalachian State University; and Jake Burkhart, Southeast Missouri State University, Appalachian State University.

Phenology, or the timing of life history events, can be influenced by abiotic factors including rainfall, temperature, and photoperiod. In amphibian communities, the timing of breeding events and arrival order of species can directly influence food web interactions and ultimately whole pond community structure. To better understand the variability of arrival times, we monitored breeding phenology of two fall-breeding salamander species, the Marbled Salamander (*Ambystoma opacum*) and the Ringed Salamander (*Ambystoma annulatum*). We used two drift fences to partially enclose approximately 50% of three wetlands in central Missouri; each fence had an entry point with a wildlife trail camera mounted above to capture photos of adult salamanders moving into and out of wetlands. Cameras were set to capture

images based on a motion trigger and a timelapse, with recordings every minute between 20:00-06:00 from 9/3/2017 - 11/17/17, encompassing the typical movement period during breeding events for these species. Through the fall of 2017, we captured images of 37 *A. opacum* and 139 *A. annulatum* migrating to or from wetlands, with major breeding pulses occurring on 9/17/17-9/18/17 and 10/3/17-10/6/17. Additionally, we captured images of 17 other species of herpetofauna and 11 species of non-herpetofauna, suggesting that camera traps may be a useful and non-invasive tool for monitoring movements of amphibians as well as predator presence at wetlands. The data presented here are the first year of an ongoing monitoring project. We will continue to gather information on the effectiveness of trail cameras to monitor amphibian phenology.

EFFECTS OF ROADS ON MOVEMENT BEHAVIOR OF TEXAS RAT SNAKES (*ELAPHE OBSOLETA LINDHEIMERI*).

Tevin Terry*, Athens State University, tterry3@my.athens.edu; J.D. Willson, University of Arkansas; Brett DeGregorio, University of Arkansas, USACE-ERDC-CERL, University of Illinois-Urbana/Champaign; Jinelle Sperry, USACE-ERDC-CERL, University of Illinois-Urbana/Champaign; Shannon E. Pittman, Athens State University.

Roads act as significant movement barriers for a variety of species, negatively impacting population connectivity, survival, mating behavior, and recolonization rates. These negative impacts may be particularly acute for species with low rates of movement, such as reptiles. Previous studies in the eastern US and Canada have documented the response of rat snakes to roads, showing evidence for neutral responses to roads or road avoidance. We were interested in the impacts of roads on the movement behavior of Texas rat snakes in the oak woodland habitat found around Fort Hood, Texas. We radio-tagged 62 individual snakes in order to observe their free-range movements in response to roads. The landscape was dominated by grass undergrowth and oak overstory. We compared the observed number of road crossings of our radio-tagged snakes to number of expected road crossings for simulated snakes moving randomly in relation to the road. We found little evidence for road avoidance, and we found that some individuals showed evidence for road attraction. The consequences of road attraction for the survival of Texas rat snakes is an important area of future research. These results illustrate potential geographic differences in response to roads among populations of the same or closely related species: Texas rat snakes in this study responded to roads differently than rat snakes in the eastern US and Canada, highlighting the importance of local habitat characteristics in determining the interactions between individuals and anthropogenic disturbance.

SURPRISINGLY HIGH TERRESTRIAL SALAMANDER DENSITIES NEAR THEIR SOUTHERN RANGE EDGE.

Lily M. Thompson*, University of Richmond, lily.thompson88@gmail.com; Raisa Hernández-Pacheco, University of Richmond; Chris Sutherland, University of Massachusetts-Amherst; Kristine L. Grayson, University of Richmond.

Unlike rare or isolated endemic amphibian species, common species provide an opportunity to measure population dynamics across a wide range of environmental conditions in order to examine the processes that determine abundance and shape geographic ranges. Furthermore, studying these species at their range limits provides a window for understanding the dynamics expected in future environments modified by climate change and human impacts. We quantified patterns of seasonal activity, density, and space use in the Eastern red-backed salamander (*Plethodon cinereus*) near its southern range edge and compared the spatial ecology of this population to previous findings from the core of their range. The phenology of surface activity in this southern population was consistent with expectations based on the temperature limitations of warmer climates. However, given the climate and urbanization levels of the study area, this population maintains unexpectedly high densities (up to 5.26/m² on average) and large home ranges (average of 37.0 m² across sites). Our study suggests that ecological factors known to strongly regulate amphibian populations (e.g., temperature, forest fragmentation) are not necessarily constraining this suburban southern population. We hypothesize that local adaptation combined with limited interspecific competition are driving our observed densities and home range sizes. This study highlights the utility of studying a common amphibian as a model system for investigating population processes in environments under strong selective pressure.

CHARACTERIZING THE SOCIAL INTERACTIONS AND VOCALIZATIONS OF GOPHER TORTOISES (*GOPHERUS POLYPHEMUS*). Oscar P. Thompson*

oscar.thompson@uga.edu and Kimberly M. Andrews, Odum School of Ecology, University of Georgia.

As part of an ongoing gopher tortoise (*Gopherus polyphemus*) translocation project in southeast Georgia, we are examining the social interactions between resident and translocated individuals at a local Wildlife Management Area. We employed multiple techniques to study the integration of translocated individuals into a resident population as part of an on-going study: gps and vhf telemetry, and game cameras positioned to overlook the burrow aprons of resident and translocated females. Vocalizations have been observed in turtles and tortoises, yet these behaviors have not been characterized in gopher tortoises. Our specific goal was to identify the frequencies at which gopher tortoises vocalize and to classify the different vocalizations as associated with different behavioral interactions. During the 2018 season, we deployed five SM4 Wildlife Acoustic audio recorders at female burrows that had demonstrated the most frequent social and copulatory interactions with male tortoises. To analyze our data, we used Kaleidoscope, an acoustic analysis software that separates and classifies different vocalizations. By pairing game cameras with audio recorders at female burrow aprons, we trained the software using audio files where we documented a known interaction between individuals. We were able to analyze audio data, pairing the vocalization events with behavioral interactions on the game cameras. To train Kaleidoscope, we

manually identified and labelled vocalization clusters that could then be used as a filter, allowing Kaleidoscope to more accurately screen for tortoise vocalizations in new recordings.

PHYLOGENOMIC EXAMINATION OF A CONTACT ZONE BETWEEN THREE DUSKY SALAMANDER LINEAGES IN SOUTH CAROLINA. Jessica Trueblood, Haley Honeycutt, and David A. Beamer Ph.D, Nash Community College.

Recent phylogenetic reconstructions using genomic datasets have offered eye opening insights into the evolutionary history of dusky salamanders (*Desmognathus*). One striking finding is the presence of multiple species and lineages within salamanders historically considered to represent a single species. This unexpected finding necessitates the examination of contact zones between these recently recognized species/lineages. One such contact zone is located in northern South Carolina near the boundary between the Blue Ridge Escarpment and the Piedmont. In this region three candidate species; *conanti* A, *conanti* F, and *fuscus* C occur. Since previous research has identified hybridization between certain lineages of *conanti* and *fuscus*, a thorough survey of the medium-sized, streamside dwelling dusky salamanders is warranted. To this end we collected both genomic and mitochondrial DNA sequence data which we used to characterize the populations from this region.

DETECTION OF SNAKE FUNGAL DISEASE CAUSING FUNGUS, *OPHIDIOMYCES OPHIODIICOLA*, ON FREE RANGING SNAKES IN MANAGED HABITATS IN NORTHWEST GEORGIA. Jennifer Turner*, jturn148@students.kennesaw.edu, Sara Grimm*, sgrimm5@students.kennesaw.edu; Miranda Gulsby and Thomas McElroy, Kennesaw State University.

Snake fungal disease (SFD), caused by the fungus *Ophidiomyces ophiodiicola*, is a potentially lethal fungal skin infection that is associated with localized declines of many snake populations in North America and abroad. Symptoms include open wounds, dermatitis lesions, abnormal shedding, and behavior, however not all infected snakes exhibit symptoms. This disease was originally documented in rattlesnakes during 2006 and increased survey efforts since have found it in many other snake species. In Georgia, surveys for this disease have been performed heavily in southern portions, but minimal sampling efforts in the northern portion. The research goal is to fill a knowledge gap for the distribution of SFD in the state of Georgia. Our field team sampled snakes using a variety of methods (drift fences, road cruising, and visual encounter surveys) in the Paulding and Sheffield Wildlife Management Areas in northwest Georgia during 2018. Snakes caught using these methods were swabbed in the nasal pits, along the upper lip and along a portion of the body using sterile swabs. For each snake swabbed, photographs and morphometric data were collected to document any skin lesions or characteristic symptoms on SFD. From 11 snake species, we collected a total of 88 swabs during this survey. DNA extractions and PCR laboratory experiments will be conducted to determine presence of *O. ophiodiicola* from the swabs. We anticipate the results will determine the prevalence of *O. ophiodiicola* in free-ranging snakes,

infection variation between species sampled, and add to the distributional knowledge of this disease in Georgia.

PHYLOGEOGRAPHIC ANALYSIS OF SEEPAGE SALAMANDERS

(*DESMOGNATHUS AENEUS*). Henri Vega-Bernal*, Nash Community College, hvegabernal334@st.nashcc.edu; David A. Beamer, Nash Community College.

The Seepage salamander is one of North American's tiniest vertebrates (typically less than 60 mm in full body length) and is one of the smallest salamanders in the world. These salamanders are distributed across a large area in the southeastern United States. However, given their small size and physiological makeup, their potential for dispersal is probably limited which provides the opportunity for diversification. We collected DNA sequence data from ~75 populations and ~200 individuals to test whether there is strong genetic structure across their geographic range. Our phylogenetic reconstruction, based on mitochondrial DNA (COX1) recovers six well supported clades. This result presents the possibility that there is more than a single species of Seepage Salamander.

PREDICTING SOUTHERN ZIGZAG SALAMANDER (*PLETHODON VENTRALIS*) OCCUPANCY IN A FRAGMENTED LANDSCAPE WHILE ACCOUNTING FOR IMPERFECT DETECTION. Bryce Wade and Todd W. Pierson, University of Tennessee Knoxville, bwade12@vols.utk.edu.

Habitat loss and degradation for urban or agricultural use are among the largest factors leading to a decline in biodiversity. Understanding how these land use changes affect the distributions of amphibians and reptiles is important for conservation. The Southern Zigzag Salamander (*Plethodon ventralis*) is a relatively recently described species (1997) and has been the subject of little research. This species can be locally abundant in the Ridge and Valley—including in some urban and disturbed habitats—but populations often appear to be discontinuous across the landscape. Here, we are using repeated sampling of random quadrats and occupancy models to better understand the predictors of *P. ventralis* occupancy among urban forests in Knox County, TN. We plan to evaluate models with site-level occupancy covariates like forest patch size, isolation, and underlying geology and observation-level detection covariates such as temperature and precipitation. We hope that these data will improve our understanding of the local distribution of *P. ventralis* and, more broadly, how amphibians respond to urban development.

EXPLORING MECHANISMS REGULATING INTERSPECIFIC INTERACTIONS IN HEADWATER VERTEBRATE COMMUNITIES. Eli Walker*, walkeeh0@sewanee.edu; Kristen Cecala, University of the South; Josh Ennen, Tennessee Aquarium Conservation Institute; Jon Davenport, Appalachian State University.

Vertebrate communities in headwater streams are assumed to be regulated through competitive and predatory interactions. While documented predation is rare, studies regularly report competitive dominance by fish as larger competitors reliant on aquatic habitat that exclude semi-aquatic salamanders to use marginal stream habitat. However, it is unclear whether fish outcompete salamanders for food, cover, or through the threat of predation. This study sought to determine if competitive outcomes between a headwater fish and headwater salamander were regulated through resource depletion (exploitative competition) or behavioral avoidance (interference competition). We reared mottled sculpin (*Cottus bairdii*) and larval red salamanders (*Pseudotriton ruber*) for 6 weeks in independent flow through mesocosms with intra- and inter-specific pairs allowed to interact or physically blocked from interacting with one another or influencing the available food and cover availability. Mottled sculpin negatively influenced growth of red salamanders regardless of whether they were allowed to physically interact suggesting that this community is regulated through interference competition and behavioral avoidance. The presence of fish also appeared to increase the probability of metamorphosis by larval red salamanders suggesting potential life history implications of co-occurrence with fish.

FATE OF THE FROSTED FLATWOODS SALAMANDER POST HURRICANE

MICHAEL. Rebecca C. Watling, USGS, Gainesville, FL, rebecca.watling42@gmail.com.

St. Marks National Wildlife Refuge is located on the gulf coast of the Florida panhandle. This refuge is home to the federally threatened frosted flatwoods salamander (*Ambystoma cingulatum*). On October 10, 2018, Hurricane Michael struck the region sending salt water storm surge flooding much of the refuge, including many known salamander breeding ponds. We measured the specific conductance (SpC) of ponds using a HydroLab Quanta water quality meter and trapped adult salamanders along drift fences around five ponds to assess the immediate response of salamanders to storm surge. At overwashed ponds, SpC was as much as 217 times greater after the hurricane than it had been in the spring (84 S/cm to 18,200 S/cm), while non-overwashed ponds remained the same. The catch rate for frosted flatwoods salamanders has decreased by 36% relative to the same trapping time frame in 2017, and the total number of captures are dominated by a few non-target species. The full extent of the impact may not be apparent for a few generations, as eggs and larvae are typically the most sensitive to environmental change. With the changing climate, we expect hurricane impact to become a more prevalent threat for this sensitive species.

IMPACTS OF CANOPY DENSITY ON GROWTH AND DEVELOPMENT OF THE STREAMSIDE SALAMANDER (*AMBYSTOMA BARBOURI*) IN MIDDLE

TENNESSEE. Nicole A. Witzel*, Tennessee State University, nwitzel@my.tnstate.edu; Kyle D. McGear*, Tennessee State University, kmcgeary@my.tnstate.edu; and William Sutton, Tennessee State University.

Canopy density affects the amount of sunlight that reaches low-order streams, which can impact organisms that rely upon stream productivity for recruitment and survival. The streamside salamander (*Ambystoma barbouri*) is an ambystomatid salamander native to Middle Tennessee, that uses ephemeral streams of the region for breeding and larval development. To examine the effect of canopy density on *A. barbouri* larval growth, 13 ephemeral stream sites were visited 4 times from December 2016 to May 2017. These sites exhibited a wide range of stream shading, from completely open to almost entirely covered by canopy. We took canopy images and used the program Gap Light Analyzer to measure the amount of canopy openness over the stream sampling transects. We captured larvae within a 50m transect and measured snout to tail length (mm) and mass (g). Our objective was to determine the impact of canopy openness on growth and development of the species. We hypothesized that greater canopy openness would produce larger, more robust *A. barbouri* larvae and at a faster rate when compared to streams with greater canopy cover. Faster growth and metamorphosis are likely to be advantageous to the species, as they would be able to emerge from ephemeral streams and take refuge before the streams dry in the spring. We theorize that *A. barbouri* may be more suited to open or glade habitats, and through urbanization and lack of properly managed systems, may now rely on more heavily wooded streams for reproduction.