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Oral Abstract Booklet

Abstracts are listed alphabetically by first author's last name.
Presenting author is denoted with an asterisk.

TROPHIC AND COMMUNITY STRUCTURE OF SNAKE ASSEMBLAGES IN SHORTLEAF PINE FORESTS WITH DIFFERENT MANAGEMENT REGIMES.

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Land-use practices such as intensive silviculture and fire suppression are common in shortleaf pine forests of eastern Texas. These practices have contributed to the loss of shortleaf pine savannahs that were once widespread throughout the southeast. Fortunately, there is a renewed interest in restoring these ecosystems through the application of forest management techniques (i.e., prescribed fire, thinning). While these applications have been shown to alter forest structure, there is little known about how these efforts influence energy flow and the consumer-resource relationships that determine community structure. Here we present the results on the trophic structure of snake communities at two shortleaf pine sites under different management regimes (high-frequency [A] vs. low-frequency [B]). We captured snakes from May-July in 2018 and 2019 using box traps and drift fences. At each trap we measured 7 habitat variables, and collected dominant basal resources and potential prey. Using stable isotope analysis, we compared community-wide metrics of trophic structure and performed isotopic mixing-models to determine the relative contribution of resources to snake consumers. We found that snakes species from site A exhibited increased trophic redundancy. At site B, we observed trophic divergence between snake species, with species supported by a wider range of resources and relative tropic positions. Mixing-models and prey abundance data suggested food-web structure was influenced by the loss/gain of energetic pathways. Our results imply forest management as a disturbance that can affect the stability of forest food-webs, and impact the resilience of predator guilds in the wake of species loss.

EVOLUTIONARY HISTORY OF THE GREEN SALAMANDER COMPLEX AND THE CONSERVATION STATUS OF A NEW MICRO ENDEMIC SPECIES (*ANEIDES CARYAENSIS*).

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Green salamanders (Plethodontidae: *Aneides aeneus*) are rock outcrop habitat specialists, possessing numerous unique morphological adaptations (e.g., prehensile tail and squared toe-pads) for climbing. Some authors believe *A. aeneus*, which is widely distributed across the Appalachian Mountains of the inland eastern United States, comprises a species complex due to

substantial karyotypic variation among populations. We conducted a population genetic and phylogenetic study across the range of *A. aeneus* and discovered substantial genetic structure, including four distinct lineages, one of which we recently described as *Aneides caryaensis*. Restricted to a narrow geographic distribution in western North Carolina, this species faces pressing conservation threats due to rapid real estate and tourism development in the area. We also recommend the recognition of three geographically distinct and reciprocally monophyletic lineages as evolutionarily significant units due to strong mitochondrial and nuclear differentiation among them. *Aneides aeneus* has been petitioned for listing under the Endangered Species Act, and our study further highlights the need for conservation management of this complex. Our formal recognition of the extent of genetic and evolutionary diversification of the complex is a critical step in establishing conservation strategies.

UNDERSTANDING THE IMPLICATIONS OF PERKINSEA INFECTION IN CUBAN TREEFROGS (*OSTEOPILUS SEPTENTRIONALIS*).

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Invasive species can influence the structure of a community by serving as hosts for pathogens, altering the disease dynamics in a given area. Recent work has identified that the Cuban tree frog (*Osteopilus septentrionalis*), an invasive species in much of the southeast United States, can be heavily infected with the protist pathogen, Amphibian Perkinsea (hereafter Perkinsea). However, little is known about the consequences of these infections and the role that *O. septentrionalis* might play in altering the native disease community. To elucidate the relationship between this invasive host and Perkinsea, we collected *O. septentrionalis* egg masses from Perkinsea-naïve wetlands and hatched the tadpoles in the lab. We then infected the tadpoles with Perkinsea spores at different concentrations (0, 25, 50, 75, 100 spores/µL) and monitored the larvae for 60 days or until metamorphosis. Additionally, we measured the length of the tadpoles through the first four weeks post-inoculation. There was a significant difference in survival among treatment groups ($p = 0.04$) with the 100 spore/µl treatment having the highest mortality of any group. However, none of the tadpoles infected with 25 spores/µl perished, implying *O. septentrionalis* may be able to tolerate low levels of infection. The average weekly growth rate of the uninfected animals was significantly higher than those that were infected with Perkinsea ($p = 0.009$). By understanding the implications of Perkinsea infections in the invasive *O. septontrionalis*, we can begin to better understand the role of *O. septontrionalis* in negatively impacting the communities of Florida's native amphibians.

HIGH SCHOOL HERPETOLOGY: USING PHENOMENA-DRIVEN INQUIRY TO INSTILL A CONSERVATION ETHIC.

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With the ever increasing importance of conservation initiatives due to the global biodiversity crisis, instilling a conservation ethic in students early in their education may be a useful tool in protecting herpetofauna. Here we propose the use of a strategy known as Phenomena-Driven Inquiry (PDI) as a mechanism by which to engage and fascinate high school age students and be

used as a jumping off point for the exploration of conservation related issues. With a focus on students using science to solve real world problems as a core component of the Next Generation Science Standards (NGSS), PDI is rapidly becoming a widely used teaching strategy in STEM education. Here we present PDI as a concept and describe how it can be used in a herpetology classroom to inspire, motivate, drive discussions and problem solving, and most importantly, instill a conservation ethic. Also presented here are the qualitative results of the pilot test using this powerful pedagogy in a high school herpetology class.

USING ECOLOGICAL NICHE MODELING TO DIRECT SURVEY EFFORTS FOR CRAWFISH FROGS (*LITHOBATES AREOLATUS*) IN LOUISIANA.

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One-third of amphibian species globally are experiencing population declines due to habitat loss and alteration, environmental contaminants, disease, introduced species, exploitation, and climate change. The crawfish frog has disappeared throughout much of its historic range primarily due to conversion of its habitat to agriculture. Most Louisiana records are from prior to the 1970s, and more recently the species has been documented at just one location in the extreme northwestern part of the state. In spring 2019, we conducted nighttime call surveys along roads near historic crawfish frog locations in Louisiana and in areas where potentially suitable habitat remains. Despite considerable effort (34 survey nights), we encountered no crawfish frogs. To confirm that our survey routes are in suitable areas for crawfish frogs and to identify other suitable areas for future surveys, we generated a distribution model using locality information from 1990–present from Louisiana, Texas, and Oklahoma, and 12 bioclimatic variables related to temperature and precipitation from the WorldClim database. Our model indicated that marginally suitable conditions for crawfish frogs exist in parts of northern Louisiana, especially the northwestern portion of the state. Perhaps most promising, the model predicted the best conditions occur in a small area that includes a unit of the Red River National Wildlife Refuge where there were unconfirmed reports of calling crawfish frogs in 2008. Future work will incorporate additional environmental data on land cover, soil, and hydrology, and our final distribution model will guide call survey efforts for crawfish frogs across Louisiana in 2020.

GROUND COVER AND NATIVE ANT PREDATION INFLUENCE SURVIVAL OF METAMORPHIC AMPHIBIAN SPECIES OF CONCERN.

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Longleaf pine forests historically supported rich groundcover vegetation maintained by frequent fire but little other disturbance. Groundcover creates microclimates with lower temperatures, higher humidity, and increased soil moisture which provide refugia for wildlife and influence prey and predator communities. High disturbance across the Southeastern United States means that many sites exhibit minimal groundcover consisting of weedy annual species. Additionally, in disturbed soils the ant genera, *Dorymyrmex*, becomes highly abundant; prior observation suggested these ants were predacious and potentially a significant hazard to migrating

metamorphic amphibians. Metamorphic amphibians risk solar exposure and predators as they migrate to upland refugia. Ground vegetation is hypothesized to increase survival of migrating metamorphic amphibians through reducing water loss and providing refuge from predation. Therefore, the objectives of our work are to establish if the native ant genus *Dorymrymex* is a major cause of juvenile amphibian mortality, and to quantify the effects of ground cover and native ant predation on the survival of juvenile amphibians. We used a factorial terrestrial mesocosm design; mesocosms were planted with native wiregrass to represent high (8), moderate (4), and no groundcover (0) with and without ant exclusion treatments. Trials were conducted with Ornate chorus frogs (*Pseudacris ornata*) and Gopher frogs (*Rana* [*Lithobates*] *capito*). *Dorymrymex* species were the dominant cause of mortality. Ant exclusion and ground cover at both levels significantly improved short term survival. The results of this research suggest that minimizing soil disturbance and increasing native groundcover are viable strategies for mitigating juvenile amphibian mortality.

CHALLENGES OF MANAGEMENT ON LAND TRUST OF NORTH ALABAMA PROPERTIES.

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Land trusts are developed for many different reasons. Whether it be to preserve a certain species, greenspace, etc., it can be challenging to conserve areas and species on land trust properties for many different reasons. The Land Trust of North Alabama currently owns roughly 7,600 acres of land, with several properties being open to the public. Opening up properties to the public is very important as it gives future generations the opportunity to enjoy these various habitats as well as help people learn about the importance of conservation, however there is always a juggling act of how to do this in a way which will not degrade habitat quality or potentially impact certain species negatively. For instance, certain features that may be most attractive about a property could also be the areas containing sensitive species, thus putting a dilemma on optimizing recreation and preserving certain habitats. Also, being membership based there is a dilemma of utilizing certain active management techniques which some view as negative (e.g. thinning, prescribed fire), which could be used to increase habitat quality but may come at the cost of membership backlash. Last, comes the issue of even knowing what is present on certain properties. With no biologists on staff, informed volunteers as well as incorporating citizen science are the main sources of data, but the issue still remains that sometimes certain species may be present that go unnoticed. So while preserving land is better than not for species conservation, it does not go without challenges.

URBAN TURTLE PROJECT: GIVING CITIZEN SCIENTISTS OPPORTUNITIES TO PARTICIPATE IN TURTLE CONSERVATION RESEARCH.

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The aim of the Urban Turtle Project is to collect long-term data on the demography, ecology, and conservation of freshwater turtle species that inhabit the rivers and tributaries of the Birmingham metropolitan area. Started in Spring 2018, regular trapping and surveying have been conducted

at sites in the Cahaba River and its tributary of Pinchgut Creek. In addition to these efforts, larger weekend-long surveys have been completed in the Shades Creek (Cahaba River watershed) as well as Valley Creek and Turkey Creek (Black Warrior River watershed) with the assistance of citizen scientists. Another goal of the Urban Turtle Project is to increase the public's awareness of Alabama's impressive turtle biodiversity, and the inclusion of citizen scientists in the field sampling is one method to reach that goal. To date, 57 participants have volunteered over 150 hours and almost 200 turtles have been captured and marked (if deemed of appropriate size). The total catch includes nine species: *Apalone spinifera spinifera, Chelydra serpentina, Graptemys pulchra, Graptemys geographica, Macrochelys temminckii, Pseudemys concinna, Sternotherus minor peltifer, Sternotherus odoratus,* and *Trachemys scripta*. Project data have extended the range of *Macrochelys temminckii* in the Cahaba River and provided important insight into the ecology and demography of *Graptemys pulchra*.

AMERICAN TURTLES SAFE: PRESERVING AMERICAN TURTLES AND BUILDING A PATH FROM CONFISCATION TO CONSERVATION.

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Illegal trafficking is a significant cause of decline in North American turtle populations and, law enforcement efforts to curtail this trade are at a crisis level. The numbers seized in illegal trade exceed the capacity of state and federal agencies and cooperating zoos to hold them. This capacity needs to be expanded. Moreover, there are no established protocols for either releasing confiscated turtles back into the wild or for integrating them into breeding programs to fuel population augmentation and reintroduction efforts.

The broad scope of this problem presented an ideal fit for the Association of Zoos and Aquariums (AZA) SAFE (Saving Animals from Extinction) Program that prioritizes collaboration among AZA institutions and implements strategic conservation and stakeholder engagement activities.

This SAFE Program follows the One Plan approach developed by the IUCN Conservation Planning Specialist Group that supports an integrated approach to species conservation planning through joint development of management strategies and conservation actions, bridging the gap between wild and captive population management.

Focusing on five species of significant conservation concern, this program has three goals:

1. Conserve and expand wild populations of spotted, bog, wood, Blanding's and box turtles.
2. Assist regulators, wildlife managers and law enforcement efforts to protect wild turtles.
3. Develop a pathway for confiscated turtles to contribute to effective conservation efforts.

Ultimately, we hope that this SAFE Program will develop protocols applicable to the conservation of all species of turtles and to the repatriation of confiscated individuals whenever possible.

IN-SITU DETECTION OF HELLBENDERS (*CRYPTOBRANCHUS ALLEGANIENSIS*) OCCUPYING ARTIFICIAL SHELTERS USING SUBMERSIBLE PASSIVE INTEGRATED TRANSPONDER (PIT) TAG SCANNING TECHNOLOGY.

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Cryptic species are difficult to study and often of conservation concern, as typified by the eastern hellbender (Cryptobranchus alleganiensis). Traditional methods for sampling hellbenders involves lifting rocks, which damages essential habitat and can potentially injure both animal and surveyor. Implementation of artificial shelters has made studying hellbenders less dangerous for the animal and less destructive to stream habitat; however, researchers using shelters must often manually capture occupants to identify them. We tested the potential for a submersible portable Passive Integrated Transponder (PIT) antenna to accurately detect PIT-tagged hellbenders within shelters. We tested the effects of the presence and depth of cover rocks on top of shelters, PIT tag location within the shelter, and tag orientation on detection efficiency of hellbenders. For all scanning surveys, occupancy and PIT tag identity was verified manually. For the 32 shelters occupied by a tagged individual with cover rocks in place, the scanner accurately detected 31% of the animals versus 88% when cover rocks were removed. The detection efficiency of the scanner dropped below 50% once cover rock depth exceeded 11 cm. Tags placed near the interface of the entrance tunnel and chamber, or along the chamber walls, had higher detection efficiencies than those in other locations within the shelter. Vertically oriented tags were significantly more likely to be detected than horizontally oriented tags. Our study demonstrates that while this technology has certain limitations, it shows potential as a research tool for studying hellbenders and other taxa without the need to physically handle individuals.

MOVEMENT AND BEHAVIOR OF TRANSLOCATED ADULT ALLIGATOR SNAPPING TURTLES (*MACROCHELYS APALACHICOLAE*) IN THE CHOCTAWHATCHEE RIVER SYSTEM IN NORTHWEST FLORIDA

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Translocation has increasingly been used as a conservation tool for multiple species to reestablish or augment existing populations. Alligator snapping turtle (AST; *Macrochelys apalachicolae*) populations are declining throughout their range, though those in the Florida panhandle are not well studied. The AST population size in the Choctawhatchee River system is unknown but presumed low from state surveys, making it a good candidate site for repatriation efforts. We received 9 confiscated adult ASTs (4 male, 5 female; mean carapace length 423.78mm) from the Florida Fish and Wildlife Conservation Commission and released them at the same location on the East River (a Choctawhatchee River channel) on 6 Sept 2017. ASTs were then radio-tracked to monitor survival and movement. One transmitter failed immediately, and we attempted to locate the remaining eight turtles approximately daily for the first year and 1-2 times per week thereafter. Each individual had 96–299 documented locations from release until 2 May 2019. Two individuals (1 male and 1 female) dispersed >5 miles upriver within the first month. They were found together at the same location numerous times, indicating interaction and potential mating opportunities. The other six remained primarily in the East River and adjacent floodplains, also with some overlapping locations. Though translocation success cannot be accurately measured in the short term for such a long-lived and cryptic species, the establishment of home ranges and continued overlap of turtles suggest that this population is likely to have successful reproduction and recruitment, although further long-term research is warranted.

PARTNERING WITH THE NATURAL RESOURCES CONSERVATION SERVICE TO RESTORE AND CONSERVE WILDLIFE HABITAT ON PRIVATE AGRICULTURAL LANDS

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More than half of all species protected under the Endangered Species Act occur partially or entirely on private lands. In the Southeastern US, which his home to the largest density of imperiled species in the of any region in the country, approximately 75% of the land base is devoted to farming, ranching and forestry. Privately owned working lands play a crucial role in the provision of water quality and quantity, habitat availability, and connectivity, all of which are essential to the survival of many species. For many reptile and amphibian species, habitat and population declines cannot be reversed without active restoration and management of habitat on agricultural lands.

How can conservationists find, champion, and fund much needed habitat protection efforts on agricultural lands at a meaningful scale? The Natural Resources Conservation Service (NRCS), a branch of the US Dep't of Agriculture, is charged with helping America's farmers conserve the nation's soil, water, air and other natural resources. It is also the single largest source of federal funding for conservation. Most importantly, NRCS is increasingly being incentivized to make investments in conservation practices that benefit wildlife. By partnering with NRCS at the federal, state and local level, conservationists can help develop initiatives and guide funding towards conservation outcomes for any species. As a large and complex government bureaucracy, partnering with NRCS can seem daunting. This presentation will offer a guide, with several examples, to developing fruitful partnerships with NRCS that generate win-win outcomes for farmers and wildlife.

INCREASES IN KNOWN HOST SPECIES AND GEOGRAPHIC RANGE IN AN INVASIVE PENTASTOME PARASITE ARE AN EMERGING CONSERVATION THREAT TO NORTH AMERICAN REPTILES AND AMPHIBIANS.

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Parasite spillover, the spread of nonindigenous parasites to native species, can be an important consequence of the introduction of nonnative species. *Raillietiella orientalis*, an Asian pentastome (endoparasitic crustacean), was introduced to south Florida with Burmese Pythons. This parasite has now spread to native snakes, lizards, and anurans. From August 2018 to January 2020, we dissected over 200 lizards and frogs from a central Florida site, where snakes have a high prevalence of *R. orientalis*, to determine key intermediate hosts in this parasite's complex lifecycle. We found ground-dwelling anurans (*Lithobates sphenocephalus* and *Anaxyrus terrestris*) had a higher prevalence of pentastome nymphs than treefrogs (*Hyla cinerea*) or *Anolis* lizards. We examined cloacal washes or necropsied individuals of over 200 snakes from eight species to determine the definitive host range. Five snake species hosted pentastomes,

including two species (*Thamnophis sauritis* and *Lampropeltis elapsoides*) that were not previously documented definitive hosts. Pygmy Rattlesnakes (*Sistrurus miliarius*) had the highest prevalence of *R. orientalis* with over 60% of all individuals infected at one study site. The parasites appear to have major negative health consequences in *S. miliarius*. The impact of this invasive parasite on native reptile and amphibian populations will be a function of a variety of unknown aspects of its biology, including its rate of spread, the diversity of the intermediate host species, and the effects of pentastome infection on host fitness. We discuss new approaches to parasite detection and make predictions about its geographic spread and host diversity in North America.

TESTING THE FEBRILE RESPONSE OF SNAKES INOCULATED WITH *OPHIDIOMYCES OPHIODIICOLA (O.o),* THE CAUSATIVE AGENT OF SNAKE FUNGAL DISEASE.

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Snake Fungal Disease (SFD) is a fungal pathogen of wild snakes populations, predominantly in the Eastern and Midwestern United States. SFD is characterized by heterophilic granulomas that can form around the mouth and eyes with severe cases causing weight loss, impaired vision and eventual death. Researchers, making field observations, have noted early season basking from severely infected snakes. This may suggest that snakes are attempting to raise their body temperature, inducing a febrile response, to combat the mycosis. This study tested the hypothesis that the causative agent of snake fungal disease (*Ophidiomyces ophiodiicola*) induces a febrile and behavioral response of seeking differential basking temperature to regulate body temperature. Eastern ribbon snakes (*Thamnophis sauritus,* n=30) were sham or *O.o* inoculated. Seven days after inoculation, snakes were tested on a thermal gradient that ranged from 40°C to 18°C. The internal body temperature of each snake was measured every 30 minutes for eight hours with a thermal probe inserted into the cloaca of each snake. Additionally, substrate temperatures, where the snake was basking, were measured every 30 minutes, using a laser temperature gun. Snakes inoculated with *O.o* did not demonstrate significantly different internal body temperatures, but did bask at significantly higher temperatures.

HYDROLOGICAL ALTERATIONS AS A POTENTIAL DRIVER OF FRESHWATER TURTLE COMMUNITY ASSEMBLAGES IN MISSISSIPPI.

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From 2017-2019, we extensively sampled the Pearl, Pascagoula, and Tombigbee River drainages in Mississippi, logging over 700 total trap nights in each drainage. Despite drawing from a similar species pool, the freshwater turtle assemblages showed significant variation between drainages. Catch-per-unit-effort (CPUE) was highest in the Tombigbee River drainage ($\mu = 1.12 \pm 0.78$), followed by the Pascagoula River drainage ($\mu = 0.77 \pm 0.57$), with the Pearl River drainage exhibiting significantly lower catch rates ($\mu = 0.39 \pm 0.24$). While CPUE was highest

from the Tombigbee River drainage, the corresponding turtle community also represented the least even of the drainages as determined by Shannon's equitability index (J). Much of the unevenness of the Tombigbee River sites can be attributed to higher relative abundances of generalist species, notably *Trachemys scripta elegans* and *Apalone spinifera*, which together constituted 79% and 89% of total captures in lotic and lentic sites, respectively. These three drainages not only exhibit variable turtle assemblages, but also distinct hydrological histories, with the Pascagoula River representing a pristine, free flowing system, the Pearl River having experienced impoundment and straightening, and the Tombigbee River being severely altered as it was channelized to connect with the Tennessee River via the Tennessee-Tombigbee waterway. Using USGS stream gage data collected over several decades, we employ the Indicators of Hydrologic Alteration© method to examine at how flow regimes have changed in these systems and the potential impact of various ecological parameters on freshwater turtle assemblages.

DIFFERENCES AMONG SIX SOUTHEASTERN US AQUATIC SNAKE SPECIES IN THEIR METABOLIC RESPONSES TO INCREASED TEMPERATURES.

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Physiological maintenance by ectotherms is largely dependent upon temperature. Abrupt changes in environmental conditions may lead to significant shifts in energy budgets, with higher temperatures necessitating more resources be allocated to maintenance instead of reproduction. Reptiles as a whole are of conservation concern; thus, it is important for researchers to elucidate their physiological responses to temperature shifts, particularly given current climate change predictions. In this study, we compare metabolic responses among several southeastern aquatic snake species and place them in the context of their respective ecology to gauge their vulnerability to predicted climate change. We measured metabolic rates at three temperatures (25C°, 30C°, and 35C°) in six species of aquatic snakes that vary substantially in their ecological traits: mud snakes (*Farancia abacura*; n = 12), glossy crayfish snakes (*Liodytes* [*Regina*] *rigida*; n = 5), black swamp snakes (*Liodytes* [*Seminatrix*] *pygaea*; n = 16), red-bellied watersnakes (*Nerodia erythrogaster*; n = 10), banded watersnakes (*Nerodia fasciata*; n = 16), and Florida green watersnakes (*Nerodia floridana*; n = 13). Our findings, when combined with knowledge of other relevant ecological and physiological characteristics, may be a useful tool for predicting relative sensitivities of aquatic snake species to predicted climate change scenarios.

ASSESSING THE INFLUENCE OF STRESS AND BEHAVIOR ON SUSCEPTIBILITY TO AND RECOVERY FROM SNAKE FUNGAL DISEASE IN THE TIMBER RATTLESNAKE (CROTALUS HORRIDUS)

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Mortality in wild snake populations from Snake Fungal Disease (SFD), caused by the fungus *Ophidiomyces ophiodiicola (Oo*), has been documented since 2006. Yet, causes of the disease are still unclear. We investigated the effects of stress, including baseline and elevated

corticosterone and corticosterone reactivity and variability, on SFD dynamics in Ttimber rattlesnakes (*Crotalus horridus*). Additionally, we are evaluating the relationship between stress and timber rattlesnake 2nd and 3rd order habitat selection. In summer 2018 and 2019, we captured and transmittered 20 timber rattlesnakes. From the point of capture through late October in 2018 and 2019, we tracked each individual weekly and will continue tracking them during spring and summer 2020. We collected blood and swab samples once per month from each individual to quantify corticosterone levels and *Oo* presence, respectively. We analyzed corticosterone using an enzyme-linked immunosorbent assay and determined the presence of *Oo* using quantitative polymerase chain reaction. Additionally, we measured habitat attributes at used and random locations once per month to quantify habitat selection. In summer 2018, 40 % (n = 4 of 10 captures) of timber rattlesnakes tested positive for Oo. We are currently processing blood samples, additional swabs, and data on habitat attributes and will present the results of these data. The results of this research will have broad implications for reptile conservation as it pertains to anthropogenic stress and associated population declines related to diseases.

INVESTIGATING CHANGES IN POPULATION SIZE OF VIRGINIA BOG TURTLES (*GLYPTEMYS MUHLENBERGII)*

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Bog turtles (*Glyptemys muhlenbergii*) are a federally threatened species that occur in a disjunct range (northern and southern populations). Declines have been documented across their range, with many populations in the north being extirpated or severely reduced in comparison to historic distributions. In Virginia, bog turtles are listed as State Endangered, but prior to this past summer, population sizes had not been estimated in over two decades which limits managers' ability to infer their population status.
In 1997, the Virginia Department of Game and Inland Fisheries and Virginia Tech conducted an intensive mark-recapture survey at six sites of known occupancy. During the spring of 2019, we resurveyed the same sites using the same methodology (survey effort, surveyors, and survey technique) to obtain current population estimates. Both the number of capture events and the number of unique individuals captured were lower in 2019 than 1997, suggesting that the populations in question have, for the most part, declined. The data collected (and supporting information on habitat changes and from less intensive surveys in the past 10 years) indicate populations at two of six sites are extirpated, two of six sites have experienced declines, and two sites may still be stable. However, it is possible that changes in phenology and detection probabilities influenced capture rates, which we plan to investigate via surveys in 2020. We will discuss the implications of these results for bog turtles in the southern portion of their range as well discuss future research intended to expand on these results.

ASSESSMENT OF TURTLE AND LEECH (HIRUDINEA) PARASITE-HOST ASSEMBLAGE VARIATION IN MIDDLE TENNESSEE WETLANDS ACROSS A DISTURBANCE GRADIENT.

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Prior research has established clear links between decreased reptile biodiversity in degraded or disturbed habitats, including chelonian groups. There are negative impacts associated with high parasite loads on hosts, and previous studies found parasite loads increase with habitat disturbance, however there have been no published attempts to evaluate detectable sublethal health effects associated with this potential increase in chelonian ectoparasite (leech) load. Thus we assessed if leech loads varied across a landscape disturbance gradient in Middle Tennessee wetlands and if they follow measurable patterns of increased sublethal health effects on chelonians by assessing heterophil:lymphocyte ratios, packed cell volume, and host body condition. We sampled 19 wetlands from June-October 2018 and obtained data from three host species; *Trachemys scripta elegans, Sternotherus odoratus,* and *Chelydra serpentina*. Collectively, the interpretation of these data may be used to understand how anthropogenic disturbance affects wetland turtle-leech communities and potential associated health implications.

PIEDMONT PINESNAKES: UNCOVERING EXTANT POPULATIONS WITH INSIGHT INTO HABITAT SELECTION.

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Eastern Pinesnakes represent a group of increasingly rare, threatened, and disjunct populations historically ranging across much of the US east coast. Of the three putatively recognized subspecies, non-coastal members of the Northern Pinesnake *Pituophis melanoleucus melanoleucus* remain largely unstudied. Although several attempts have been made to rediscover old or document new populations, few vouchers have been produced over the last 3 decades. In 2012, we initiated a large-scale effort across 3 major ecoregions of north Georgia with an emphasis on: 1) documenting extant populations, 2) monitoring radio telemetered individuals, and 3) identifying conservation properties for long-term monitoring. Using a combination of citizen science outreach and repeat box trap drift fence surveys, we documented >70 records over an 8-year period (2012-2019). This includes all but 5 of the 30 counties within the predicted range, as well as a range extension approximately 45 km south of the nearest record. We also used preliminary location data from 3 adults (2 males and 1 female) collected during the 2019 summer and fall to assess habitat selection from 3 conservation tracts across the upper Piedmont. The documentation and monitoring of these individuals has contributed support for private, state, and federal partners to consider non-coastal Pinesnake populations as tangible, extant conservation priorities.

OMAHA'S HENRY DOORLY ZOO AND AQUARIUM IN-SITU AMPHIBIAN CONSERVATION PROGRAM AND CURRENT SE US PROJECTS .

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The Omaha's Henry Doorly Zoo and Aquarium created The Ampibibian Conservation Area (ACA) in 2006, as an on-ground, fully biosecure facility with the capacity to house and breed multiple critically endangered and or functionally extinct amphibian species. The closed-to-the-public ACA, consists of a 4200 square foot passageway with 14 isolation rooms to house individual species or regions. In partnership with more than a dozen government/state agencies, other zoological institutions, and universities, we have released approximately 70,001 individual amphibians back into native habitat. Many of our projects are focused on North and Central American species, as of 2020, we have 18 species in our program. Our current projects in the SE include the Dusky Gopher Frog (*Lithobates sevosus*) and the Striped Newt (*Notophthalmus perstriatus*). We are constantly seeking additional projects to take on as well as expanding our partnerships in projects in the SE region.

EXPLORING MULTILEVEL HABITAT SELECTION BY FLATTENED MUSK TURTLES TO INFORM CONSERVATION EFFORTS FOR THE SOUTHEAST'S MOST IMPERILED TURTLE SPECIES.

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The Flattened Musk Turtle (*Sternotherus depressus*) is a small kinosternid turtle endemic to the portion of the Black Warrior River Basin (BWR) above the Fall Line in Alabama. Listed as threatened under the Endangered Species Act and critically endangered by the International Union for the Conservation of Nature, S. depressus populations have experienced range-wide declines attributed to sedimentation and chemical pollution from mining, agriculture, and development. In this study, we utilize trapping, visual encounter, and radio telemetry surveys in conjunction with side-scan sonar and point-transect habitat surveys to explore 2nd (population level), 3rd (individual level), and 4th order (microhabitat level) habitat selection by S. depressus in the relatively unimpacted populations of Bankhead National Forest. Our results will be utilized to inform and focus upcoming conservation efforts for the species in the BWR.

PRACTICAL PERSPECTIVES ON PARTNERSHIPS

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Most of us have some familiarity with the potential or realized value that Partnerships can bring, and even their necessity to accomplish legally and/or logistically complex objectives. Nevertheless, the majority of professionals in our field do not actively or consciously cultivate partnerships, and may not even recognize the potential roles they may be able to play in establishing or cultivating partnerships that may benefit their own objectives and goals. For those who are already more advanced in the active roles they've played in partnership development and maintenance, there may not be a recognition or valuing of purposeful encouragement and equipping of others to do the same. We will attempt to highlight some of the common themes that seem to be important in the outcomes of both successful partnerships and less successful partnerships. We will also share some practical advice from our perspective of

having experienced some really good fruits of our labor, but also from the humble perspective of still having a lot to learn ourselves. In a world of finite time, finite resources, and high stakes for the species and ecosystems that we work with, cultivating effective partnerships is essential for making the most of the time, talents, and funds with which we've been entrusted.

COLLABORATIVE CONSERVATION PLANNING IN THE NORTHEASTERN UNITED STATES: REGIONAL CONSERVATION NEEDS GRANT PROGRAM

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The management and implementation of conservation actions can often be inhibited when the distribution of a species crosses multiple government jurisdictions. In the United States, the Northeast region of the Association of Fish and Wildlife Agencies (NEAFWA) and Region 5 of the U.S. Fish and Wildlife Service (USFWS) is comprised of 13 states and the District of Columbia. Distributed within this region are 21 species of fresh and brackish water turtles, twenty of which are listed in at least one State Wildlife Action Plan (SWAP). To address the need of range wide conservation actions and coordination, the NEAFWA, the USFWS, and the Wildlife Management Institute partnered in 2007 to create the largest multi-jurisdictional collaborative in the United States: the Northeast Regional Conservation Needs Grant Program (RCN). Recognizing shared elements of SWAPs, participating states agreed to pool 4% of their respective State Wildlife Grant apportionments to fund cooperative projects that impact regional-level conservation and restoration initiatives that extend beyond state borders. The central goal of the RCN program is to develop, coordinate and implement conservation actions that are regional or sub-regional in scope, to build upon the multiple regional initiatives that already exist and complement ongoing work in individual states. Specifically, RCN projects produce 1) unifying maps of the target region's habitats, 2) common language and condition analysis of those habitats, 3) identification of regional conservation focus areas (what they are and where they are), and 4) consistent metrics to measure success and gauge effectiveness.

MHC DIVERSITY IN *RANA YAVAPAIENSIS*: A TWELVE-YEAR COMPARISON OF IMMUNOGENETIC VARIATION IN THE PRESENCE OF *BATRACHOCHYTRIUM DENDROBATIDIS* (BD)

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Batrachochytrium dendrobatidis (Bd) is a fungal pathogen that is capable of infecting hundreds of amphibian species and has caused massive population declines and extinction events worldwide. However, some amphibian populations have demonstrated an adaptive immune response to Bd. In vertebrates, adaptive immunity is controlled by the major histocompatibility complex (MHC) genes. Experimental infections of the lowland leopard frog (*Rana yavapaiensis*), a species with a variable immune response to Bd, have shown that heterozygosity or the presence of an allele dubbed allele Q at the conserved MHC class IIβ exon 2 locus correlates with decreased susceptibility to Bd. However, these patterns are not always reflected

in natural populations. To better understand how Bd drives MHC evolution in natural populations we collected tissue samples from 126 *R. yavapaiensis* individuals from 7 populations across their native Arizona range between 2017-2018. We compared MHC diversity of these individuals with 184 *R. yavapaiensis* individuals from the same 7 populations collected previously between 2006-2008. We sequenced the MHC class IIβ exon 2 of all 310 individuals using a unique barcoding PCR on the Illumina MiSeq 2x250 platform. Our sequencing results showed previously undetected MHC diversity in certain populations of *R. yavapaiensis*, with some individuals expressing multiple gene copies of MHC class II. This study demonstrates the power of using massive parallel sequencing to assist in conservation efforts.

A DECADE OF SEPARC GRAPHICS HIGHLIGHTS THE PROFOUND CONNECTION BETWEEN ART AND SCIENCE.

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Visual, artistic and graphic depictions of scientific observations have powerfully conveyed important and often complicated aspects of biology since we first started asking questions about the natural world. Visual artists, typically working closely with scientists, have guided scientific and public perception alike on topics ranging from the dinosaurs to climate change, advancing our understanding of these phenomena in the process. In the 1990's, I took a shot at illustrating my own research (aquatic feeding in pipid frogs) and found the process academically and spiritually fulfilling, and have worked professionally as a freelance scientific illustrator for the last 25 years (the last 15 of which have been entirely focused on herpetological renderings). The illustrative process — the science of observation — has provided me with amazing opportunities to become immersed in the fascinating form and function of reptiles and amphibians that I might not have otherwise become acquainted. Scientific illustration has also connected me to a wealth of passionate and inspiring researchers and conservationists, and this is best exemplified in the ten years of graphics I have had the pleasure to develop for the annual conference of the Southeast Partners in Amphibian and Reptile Conservation (SEPARC). I am incredibly grateful for these annual opportunities to connect with friends, colleagues, and partners and to celebrate the the rich herpetological biodiversity of the southeast.

THE CONSERVATION OF THE EASTERN DIAMONDBACK RATTLESNAKE (*CROTALUS ADAMANTEUS*) IN SOUTHWEST FLORIDA.

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Eastern Diamondback Rattlesnakes (*Crotalus adamanteus*) are the largest venomous snakes in North America, endemic to the Coastal Plains of the southeastern United States. Although they are not currently listed for protection, the species has experienced sharp declines over the past few decades due to habitat loss, fragmentation, and wanton killings. Additionally, literature on this species is severely lacking, particularly for snakes in the southernmost range. Our lab is preparing to fill these knowledge gaps by identifying multifaceted life history traits of *C. adamanteus* in southwest Florida. Individuals in south Florida experience warmer year-round temperatures, increased exposure to exotic species, and a vastly different landscape than

populations throughout *C. adamanteus* distribution. To study these unique populations, a pilot study began in 2015 with radio-tagged *C. adamanteus* on the campus of Florida Gulf Coast University in Fort Myers, Florida. Since then, it has expanded to include population genetics, parasitic loads, fecundity, and behavioral data for this species of concern. This project has grown substantially by the collaborative efforts of undergraduate students, local agencies including state and federal parks, as well as a strong network of local communities being engaged by conservation outreach. Herein, we present a summation of research and novel findings for *C. adamanteus* in southwest Florida. These data will provide valuable insight for the conservation of the species and assist future management practices in the region.

VERTEBRATE USE OF GOPHER TORTOISE BURROWS AND STUMP HOLES IN THE LONGLEAF PINE ECOSYSTEM.

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Some evidence suggests that pine stump holes may be important habitat features for vertebrates in the longleaf pine (*Pinus palustris*) ecosystem. Despite being documented as refugia for several species of concern including the black pine snake (*Pituophis melanoleucus lodingi*) and the eastern diamondback rattlesnake (*Crotalus adamanteus*), longleaf stumps are still harvested for their rosin. To further investigate vertebrate use of these habitat features, we surveyed 35 stump holes with trail cameras from September 2018 – May 2019. Each stump hole was paired with a nearby gopher tortoise (*Gopherus polyphemus*) burrow that was also surveyed with trail cameras to serve as a reference for a high value vertebrate refugium. To date, we have documented 49 different vertebrate species using stump holes as either refugia or foraging sites. Although species diversity and evenness were similar between stump holes and tortoise burrows, species composition differed significantly between the two habitat features. Additionally, occupancy estimates for reptiles, amphibians, and small mammals were higher at stump holes than tortoise burrows. Stump decay state influenced occupancy estimates for reptiles, amphibians, and birds with higher reptile and amphibian occupancy probabilities at less decayed stumps and higher bird occupancy probabilities at more decayed stumps.

CHYTRID GROWTH INHIBITION IN TWO FULLY AQUATIC SALAMANDERS

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Chytrid fungal pathogens, *Batrachochytrium dendrobatidis* (*Bd*) and *B. salamandrivorans* (*Bsal*) are causing amphibian die-offs worldwide. Unlike *Bd*, *Bsal* has not yet been detected in North America but poses an imminent threat to native salamander biodiversity. While susceptibility to *Bsal* varies among salamander species, the factors underlying such variation are poorly understood. Because anuran skin secretions are known to contain antimicrobial peptides (AMPs) shown to kill *Bd in-vitro,* AMPs are hypothesized to be important for limiting *Bd* infections, thereby protecting some anuran species from disease. The objective of this study was to test whether fully aquatic salamander, *Siren intermedia* (Lesser Siren) secretes peptide mixtures that

inhibit the growth of chytrid pathogens using *in-vitro* growth inhibition assays. Skin secretions were collected from 10 wild *S. intermedia.* Skin secretions were purified, enriched for peptides, pooled, and combined with either *Bsal* or *Bd* zoospores in a 96-well plate. Optical density was read daily for 14 days to assess changes in fungal growth. We found that even at low concentrations, the skin peptides of *S. intermedia* inhibited the growth of *Bsal* and *Bd.* These results suggest *S. intermedia* secrete AMPs which may protect this species from *Bsal* infections and disease. We are in the process of repeating this experiment using the skin secretions of *Necturus beyeri* (Gulf Coast Waterdog) and *Necturus maculosus* (Mudpuppy). We predict that results will be similar to those observed with *S. intermedia.*

ADDING MECHANISM TO A DISTRIUBTION MODEL CHANGES PREDICTIONS OF CLIMATE VULNERABILITY FOR A PRIORITY AMPHIBIAN.

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Rapid global change has increased interest in developing ways to identify habitats most suitable for species of conservation concern, as well as those areas most vulnerable to changing conditions. Species distribution models are one approach to predicting distributions for species and forecasting climate vulnerability. The two main types of species distribution models are correlative models and mechanistic models. Correlative models predict a species distribution as a function of environmental variables. These models rely on presence data due to the assumption of some underlying environment-species relationship. Alternatively, mechanistic models uses a species' physiology to identify suitable habitat under which it can exist. Mechanistic models require more data than correlative models, but some studies suggest that they are better at forecasting climatic suitability. We developed correlative-only and mechanistic+correlative models to compare predictions for a priority amphibian in the southeastern Blue Ridge Mountains. We focused on green salamanders (*Aneides aeneus*), a species of salamander vulnerable to climate change throughout its disjunct range (North Carolina, South Carolina, and Georgia). We measured resistance to water loss (r_i) and metabolism (VO_2) under a range of temperature and humidity values in a laboratory setting. Models under current climate conditions predicted similar conditions for both correlative-only and mechanistic+correlative models. Under two different future climate conditions, models incorporating mechanism predicted less climatically suitable habitat than correlative-only models. Because future climate projections may include non-analog climates (a lack of appropriate training data), incorporating mechanism may be useful for forecasting climate vulnerability.

ASSESSING SHORT-TERM EFFICACY OF TRANSLOCATION AS A CONSERVATION STRATEGY FOR WILD EASTERN HELLBENDERS

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Translocations have become a common conservation strategy for herpetofauna, yet are not always rigorously monitored to evaluate their success. Due to population declines and habitat fragmentation throughout its range, the Eastern Hellbender (*Cryptobranchus alleganiensis alleganiensis)* is a strong candidate for translocation in Tennessee. We evaluated the short-term success of translocation on wild Hellbenders by comparing the spatial ecology of individuals pre- and post-translocation using radio-telemetry. We studied the home range sizes, movements and multi-scale habitat use of individuals (N =27) in two sustainable populations (Tumbling Creek and Hiwassee River) for one year and then subsequently collected similar data from a portion of these individuals (N =17) that were translocated (May-July 2019) into two nearby streams with declining populations (Rough Creek and Citico Creek, respectively). We collected 1,584 location data points (869 prior to translocation and 715 post-translocation) from our four study sites. Survival rates of translocated individuals increased when moved from Tumbling to Rough Creek (80% to 100%), while they decreased when moved from Hiwassee to Citico Creek (76% to 33%). Long distance movements (>100 m) were observed in 58% of translocated individuals (7/12) at Citico Creek, compared to only 20% (1/5) at Rough Creek. The greater rate of "exploration" amongst individuals in Citico Creek could be due to increased competition for prey items with other predators (e.g. large fish, otters), and likely led to the increased predation by otters. This on-going study will serve to inform managers about the potential for translocation as a conservation strategy for Eastern Hellbenders.

CHARACTERIZATION OF THE BACTERIAL CUTANEOUS MICROBIOME OF EASTERN HELLBENDERS (*CRYPTOBRANCHUS ALLEGANIENSIS*) BEFORE AND AFTER TRANSLOCATION.

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Eastern Hellbenders are declining across historic ranges and are listed as "Endangered" in Tennessee. To augment declining populations, we conducted a translocation project for this species in eastern Tennessee. In 2018, 10 hellbenders from Tumbling Creek and 17 hellbenders from Hiwassee River were implanted with radio-transmitters and were translocated respectively to Rough Creek and Citico Creek in 2019. Disease monitoring is an essential step in translocation projects, specifically in amphibians where emerging pathogens such as *Batrachochytrium dendrobatidis* are linked to population declines. Species like the hellbender may be resilient to *Bd* due to disease resistant bacteria found on amphibian skin. However, the amphibian cutaneous microbiome is sensitive to disturbance, and changes to microbial composition may lead to an increase in disease susceptibility. To test for *Bd* and to collect microbiome samples, skin swabs were taken before transmitter insertion, translocation, and every 45 days post-translocation. I used quantitative real-time polymerase chain reaction to test for presence of *Bd*. Total *Bd* prevalence in 2018 was 60% but decreased to 0% in translocated animals in 2019. To characterize skin bacterial communities, the bacterial 16S ribosomal RNA V3 and V4 regions will be amplified and sequenced using an Illumina MiSeq System. Variation in infection prevalence and bacterial communities will be compared before and after translocation to account for any changes that may occur. This project benefits conservation

efforts to restore declining populations of the Eastern Hellbender and provide insight to what role the microbiome may have in amphibian translocation projects with regards to *Bd*.

USING MOLECULAR TOOLS TO INVESTIGATE THE NON-NATIVE DISTRIBUTION OF INDIAN GECKOS (HEMIDACTYLUS SPP.) IN THE SE U.S.

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The Sri Lankan Spotted House Gecko, Hemidactylus parvimaculatus is a small gekkonid lizard native to the Indian subcontinent. The species has recently been detected in North America, with the first specimen being positively identified with genetic data from Louisiana in 2012 (Heckard et al 2013). Like other invasive Hemidactylus species, once established they are ubiquitous in urban environments; rapidly spreading to other metropolitan centers via anthropogenic and natural means of dispersal. Since 2012, the species has been reported in two other states; Texas in 2018 and Mississippi in 2019. Understanding the history of introduction and spread by this gecko has been complicated by the unresolved taxonomy of the group. Only recently has molecular systematics been broadly applied to species in its native range in India (i.e., H. brookii sensu lato). This work has determined that the "H. parvimaculatus" from the United States are closer related to a newly resurrected taxon, H. malcomsmithi, than to H. parvimaculatus. The goal of this study was to collect extensively across the introduced range. Then, given the potential for taxonomic confusion, these specimens will be identified using mitochondrial sequence data to compare with the publicly available sequence data from previous phylogenetic studies of the H. brookii complex from the Indian subcontinent. These data should also prove useful in identifying the geographic origin of these within their native range and determine if they are the product of a single or multiple introductions.

PRELIMINARY SPATIAL AND THERMAL ECOLOGY OF STERNOTHERUS ODORATUS (EASTERN MUSK TURTLES) IN A SUBURBAN ENVIRONMENT.

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Today, most habitat fragmentation results from direct anthropogenic modifications to the landscape. Besides modification, urban expansion has resulted in a decline of natural habitat for native biota. Turtle populations across North America have decreased at an alarming rate, with a major cause being habitat destruction. Urbanization impacts on herpetofauna is limited and inference on whether urban environments provide suitable habitat for turtle populations is novel. The objective of this study is to describe movement patterns, thermoregulatory behavior, and population demographics of *Sternotherus odoratus* within a fragmented suburban environment. Nine individuals were collected in a man-made canal in Kenner, Louisiana and fitted with radio transmitters and iButton temperature loggers. Telemetry locations were obtained from spring of 2019 to winter of 2020. Opportunistic captures of additional musk turtles were reserved for mark-recapture to understand population demographics. Trapping took place from June to winter of 2020. Preliminary surveys have indicated a dense population and a female-biased population. Data collected over the past several months will be presented and discussed.

NEW DATA FAIL TO RESOLVE THE STATUS OF THE BAY SPRINGS SALAMANDER (*PLETHODON AINSWORTHI*).

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The Bay Springs Salamander (*Plethodon ainsworthi*) is known only from two poorly preserved specimens collected in Jasper County, Mississippi in 1964. As it stands, it is the only amphibian species in the United States categorized as Extinct by the IUCN. Recent research has proposed that *P. ainsworthi* may be an invalid taxon, arguing that the 55-year-old type specimens' morphological distinctiveness from syntopic *P. mississippi* is a preservation artifact. To address this concern, we experimentally preserved *P. shermani* proxy specimens in five chemical treatments and measured morphological change over time. Our results are inconsistent with the hypothesis that *P. ainsworthi* type specimens are actually poorly preserved *P. mississippi*. We briefly remark upon our attempts to use new methods to gather genetic and morphological data from the holotype of *P. ainsworthi* and summarize the state of our knowledge of this contentious taxon.

COMBINING ENVIRONMENTAL RESTORATION WITH COMMUNITY SCIENCE TO RESTORE TURTLE POPULATIONS.

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We partnered with K-12 schools and state and federal agency in a large scale environmental restoration project, Poplar Island, to evaluate conservation strategies for aquatic turtles. Poplar Island is a 700 hectare restoration / rebuilding of an island in middle Chesapeake Bay designed to increase salt marsh and coastal plain habitat of the coastal Atlantic region. We monitored a Diamondback Terrapin (*Malaclemys terrapin)* population on the island since 2004 and since 2005 have partnered with K-12 classrooms to implement an education/outreach program that head-starts terrapins. Because Poplar Island lacks the mammalian nest predators, raccoons and foxes, recruitment is high (60-90% of nest produce hatchlings per year) and results in large numbers of hatchlings annually. A portion of these hatchlings are placed in K-12 classrooms and head-started while the remainder are released immediately and function as our control group. We use mark-recapture to track both groups and compare their life histories. Using MARK we reveal that our control group has higher apparent survival than the head-starts. However, the increased size of head-starts caused by rearing in a growth conducive environment during their first winter results in a decrease in the age of first reproduction in females. We used a Leslie Matrix approach to evaluate lambda between head-starts and controls, and find that the decrease in age of first reproduction compensates such that population growth rate, lambda, is >1 and similar between the two groups. We identify that both strategies contribute to positive overall terrapin population growth rate on Poplar Island.

CHARACTERIZING STRESS IN HEAD-STARTED GOPHER TORTOISES (*GOPHERUS POLYPHEMUS*) REARED FOR AN EXTENDED DURATION.

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Chronic stress can have wide ranging adverse effects on wildlife, including immune suppression, reductions in growth or reproduction, and aberrant behaviors. Stress in wildlife can be induced by many different variables, including environmental pollutants, anthropogenic changes to the landscape, and even animal conservation programs. With over half of all extant turtle species threatened by extinction, there are many conservation initiatives, such as translocation and captive rearing, being implemented to potentially mitigate these threats. Yet how they affect baseline stress levels remains relatively unexplored, as has the role of stress in influencing the outcomes of those interventions. We aim to characterize baseline stress metrics of clinically healthy head-started gopher tortoises (*Gopherus polyphemus*) reared in captivity for an extended duration (2.5 – 3.5 years). We measured plasma and fecal corticosterone, heterophil:lymphocyte ratios, and lactate levels in 25 head-started gopher tortoises following release. We will summarize results and compare differences associated with captivity duration. Our results have the potential to refine head-starting techniques, such as the optimal duration in captivity, and may prove useful in predicting movement and survivorship of head-starts post-release into the wild. Ultimately, this would allow researchers to more effectively manage this species of conservation concern.

SNAKE ENTANGLEMENT IN EROSION CONTROL BLANKETS: CAUSES, CONSEQUENCES, AND CONSERVATION.

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In road construction projects across the United States, erosion control methods (e.g., erosion control blankets [ECBs]), are mandated to stimulate seedbed regeneration and prevent soil loss. Previous reports have suggested that snakes are vulnerable to entanglement in ECBs. We conducted two entanglement experiments to examine what factors increase a snake's risk of ECB entanglement. From first our experiment, we found that ECBs that contain fixed-intersection, small-diameter mesh consisting of polypropylene were significantly more likely to entangle snakes compared with ECBs with larger diameter polypropylene mesh or ECBs that have woven mesh made of natural fibers. Snake body size was also associated with entanglement; for every 1-mm increase in body circumference, the probability of entanglement increased 4%. Our second experiment tested if modification to the installation methods of erosion control blankets affects the likelihood of snake entanglement. This experiment examined snake entanglement in two treatments: 1) exposed erosion control blanket edge (i.e., perimeter) and 2) buried erosion control blanket edge. Snakes were less likely to attempt to pass through the mesh on the buried edge treatment and all entanglements occurred on the exposed edge treatment. These results can help construct a predictive framework to determine those species and individuals that are most

vulnerable to entanglement as well as inform natural resource agencies on additional steps that can be taken to select products that pose low risks to wildlife.

AMPHIBIANS IN A CHANGING WORLD: ASSESSING THE EFFECTS OF WARMING AND DRYING ON AMPHIBIAN LARVAE IN AN ARTIFICIAL POND EXPERIMENT.

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Anthropogenically driven shifts in climate put multiple pressures on many ecosystems. An important knowledge gap exists in our understanding of how changes in temperature and precipitation interact, and whether these interactions result in sub-lethal effects on sensitive species, such as amphibians. The primary goal of this study was to examine the developmental responses of two species of amphibian larvae to the individual and interactive effects of warming temperatures and increased drying rate of larval habitat - both plausible consequences of climate change in the eastern United States. We used replicated mesocosms to rear two anuran species: wood frogs, *Lithobates sylvaticus*; and spring peepers, *Pseudacris crucifer*. We evaluated survivorship, body size, and time to metamorphosis in response to experimentally manipulated temperature and drying over 12 weeks. Our manipulations created warming treatments that were on average 2 ±.4 ° C higher than controls. Wood frogs had significant differences in body mass and time to metamorphosis between treatments. Spring peepers had significant differences in body mass between treatments; however, we did not see significant differences in time to metamorphosis between treatments. We also saw a strong relationship between treatment and survivorship in wood frogs that was not seen for spring peepers. Temperature had the greatest effect on growth and development time in larval amphibians, but the combined effects of temperature and drying were also significant. This research demonstrates how amphibians may be affected by multiple, potentially interacting, climate pressures which are expected to occur more frequently with climate change.

HELLBENDER CONSERVATION WITHIN PRIVATE LANDS IN TENNESSEE, NORTH CAROLINA, AND VIRGINIA – LESSONS AND CHALLENGES.

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Although private lands are the home for nearly half of all species listed under the Endangered Species Act, conservation efforts often focus on public lands. Fauna and flora within private lands are especially at risk due to the increasing rate of land conservation from agricultural practices to commercial and residential development. Conservation of forestlands, ranches, and agricultural lands is essential for the success of future protection and recovery of ecosystems surrounding working lands. The Southeastern Hellbender Conservation Initiative (SEHCI) brings together a large and diverse group of partners to invest in education, outreach, and aquatic habitat restoration on private lands throughout Virginia, Tennessee, and North Carolina. Our goal is to create win-win solutions that benefit wildlife and landowners alike. Herein we share

the challenges we have faced and the lessons we have learned during the past 12 months of initiative implementation.

EFFECT OF DUSKY GOPHER FROG DEVELOPMENTAL STAGE ON MORTALITY ASSOCIATED WITH EXPOSURE TO THE PROTIST PARASITE *DERMOMYCOIDES* SP.

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Dermomycoides sp. is a protist parasite thought to have caused several years of near-zero recruitment into a wild population of the endangered dusky gopher frog. Because of rapid decomposition and predation of morbid tadpoles, mortality events are often missed, even with the use of biweekly dipnet surveys. Understanding which developmental stages of gopher frog tadpoles are most susceptible to mortality associated with infection of *Dermomycoides* sp. can help managers target surveys and perhaps guide management. We collected embryos from three different gopher frog egg clutches from the same pond. Four groups of 10 animals from each clutch, each representing a different developmental stage (egg, embryo, hatchling, and 2-weeks post-hatchling [Gosner stage 25]) were experimentally exposed to a solution containing approximately 50 protist zoospores/µL for 1 hour before being placed into 19-L aquaria. Additional groups from each clutch served as unexposed controls. Animals were checked daily, and morbid individuals were removed and preserved. Tadpoles exposed as hatchlings and 2-weeks post-hatching had significantly fewer days to mortality (17.3 days, $p < 0.05$, SE = 6.9; 16.4 days, $p < 0.05$, SE = 3.2, respectively) than all other developmental stages including the controls (≥ 30.1 days, SE = 7.7). Prior work by Atkinson (2016) and Cook (2008) showed that leopard frog tadpoles are less susceptible after Gosner stage 30. If gopher frog tadpoles respond to infection similarly to leopard frog tadpoles, there may be a developmental window of heightened susceptibility between hatching and toe development (Gosner stage 30).

HARNESSING CITIZEN SCIENCE TO ADDRESS DATA DEFICIENCY IN UNDERSTUDIED HERPETOFAUNA ON PRIVATE LANDS: LESSONS FROM THE MOUNTAIN CHORUS FROG (*PSEUDACRIS BRACHYPHONA*).

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Data deficiency in herpetofaunal conservation is often driven by an abundance of private lands that are inaccessible to traditional surveys, precluding adequate assessments of the conservation status of individual taxa. Citizen science approaches are one avenue that may allow researchers to circumvent landownership issues, although little information exists to date to test such approaches' efficacy, especially when applied to secretive taxa. We used a citizen science initiative to address data deficiency in the Mountain Chorus Frog (*Pseudacris brachyphona*) across an area composed primarily of privately-owned lands in the southern Cumberland Mountains ecoregion. We trained more than 500 citizen observers in performing auditory surveys for this species during 2018 and 2019. Those observers increased the number of known localities of Mountain Chorus Frogs in our study area from 14 to nearly 50 within a single breeding season. We found that breeding habitats for Mountain Chorus Frogs across our study

region are primarily pools that are not included in state and federal wetlands inventories, being significantly smaller and more isolated than sites identified in remotely-sensed datasets. These results indicate that data deficiency in this species may be driven in part by breeding habitats that are difficult to remotely identify, many of which occur on private lands and do not meet regulatory thresholds designed to protect wetland habitats. More broadly, our results underscore that citizen science approaches can both enhance the natural history knowledge of understudied amphibian taxa and highlight gaps in conservation policy.

ASSESSING THE CURRENT DISTRIBUTION OF THE SUWANNEE ALLIGATOR SNAPPING TURTLE (*MACROCHELYS SUWANNIENSIS*) IN GEORGIA.

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The Suwannee Alligator Snapping Turtle (*Macrochelys suwanniensis*) was recently described as a separate species, based on morphological and genetic distinctions from the Alligator Snapping Turtle (*Macrochelys temminckii*). The distribution of *M. suwanniensis* has not been thoroughly investigated in Georgia, as the majority of *Macrochelys* records in the state are of *M. temminckii*, so understanding their distribution of *M. suwanniensis* is vital for successful conservation. In 2018, we began surveying for *M. suwanniensis* throughout the Suwannee River drainage, by setting baited hoop traps in river mainstems, tributary creeks, and oxbow lakes. Areas that lacked previous survey efforts or would constitute range extensions were the primary focus. From 2018-2019 we captured 33 individuals (13 males, 9 females, 1 sex undetermined, and 10 juveniles) during 37 capture events with a catch-per-unit effort (CPUE) of 0.08. Mean adult mass, mean adult SCL, and CPUE were all lower in the river mainstems (12.1 kg, 373 mm, 0.05) than in less navigable water (26.7 kg, 472 mm, 0.15), possibly due to historical overharvest on the large rivers. We documented turtles in six new Georgia counties and confirmed the presence of *M. suwanniensis* in Georgia's upper Suwannee drainage for the first time since 1985. The scarcity of records from the Okefenokee area and upper Suwannee River could be due to river characteristics or lasting impacts from historical overharvest, and while the size and demographics of this persisting population remains unknown, there is recent evidence of reproduction.

GEOLOGICAL AND ANTHROPOGENIC CONSTRAINTS ON THE FINE-SCALE DISTRIBUTION OF A PLETHODONTID SALAMANDER.

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As humans continue to alter natural landscapes, conservation planning necessitates a better understanding of the natural and anthropogenic factors that determine the distribution of wildlife. The Southern Zigzag Salamander (*Plethodon ventralis*) is a relatively recently described species 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 used repeated sampling of random quadrats among forests contained within public parks in Knox County, Tennessee to better understand factors

predicting the distribution of *P. ventralis*. We fit occupancy models with site-level covariates such as forest patch size and the presence of invasive ground cover and observation-level covariates such as temperature and precipitation. We recorded *P. ventralis* at 15 of 56 quadrats from October 2018 to April 2019. The most important factors predicting *P. ventralis* occupancy are the presence (or lack thereof) of two invasive ground cover plants—English Ivy (*Hedera helix)* and Wintercreeper (*Euonymus fortunei*)—and the presence of limestone as the primary layer of underlying rock at a site. These results support removal of invasive plants as a key strategy to support native amphibian populations.

ECOMORPHOLOGICAL VARIATION IN SHELL SHAPE OF STRIPE-NECKED MUSK TURTLES (*STERNOTHERUS PELTIFER*).

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With six species of musk turtles currently recognized, the genus *Sternotherus* composes a significant component of Alabama's turtle diversity. *Sternotherus* morphology varies substantially along a continuum of shell shape from flattened to domed. This body shape divergence is presumably a consequence of local adaptation; species from swift streams with ample bedrock likely evolved to be flatter (e.g., *S. depressus*) than species from slower, sandy or muddy streams (e.g., *S. carinatus*). However, as much is currently unknown about the ecology and evolution of the genus, adaptive significance of shell shape variation remains an unanswered question. The stripe-necked musk turtle, *S. peltifer*, occupies a wide variety of stream habitats in Alabama and demonstrates significant intraspecific morphological variability in the Cahaba River of central Alabama, including a flattened phenotype reminiscent of *S. depressus*. This variation may be associated with location relative to the Fall Line, a geological boundary demarcating a rapid change in river bottom from bedrock to sand. Similar clines in shell shape exist for several species of Emydid turtles, but whether this convergent shell phenotype has resulted from a similar adaptive process in *S. peltifer* is undetermined. We trapped *S. peltifer* throughout the Cahaba River drainage in summer 2019 to quantify shell morphology and conducted a PCA to assess variation in relative shell height. Multiple regression was used to assess relationships among relative shell height, sex, and location relative to the Fall Line. This study contributes to a growing body of knowledge regarding the ecology and evolution of bottom-walking turtles.