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Abstracts

*Presenting author

Incidence, Severity, and Environmental Correlations of Shell Rot of a Threatened Tortoise, *Gopherus polyphemus*

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Poster

Shell rot, a chronic bacterial or fungal disease, is characterized by shell discoloration, flaky skutes, and, in more severe cases, deep lesions. Shell rot may result from trauma, poor nutrition, or suboptimal environmental conditions, however, few studies have evaluated the expression of this disease in wild, terrestrial species. My objectives were to determine how ecological conditions and ontogeny affect presence, extent, and severity of shell rot in Gopher Tortoises (*Gopherus polyphemus*). This study was conducted at Archbold Biological Station in Venus, FL, which hosts a long-studied population of Gopher Tortoises. The study area contains zones of nonnative forage grasses and areas of native scrub and sandhill habitat. Although shell rot has previously been observed in Archbold tortoises, no formal surveys have taken place. I captured and measured juvenile (n =8), subadult (n = 10), and adult (n = 7) tortoises between 3-7 years old, and evaluated the presence, severity, and extent (number of affected scutes) of shell rot. I also recorded microclimatic conditions and vegetation characteristics at their burrows. Larger tortoises had significantly greater numbers of affected scutes than smaller tortoises. Plastral scutes tended to be more affected than carapacial scutes, regardless of size class. Tortoises having access to more herbaceous vegetation within 8 m of their burrow were less likely to have shell rot and had fewer affected scutes. Preliminary analyses suggest that prevalence and severity of shell rot are not correlated with burrow temperature and humidity, or with other vegetation metrics measured as part of this study. Given broad-scale environmental changes and ongoing population declines of Gopher Tortoises, it is important to collect baseline health data and understand the ecological dynamics and potential effects of shell rot and other seemingly “benign” infections.

Techniques for Measuring Successional Vegetation Changes Following Introduction of Gopher Tortoises (*Gopherus polyphemus*) onto Reclaimed Mine Lands

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Oral Presentation

As part of ongoing research on the success of gopher tortoise (*Gopherus polyphemus*) introduction onto reclaimed heavy mineral mine lands, we monitored vegetation recovery of these reclaimed habitats in southeastern Georgia. Here, we present two techniques for measuring vegetation successional changes, a gopher tortoise-centric method and a habitat-centric method. The first technique used vegetation quadrats placed on collective reclaimed habitat on which gopher tortoises have been introduced. Specifically, we measured vegetation around selected (active and abandoned) tortoise burrows as well as unselected (random) locations containing no burrows; therefore, this design was driven by tortoise behavior. The second technique uses the point-intercept transect method for sampling as described by the Georgia Department of Natural Resources vegetation sampling protocol; therefore, this technique allows us to achieve a more thorough and continuous sampling of the habitat. We describe these two methods in detail and discuss their unique ecological applications for monitoring habitat change. We also compare their respective advantages in equipping us to direct management recommendations to our partners in the mining industry. To further assess reclaimed habitat changes, we used drone imagery and photogrammetry to measure vegetation density and growth progression alongside both vegetation sampling techniques described above. We also examine which plant species are commonly found within these reclaimed tortoise recipient sites and their use as forage by tortoises in the absence of plants more typically considered key food sources in undisturbed habitats. These results are key to determining whether reclaimed mine lands can support tortoise populations with the hope of reducing the need for long-distance animal translocations. Successful habitat reclamation also could aid in restoring populations of the many commensal species associated with tortoise burrows.

Foraging Ecology of Gopher Tortoises (*Gopherus polyphemus*) within Boyd Hill Nature Preserve, St. Petersburg, Florida, USA

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Oral Presentation (Student)

Gopher tortoise habitat has been reduced across the species range due to landscape-scale fire suppression and urbanization that have degraded habitat quality. The objective of our study was to understand the foraging ecology of an isolated population of gopher tortoises in a scrubby flatwoods ecosystem located in the southern portion of its distribution. We conducted foraging observations (n = 25) of tortoises during the summer of 2020, following them closely while observing feeding behavior. We counted the number of bites (n = 4,822) tortoises took of each plant, identified to the species level or lowest taxonomic unit possible. We analyzed the specificity of the tortoise diet by determining if what they chose to eat differed from what was available at two scales: foraging trail availability and surrounding landscape availability. Based on our results, gopher tortoises were generalist foragers, feeding most often on multiple grass species as

determined by Fiensinger's Proportional Similarity Index (PSI = 0.788). We also found through Jacob's Electivity Index (D) and Manly's alpha (α) that tortoises highly selected certain plant species including fruits of hog plum (*Ximenia americana*, D = 0.744; α = 0.121), foliage of spurge nettle (*Cnidoscolus stimulosus*, D = 0.821; α = 0.180) and prickly lettuce (*Lactuca serriola*, D = 0.772; α = 0.139). Foraging trail plant diversity was not significantly different than the surrounding landscape plant diversity through equitability analysis of Shannon's diversity. Our results provide a better understanding of the foraging ecology of gopher tortoises, including their foraging selectivity.

Experimental Effects of Wind Disturbance: Vertebrate use of Pine Treefalls

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Oral Presentation

Ecologists have long recognized the importance of natural disturbances like fire in shaping pine savanna communities, but the ecological role of wind disturbance (e.g., tropical cyclones) is much less understood. Uprooted trees increase canopy openness and create unique pit-and-mound microrelief with exposed root mats, bare mineral soil, humus, and fallen boles that may be used by a diverse community of species. Therefore, our objectives were to investigate how vertebrates used newly uprooted longleaf pine (*Pinus palustris*) trees (i.e., tipups) and determine how these communities change over time. We used static winching to topple nine live longleaf pine trees (mean DBH = 44.6 cm) to simulate wind disturbance. Within a few days, we deployed two camera traps at opposite sides of pit openings at each tipup and monitored monthly from May through December 2021. We recorded 1,115,453 photos of which 2% had vertebrates (*n* = 21,267). We detected at least 46 species that used tipups to perch, bask, forage, call/sing, or for refuge. We used negative binomial regression and model selection (AICc) to identify important variables associated with vertebrate tip up use. We found the following species/groups were more likely to use tipups soon after treefall with use decreasing with time: Southern Toad (*Anaxyrus terrestris*, *n* = 16), Bachman's Sparrow (*Peucaea aestivalis*, *n* = 59), Northern Cardinal (*Cardinalis cardinalis*, *n* = 88), Gray Catbird (*Dumetella carolinensis*, *n* = 76), Eastern Bluebird (*Sialia sialis*, *n* = 27), Carolina Wren (*Thryothorus ludovicianus*, *n* = 595)], Eastern Fence Lizard (*Sceloporus undulatus*, *n* = 174), and Skinks (*Plestiodon* spp., *n* = 42). Wind disturbance creates unique microhabitats, like structural legacies of fire, that provide sites for foraging, shelter, basking, and communication for a broad suite of vertebrates.

Groundcover Restoration on Public Lands in Florida-Time and Money

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Oral Presentation

Several public agencies in Florida (including water management districts, the Florida Fish and Wildlife

Commission, the Florida Dept. of Environmental Protection, and various counties) have undertaken "full-scale" groundcover restoration (GCR) efforts on disturbed or ruderal lands within their jurisdiction. Many of these efforts have been conducted "inhouse" with most of the work done by the public land managers, biologists and technicians. This presentation will focus on a contracted GCR project initiated in late 2019 utilizing a private vendor and managed by the Southwest Florida Water Management District (SWFWMD) to restore sandhill habitat in Marion County, Florida. Two sites totaling 54 acres were selected for restoration. Both areas were formerly sandhills converted to improved pasture several decades prior to District ownership. The presentation will cover site preparation methods, donor site selection, native seed collection and planting, post-seeding maintenance, and early monitoring results as well as associated costs. Early results show considerable decline in non-native bahia grass cover after herbicide treatment with increasing cover and frequency of wiregrass (*Aristida stricta*) and splitbeard bluestem (*Andropogon ternarius*) post-planting. Nuisance natives include dogfennel and yankeeweed (*Eupatorium* spp.). Partridgepea (*Chamaecrista fasciculata*) provides a desirable seed source for quail and other wildlife but can compete for space with other sandhill species. Time and financial aspects of conducting groundcover restoration projects will be discussed as well as potential impacts and anticipated benefits to gopher tortoises and other wildlife species resulting from the restoration of native plant communities.

Testing Population Consolidation and Headstarting to Restore a Non-viable Population of Gopher Tortoises

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Oral Presentation

Large-scale Gopher Tortoise translocations are a widespread practice to remove tortoises from imminent dangers of habitat loss for human development. However, translocation for explicit conservation goals remains an infrequently-utilized and untested tool to conserve this at-risk species. Given the effects of density on tortoise movement and population viability, we conducted a conservation effort to increase the population density of a low-density tortoise population on a public property in southern Alabama. Efforts included consolidating the resident tortoises from a fire-suppressed landscape into a temporary enclosure located in a high-quality restored sandhill. We also headstarted two cohorts of hatchlings from the site for one and two years. In total, 100 resident tortoises were consolidated into the enclosure and 98 headstarted juvenile tortoises were released into the nearby area into both soft- and hard-release conditions. Using radiotelemtry of a sub-population of consolidated adults tracked for two seasons (before and after the enclosure was removed), we found that site fidelity of the adults was 69% in the area enclosed by the pen and 93% in the wider-managed site. Adult home range area was not significantly different between the years that adult tortoises were enclosed in the pen and the year after the pen was removed. A sub-population of two-year old headstarts was also radiotracked. Radiotracked headstarts had 100% site fidelity, regardless of release condition, and home ranges significantly decreased over the study period. Mortality was extremely low in all groups. We further discuss how this research may contribute to effective strategies for the demographic management of low-density tortoise populations, particularly in the species' distributional periphery.

Where Did They Come From, Where Did They Go? Twelve Years of Gopher Tortoise (*Gopherus polyphemus*) Translocation in Florida

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Oral Presentation

The Florida Fish and Wildlife Conservation Commission (FWC) Gopher Tortoise Permitting Guidelines were established in 2009 as part of a broader strategy to meet the objective of no net loss of Gopher Tortoises (*Gopherus polyphemus*) from 2012–2022 set forth in the statewide Gopher Tortoise Management Plan. Here we present data from the FWC permitting system on the trends associated with Gopher Tortoise displacement from 2009 through 2021, and use spatial network analysis to include information on tortoise "exports" and "imports" at the county level. From 2009–2021 a total of 75,339 tortoises were relocated from the three most common permit types. Of these, 66,064 tortoises (87.7%) were translocated off-site to different properties. Gopher Tortoise translocations show an increasing trend from 2009–2019, with the number of tortoises displaced annually appearing relatively stable from 2019–2021. Acres of impacted occupied Gopher Tortoise habitat also exhibit an increasing trend, with a total of 279,438 acres of occupied gopher tortoise habitat impacted by projects under development site permits. Conversely, from 2008–2022, 52,786 acres of suitable gopher tortoise habitat have been permitted as recipient sites to accept translocated tortoises. Network analysis shows an increasing trend in connectedness associated with an increased number of permits issued over time. Additionally, there is significant structure within the translocation network, suggesting that either economic (e.g., travel costs) and/or policy (e.g., latitudinal limits on translocation distance) constraints might encourage these more regional subcomponents within the larger statewide network.

Mitigation Translocation of Gopher Tortoises in Florida: Spatial ecology and population monitoring

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Oral presentation

Due to widespread habitat destruction in Florida, tens of thousands of gopher tortoises (*Gopherus polyphemus*) have been translocated to protected recipient sites with a soft-release strategy using outdoor enclosures ("pens"). Monitoring the ecological impacts of translocation is critical to the success of such programs to ensure populations can be self-sustaining, but translocation processes (such as the use of pens) can result in spatial structuring that impedes effective population estimation. Our objectives were to 1) investigate the space use of translocated gopher tortoises in relation to pen edges; 2) assess if line transect distance sampling (LTDS) may be suitable to monitor these populations given spatial structuring around pens. For objective 1, we used camera-trap arrays, burrow distribution surveys and GPS telemetry methods

to understand tortoise space use within pens; comparing results to simulated random samples. For objective 2, we used simulation modeling to produce 3,024 unique scenarios of translocated tortoise populations that differed in recipient site and population properties. We virtually sampled simulated tortoise populations using line transect distance sampling (LTDS) methods, which we analyzed using a custom Bayesian hierarchical model to estimate population densities. Our results demonstrate that there can be highly irregular clustering of burrows and individual movements near pen edges; however, populations may not always exhibit such spatial patterns. LTDS can produce unbiased population size estimates across translocation scenarios, but careful survey design is warranted when an evident "clustering effect" is discovered, to avoid gross inaccuracies of density estimations.

Gopher Tortoise Nest-site Selection at Burrows and the Effects of Nest Environment on Hatching Success

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Oral Presentation (Student)

Nesting and early life stages are periods of high mortality for many turtle species. In gopher tortoises (*Gopherus polyphemus*), few studies have investigated nest-site selection and, to our knowledge, none have evaluated the effects of differing nest environments on hatching success. We are investigating gopher tortoise nest-site selection and the impact of nest environment on clutch hatching success at the Jones Center at Ichauway in Southwest Georgia. From mid-May to mid-July 2022 and 2023, we conducted repeated searches at burrows to locate nests, excavated and collected nest data, and re-buried nests as they were found. Once eggs were estimated to be past the critical point for sex determination, nests were moved into indoor incubators to allow for accurate measurement of hatching success. We collected soil samples, measured canopy and ground cover at nest locations (n=68), and collected the same samples at an equal number of burrows where no nests were found. This presentation will include data on the relationship between canopy, ground cover, and nest-site selection in gopher tortoises – initial analyses indicate that tortoises select nest sites with lower canopy and understory vegetation cover. As vegetative cover and soil composition likely influence nest factors important to incubation, such as nest temperature and soil moisture, we predict that burrows with nests will have lower canopy cover and soils with more sand content than random non-nest burrows. Ultimately, we will identify vegetation and soil parameters associated with nest-site selection and hatching success in gopher tortoises to guide best management practices.

Survival and Reproduction in Translocated Gopher Tortoises (*Gopherus polyphemus*): Region-of-origin effects and outbreeding depression

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Oral Presentation

Determining the effects of geographic origin on translocation outcomes can guide policy to improve translocation success. Here, we report on two studies of translocated gopher tortoises (*Gopherus polyphemus*) examining how geographic origin influences adult survival and nest hatching success at Nokuse, a large recipient site in the Florida panhandle. Survival analysis of a large, individually-identified carcass dataset collected over 16 years revealed that tortoises from central Florida have relatively higher survival than tortoises from other regions (including the panhandle) when translocated to Nokuse. Survival curves from carcass encounters at three well-studied release sites at Nokuse suggest annual true survival ranged from 92-95% for the first 5 years following release; a matrix population model suggested that these rates, if sustained, are likely too low to maintain sustainable populations. In a three-year study of reproduction at two release sites at Nokuse, we tested whether maternal region of origin, climate difference between origin and release sites, and parental genetic distance predicted nest hatching success. We found that females from northeast Florida produced clutches with lower hatching success than females from other regions across the state. We detected regional differentiation in female nest site selection behavior in the common environment, though these differences did not mediate the regional effect on hatching success. We also found evidence for outbreeding depression: hatching success declined with increasing parental geographic and genetic distance, dropping from 93% to 67% across the observed range of outbreeding. Together, these results suggest that newly translocated or admixed populations may experience reproductive costs due to historic local population differentiation, and that local adaptation and outbreeding depression could hamper conservation efforts. Limitations on the distance tortoises can be translocated could partially mitigate negative effects on reproduction in this species already experiencing low reproductive rates.

Growth in the Southernmost Gopher Tortoise Population: Implications for conservation and adaptation

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Poster

Gopher Tortoises (*Gopherus polyphemus*) provide homes to >350 species of animals within the habitats they reside, as well as disperse seeds of vital native plant life, earning a status as an ecosystem engineer and a species of greatest conservation need. In Florida, the state-threatened species have to deal with multiple threats to their population status such as habitat loss and climate change. Past studies in Conecuh National Forest (Alabama) and University of South Florida's Ecological Research Area (Tampa, Florida) have studied growth of gopher tortoises and found that in these areas, tortoises reach maturity between 22-23 and about 12 years of age. However, growth data is missing from the southernmost populations. To fill this gap, we analyzed an existing long-term growth dataset from the southernmost part of the geographic range (Miami-Dade County, Florida), and we collected monthly growth data of juvenile and sub-adult tortoises.

We applied the Von Bertalanffy Growth Function to predict the tortoise's growth rates, as well as use the tortoise's length as a function of age. We found that Gopher Tortoises in the southernmost populations reached maturity at 7 to 8 years of age. Our study provides an important supplement to past studies of Gopher Tortoise growth, because South Florida's sub-tropical climate may predict accelerating growth rates for northern populations of Gopher Tortoises under increased temperatures from climate change.

Preliminary Efforts to Reintroduce Gopher Tortoises and Gopher Frogs to a Previously Inhabited Landscape

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Poster

The 41,363-acre Econfina Creek Wildlife Management Area in northwest Florida was historically dominated by longleaf pine sandhills where the Gopher Tortoise and Gopher Frog once thrived. Converted to commercial stands of sand pine during the last century, this habitat is currently being restored to its natural state through projects initiated by NW Florida Water Management District. To reintroduce gopher tortoises and gopher frogs, the Florida Fish and Wildlife Conservation Commission (FWC) installed a 50-acre recipient pen that includes 47 acres of xeric tortoise soils and 3 acres of ephemeral wetlands. Staff are currently releasing tortoises onsite and will begin headstarting gopher frogs in spring 2024 for direct release into the pen. Tortoise burrow and egg mass counts will be conducted over the coming years to measure success.

Seeing Blue: Seven Years of Eastern Indigo Snake Reintroductions in the Florida Panhandle

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Oral Presentation

The eastern indigo snake (*Drymarchon couperi*; EIS) is listed as a federally threatened species, and populations have significantly declined over the last half century, to the point where the species is considered extirpated through a portion of its historic range. Presumed population extirpations in the Florida Panhandle and westward through Alabama and Mississippi are linked to habitat loss, habitat degradation by fire suppression, and the decline of gopher tortoises (*Gopherus polyphemus*), which the EIS depends on for their burrows. With the goal of reestablishing self-sustaining populations of EIS in this portion of its historic range, carefully managed reintroductions of snakes bred in captivity are a component

of the EIS Species Recovery Plan. An ambitious EIS reintroduction project was established in Alabama's Conecuh National Forest in 2010. Shortly thereafter, in 2017, the reintroduction effort expanded to The Nature Conservancy's Apalachicola Bluffs and Ravines Preserve (ABRP), located in the Florida Panhandle. The ABRP is managed to restore habitat and benefit wildlife, including tortoises. Snakes used for the Florida reintroductions were bred in captivity by the Central Florida Zoo's Orianne Center for Indigo Conservation (OCIC). Understanding the fate of these reintroduced snakes is an adaptive challenge. As a part of the Florida reintroduction, the initial cohorts of released snakes were equipped with radio telemetry equipment and a disease survey was performed. Additional funding allowed for expansion of OCIC's captive colony, habitat management at ABRP, and installation of automated monitoring systems at ABRP. As of 2023, 126 EIS have been released at ABRP. To highlight this collaborative species recovery effort, we present a history of the reintroduction project in Florida, an overview of the automated monitoring system, and additional observations made throughout this project.

Gopher Tortoise Disease Study in the Red Hills Region

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Poster

Gopher tortoise (*Gopherus polyphemus*) relocations are becoming more common due to habitat loss, and often tortoises are not screened for pathogens prior to relocation, possibly contributing to the spread of pathogens. We are investigating the baseline health status for gopher tortoise populations on private land in the Red Hills region of Florida and Georgia, prior to them becoming potential tortoise recipient sites and will be analyzing data from a total of 60 cameras to identify possible behavior trends amongst infected individuals. We trapped from previously surveyed populations at a total of six properties and collected morphometric data from captured individuals over two years. Additionally we collected an oral/choanal swab, a blood sample and fecal sample opportunistically from individuals to test for pathogen presence. The swabs were then sent to the University of Illinois Wildlife Epidemiology Laboratory to test for several pathogens of interest including: *Ranavirus* sp., *Mycoplasma* sp., *Helicobacter* sp., Herpesviruses, Adenoviruses, and coccidian parasites. PCV and total protein were read and blood smears were created. Preliminary findings have shown an unexpected bacteria presence (*Leptospira* spp.) in at least two sites and higher than anticipated pathogen prevalence in the "control" site with both Tortoise Helicobacter and *Mycoplasma agassizii* detected. Further analysis of the incoming disease results will provide further insight to disease prevalence in the Red Hills and possible relationships between age class, body size or parasite load. This research is still in progress and future steps include analyzing camera data to quantify behavior trends of infected individuals.

Assessment of the Genetic Diversity and Relatedness of Gopher Frogs (*Rana* [*Lithobates*] *capito*) on the Conecuh National Forest, Covington County, AL

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Poster

Gopher frogs (*Rana* [*Lithobates*] *capito*) are pond-breeding amphibians native to longleaf pine forests in Alabama, Florida, Georgia, North Carolina, and South Carolina, where they are state-protected across their range. In Alabama, gopher frogs are known to consistently breed only in two ponds, both located on the Conecuh National Forest. Life history traits of amphibians, including gopher frogs, may influence the genetic connectivity of populations. In particular, breeding site fidelity and variable reproductive success across years can make amphibian populations vulnerable to a loss of genetic diversity. Additionally, the small populations in Alabama are geographically isolated from other known gopher frog populations, which may increase the risk of genetic drift. Through this project, we aim to assess the genetic diversity of gopher frogs in the Conecuh National Forest via microsatellite genotyping. Metrics of genetic diversity, relatedness, and inbreeding will be determined and compared to gopher frog populations in Florida (where connectivity is comparably high) and North Carolina (where connectivity is reduced), as well as the dusky gopher frog (*Rana* [*Lithobates*] *sevosa*) population in Mississippi (where genetic drift and a population bottleneck have been previously described). Results from this project will identify where more intensive management strategies to enhance the genetic structure of this species within Alabama can be effective in supporting the conservation of gopher frogs and other species of concern.

The Influence of Soil Texture and Vegetation Structure on Gopher Tortoise (*Gopherus polyphemus*) Burrow Characteristics and Burrow Site Selection.

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Oral Presentation (Student)

The gopher tortoise (*Gopherus polyphemus*) is a keystone fossorial species that has experienced severe range-wide population declines due to habitat loss, degradation, and fragmentation. Gopher tortoises excavate extensive burrows that provide refuge from extreme temperatures, fire, and predation. Habitat characteristics, specifically soil and vegetation structure, greatly influence burrow structure and placement. Our objectives were to assess the effects of soil texture on burrow temperature and structure and to examine fine-scale burrow site selection in longleaf pine (*Pinus palustris*) forests of southwestern Georgia. Our study sites were located at the Jones Center at Ichauway in Baker County, GA and Greenwood Plantation in Thomas County, GA. We used multiple multivariate regression to assess the effect of percent clay on burrow temperature, angle of descent, length, and depth. Burrows in clayey soils were shorter and shallower than those in sandy soils. However, we did not see differences in burrow temperature suggesting that soil texture affects the depth required for burrows to reach stable temperatures. We used generalized linear models with a binomial distribution (burrow = 1, non-burrow = 0) to compare habitat characteristics at burrow and non-burrow points. At Ichauway, gopher tortoises selected burrow sites with high percentages of sand, low canopy and midstory cover, and more herbaceous ground cover. We found no

difference between habitat characteristics of burrow and non-burrow sites at Greenwood Plantation suggesting the habitat was more homogeneous than at Ichauway. Our results support the contention that in heterogeneous habitat, gopher tortoises prefer areas with sandy soils, low canopy and midstory cover, and high herbaceous ground cover, although they demonstrate a tolerance for a wider gradient of habitat conditions than has generally been reported.

The Prevalence of Lead in Florida Chelonians

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Oral Presentation

Lead is a natural occurring heavy metal in the earths crust and has no necessary role in the body. Lead is one of the first metals used by humans and has caused an increased risk of lead exposure and lead toxicosis in people and wildlife. Resources on lead related studies in reptiles is limited and is what sparked this study on the prevalence of lead in Florida's chelonians. Is lead a concern in Florida and if so, what species and what direct effects could lead have on these individuals and overall populations? This study started in April of 2022 and has covered a large portion of the state with over 600 lead tests processed using the Lead Care II analyzer. To date 17 species of chelonian have been tested for lead. Samples were obtained from turtles and tortoises after they were admitted for care and rehabilitation due to illness or injury, or during partnered research surveys and tortoise excavation sites. The prevalence of lead exposure in Gopher tortoises (*Gopherus polyphemus*) ranks the highest of all studied species. This project has allowed us to develop focus points for further research in species at higher risk for lead exposure and toxicosis like the gopher tortoise.

Improving Methods to Live-capture Gopher Tortoises to Reduce Trap Time and Temperature

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Poster

Live-trapped gopher tortoises (*Gopherus polyphemus*) face a multitude of dangers including high levels of stress, fire ants, and overheating due to sun exposure. To improve the welfare of trapped animals, we explored different trap shading techniques and the use of cell-enabled game cameras to reduce excessive heat exposure and the time spent inside a trap. To test how different trap shading techniques affect internal temperature, we programmed iButtons to log temperature every 10 minutes and placed them on 1.5-inch-tall wooden blocks inside standard wire live-traps (32x10x12in). We tested a variety of different shading materials, including reflective bubble-insulation (Reflectix R-21 Unfaced Reflective Roll), silt fence (Beltch 935), and burlap (10 oz), by placing traps in full sun for 8+ hours in early summer in northwest Florida. We found that traps with reflective insulation covering the top and two long sides were cooler than other treatments by 1.1-3.9 °C (2-7 °F) and were only 1.7-2.8 °C (3-5 °F) warmer than ambient temperature

loggers in deep shade, providing an affordable and effective shading solution. To reduce time animals spent in traps, we attached cell-enabled motion-trigger cameras (Covert WC30) to the wire live-traps to immediately alert researchers of a capture. Previous trapping protocol of three trap checks throughout the day (10am, 2pm, & 7pm) had an estimated average of two hours spent in a trap; by comparison, the cameras reduced in-trap time to an average of 5.1 minutes. We also tested if the use of cameras positioned at burrows could allow targeted hand-capture without the use of a trap. The effort of two researchers caught tortoises at a rate of 0.45 per day with this method, compared to 1.4 tortoises per day using traps. Our results provide critical insight to reduce excessive heat exposure and trap stress, and suggest tools to increase capturing efficiency.

Aquatic Salamanders, *Amphiuma means* and *Siren lacertina*, Exhibit Differences in the Relationship between Water Depth and Body Condition

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Poster

Aquatic salamanders, *Amphiuma means* (Two-toed amphiuma) and *Siren lacertina* (Greater siren), represent a large portion of the biomass in geographically isolated wetlands and likely serve as apex predators in these ecosystems. Despite this, very little is known about their life-histories and ecology. To begin to address this knowledge gap, we established a capture-mark-recapture study from March to June in 2016 - 2017 and in 2023 at Ichauway in southwestern Georgia. We used commercial crayfish traps with nine traps deployed at eight grids across one wetland. Salamanders were measured, weighed, and implanted with Passive Integrated Transponders (PIT tags). Water depth was measured at the start and end of every trapping period. We developed linear mixed models for 2016 and 2017 data with year as a random effect to determine if there was a relationship between aquatic salamander body condition and water depth for each species, separately. We examined the same relationship for A. means in 2023 in a separate linear regression due to differences in water depth measurement methods and grid locations. We captured 37 *S. lacertina* and 13 *A. means* in 2016 and 30 *S. lacertina* and 10 *A. means* in 2017.In 2023, 2 *S. lacertina* and 23 *A. means* were captured. In 2016-2017, results showed that *S. lacertina* body condition increased with water depth ($p < 0.05$) while *A. means* body condition decreased as water depth increased ($p < 0.01$). In 2023, *A. means* body condition increased with water depth ($p < 0.01$). *Siren lacertina* body condition was highest in March and *A. means* body condition was highest in June/July suggesting that the seasonal activity patterns for these two species differ and, for *A. means*, their body condition relationship to water depth is plastic.