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Presentation Abstracts

Understanding the Effectiveness of Permitted On-Site Relocation for Gopher Tortoises in Southwest Florida

M. Kyle Brown[1]*, Nick Jennings[1], Nick Lechmanik[1], Rebecca Schneider[1]
[1] Florida Fish and Wildlife Conservation Commission, 3900 Drane Field Road, Lakeland, FL 33811

The gopher tortoise (*Gopherus polyphemus*) is a state-listed species in the state of Florida, heavily impacted by habitat loss, alteration, and degradation. Southwest Florida is a rapidly growing region of the state where gopher tortoises are often displaced by development activities. In 2008, the Florida Fish and Wildlife Conservation Commission (FWC) implemented and have subsequently revised the Gopher Tortoise Permitting Guidelines, creating a system where gopher tortoises affected by development are required to be relocated rather than entombed at a development site. Relocation permits authorize the capture and relocation of tortoises to a permitted off-site recipient location or on-site to undisturbed portions of the property being developed. On-site relocation of tortoises is often an affordable mitigation option for landowners compared to offsite relocations and allows tortoises to stay within their home range. However, little is known about the success of on-site relocations. FWC staff surveyed 246 properties permitted between 2016 and 2021 for on-site relocation of gopher tortoises, seeking to determine: (1) Are on-site relocation areas maintained as suitable habitat?, (2) Are gopher tortoise burrows present at the property or nearby?, and (3) Are current residents aware of the need to maintain the on-site recipient areas as suitable habitat? In this presentation, we will discuss the findings of the surveys and discuss opportunities to improve the effectiveness of on-site relocation of gopher tortoises in Florida.
Presentation Type: Oral

Long Term Gopher Tortoise Monitoring at Ichauway: Implications for Management

Daniel A. Crawford[1], L. Mike Conner[1], Jennifer M. Howze[1], Jonathan M. Stober[2], Lora L. Smith[1]*
[1] Jones Center at Ichauway, 3988 Jones Center Drive, Newton, GA 39870
[2] Shoal Creek Ranger District, Talladega National Forest, United States Forest Service, Heflin, AL 36264

Extensive tracts of mature, second growth longleaf pine savanna with native ground cover dominate the Jones Center at Ichauway in southwestern Georgia. However, a legacy of historic annual dormant season fires fostered encroachment of fire-resistant (mesic) oaks (*Quercus virginiana*, *Q. laurifolia*, and *Q. nigra*) on portions of the property. To maintain longleaf pine savannas and restore hardwood encroached areas, recent (since the mid-1990s) burn prescriptions include a 2-3 year return interval with every 2nd or 3rd burn, on average, occurring during the growing season. Additionally, managers employed mechanical removal of mesic oaks on 2837 ha of mixed-pine hardwood forests during 1998-2021. Ichauway supports a regionally significant population of gopher tortoises with estimates of more than 5000 individuals on approximately 6870 ha of upland soils. At 5-year intervals since 2006, we surveyed for tortoise burrows using line transect distance sampling and scoped detected burrows to determine occupancy. Expanding upon recent hierarchical modelling approaches for data collected via line transect distance sampling, which account for intrinsic and extrinsic factors affecting variability in burrow detection, we examined the effects of mechanical hardwood removal efforts on the local gopher tortoise population. Preliminary results suggest that 1) tortoise abundance increased in areas where mechanical hardwood removal occurred while remaining constant in untreated areas and 2) the proportion of sub-adult (<22 cm) and adult (22+ cm) individuals increased and decreased, respectively, in treated areas. Furthermore, analysis of concurrent track count data suggests that hardwood removal locally reduced abundance of a common nest predator, the raccoon (*Procyon lotor*), which may mechanistically explain increased abundance of subadult tortoises in those areas. Our preliminary results provide critical insights on demographically variable responses of a gopher tortoise population to active restoration efforts in a longleaf pine ecosystem while demonstrating the importance and utility of long-term monitoring efforts, particularly for long-lived species of concern.
Presentation Type: Poster

Gopher Tortoise Stewardship in Southwest Florida: A Collaboration Between the City of Naples, Naples Preserve and Florida Gulf Coast University

Nora E Demers[1]* and Rebecca J Speer[2]
[1] Department of Biological Sciences, Florida Gulf Coast University, Fort Myers, FL 33965
[2] Recreation Assistant-Naples Preserve, City of Naples, 1690 Tamiami Trail North- Naples, FL 34102

Naples Preserve is a 9.47 acre preserve located in the heart of the City of Naples. It has a population of approximately 100 gopher tortoises, with the majority of them less than 13 years of age. Nora Demers at Florida Gulf Coast University (26 miles to the north of the Preserve) has collaborated with Becky Speer at the Preserve on several research projects including examining growth rates, and parasite load in scat to have IN addition dozens of students have completed part of their required service learning doing habitat restoration at Naples Preserve. We will present details of these collaborations and future opportunities and goals.
Presentation Type: Poster

Gopher Tortoises are Frugivores? Seasonal Shifts toward Frugivory by *Gopherus polyphemus* in the Imperiled Pine Rocklands of Southeastern Florida

Adrian Figueroa[1]*, Alyssa Herrera[2], Lydia Cuni[3], and Dr. Steven Whitfield[4]
[1] Florida International University, Department of Earth and Environment, Miami, FL, 33199;

Florida International University, Institute of Environment, Miami, FL, 33199; Zoo Miami, Conservation and Research Department, Miami, FL, 33177. [*afigu083@fiu.edu*]
[2] Florida International University, Department of Biological Sciences, Miami, FL, 33199; Zoo Miami, Conservation and Research Department, Miami, FL, 33177.
[3] Fairchild Tropical Botanic Garden, Coral Gables, FL 33156.
[4] Zoo Miami, Conservation and Research Department, Miami, FL 33177. Florida International University, School of Environment, Arts, Society, Miami FL 33199.

Frugivory is an important foraging behavior often leading to seed dispersal for fleshy fruited plants. Thus, most animal-mediated seed dispersal literature has focused on traditional frugivores due to the prevalence of fleshy fruits in their diet. This approach has led to research biases that imply traditional frugivores are primarily important for maintaining this ecological process over other animals that diverge in their foraging behavior. Previous research has unveiled that scats from diverse faunae contain seeds of plants with disparate dispersal syndromes aside from endozoochorous plants (with fleshy fruits). Herbivorous gopher tortoises (*Gopherus polyphemus*) – a state-threatened species in Florida – currently inhabit the globally imperiled pine rockland habitat at The Richmond Tract in Miami, FL. These tortoises have been previously documented to ingest seeds of various plant species at this site but surprisingly lacked seeds of many fleshy fruited species. However, this observation was due to sampling biases focusing on dry season scat collection. Many of the same individual tortoises have now been tracked longitudinally for a year and a half with weekly scat collections characterizing their diet and role as seed dispersers across the wet and dry seasons. Through this research, clear patterns have emerged reflecting dietary shifts in response to the fruiting phenology of large-seeded fleshy fruited pine rockland plant species. In this talk, I will discuss results from scat dissections as part of my dissertation research and share the implications of this frugivorous behavior by gopher tortoises for the conservation of the pine rockland plant community.
Presentation Type: Oral, Student

The Mississippi Amphibian Monitoring Program (MAMP) Past and Future

Jennifer Frey[1]*, Kathy Shelton[1], Michael J. Andres[2], Aaron Holbrook[1], Nicole Hodges[1]
[1] Mississippi Department of Wildlife Fisheries and Parks/Mississippi Museum of Natural Science, 2148 Riverside Dr, Jackson, MS 39202
[2] Division of Coastal Sciences, The University of Southern Mississippi, 703 East Beach Dr. Ocean Springs, MS, 39564

The Mississippi Amphibian Monitoring Program (MAMP) was a volunteer based anuran (frogs and toads) statewide monitoring system established in 2001 to assist with species-specific status assessments of Mississippi's frog populations. MAMP was canceled in 2015 due to lack of funding. At the program's peak, a total of 27 species was recorded from 36 of 76 routes statewide. MAMP followed the protocols set by the North American Amphibian Monitoring Program, NAAMP, which ended in 2015 as well. Each route was surveyed by a call trained volunteer three times a year in the late winter, spring, and summer. The routes had 10 stops located near a wetland, pond, stream or other water feature. Each stop was monitored for five minutes, all calls heard were recorded according to a calling index and data was then entered online. The Mississippi Museum of Natural Science (MMNS) seeks to bring back the MAMP program for the 2023 season but with a few modern changes. First, we created an app to record

data in real time. Second, we are revamping the routes and adding acoustic recorders to routes from which no data had been previously collected, are difficult to access or are hot spots we want to target for certain species of concern. We will present the yearly data and species richness of routes to inform the 2023 monitoring. Future monitoring will emulate the past while incorporating new technologies and methods for this continuing program to provide us with a better understanding of the status of frog populations in Mississippi.
Presentation Type: Oral

Occupancy and Detection Rates of Federally-Threatened Skinks on Private Conservation Banks

Neal Halstead[1]*, Victoria Franks[1], Tara Rambo[1], Eric Sievers[1], David Sumpter[1]
[1] Wildlands Conservation, 15310 Amberly Dr., Suite 185, Tampa, FL 33647
[*nhalstead@wildlandsconservation.org*]

Florida sand skinks (*Plestiodon reynoldsi*) and blue-tailed mole skinks *(Plestiodon egregius lividus*) are two Federally-threatened lizard species restricted to xeric habitats in peninsular Florida's central ridges. Conservation banks have been established as the primary mechanism to mitigate for unavoidable take of both species. Until recently, these species were functionally treated as a single entity for the purposes of determining take, with the presence of blue-tailed mole skinks assumed whenever sand skinks were detected. Here we present the results from the pilot phase of a study to update the current status and distribution of both species throughout their respective ranges, with a focus on determining the joint occupancy probabilities for these species. We used drift fence arrays with pitfall, funnel, and camera traps, as well as visual encounter surveys to sample for the presence of both skink species and other herpetofauna in thirty 1-ha sampling units across six private properties in the central Lake Wales Ridge. In addition, we deployed 200 coverboards at each of 20 of these sampling units to estimate detection and occupancy probabilities. As expected, coverboards were the most cost-effective technique for detecting the presence of Florida sand skinks. Sand skink occupancy within each 1-ha sampling unit was best predicted by soil type, distance to the nearest skink soil, habitat tier, and elevation. At the individual coverboard level, detection of sand skinks was best predicted by habitat type, and detection under coverboards also varied among sampling occasions. Coverboards were also effective for detecting blue-tailed mole skinks. However, capture and detection rates of blue-tailed mole skinks were significantly higher outside the sand skink survey season (March through mid-May), with detections under coverboards highest during the winter months.
Presentation Type: Oral

Cliques in the Peninsula: Assessment of Social Structure in Gopher Tortoises at Boyd Hill Nature Preserve

Michael Hilton* and Jeff Goessling
Natural Sciences Collegium, Eckerd College, 4200 54th Ave S St Petersburg FL 33711
[*goessljm@eckerd.edu*]

Recent technological advances have allowed wildlife ecologists to begin to understand the complexity of relationships among individuals within populations. Given gopher tortoises have high site fidelity, naturally exist in high population densities, and are long lived, their population

social structures may be among the most complex within Reptilia. Prior studies have demonstrated that gopher tortoises form non-random interactions with each other, described as "cliques" in a southern Georgia population of tortoises. Herein, we tested for the presence of this complex social structure at Boyd Hill Nature Preserve in Pinellas County, FL, using camera traps placed at 12 active tortoise burrows and set to record every 5 seconds for an entire year during daylight hours. We found that cliques are not present within this population when we only considered social interactions as co-occurrence of two individuals. However, when we only considered interactions to be positive, namely burrow sharing between same- or opposite-sex pairs and burrow chasing between opposite-sex pairs, we found that cliques were significantly present. This study has implications for basic understanding of sociality in turtles and also conservation efforts for this intensively-managed species.
Presentation Type: Oral

Eastern Indigo Snake Recovery Efforts on Apalachicola Bluffs and Ravines Preserve
Alyssa A. Hoekstra[1]*, James E. Bogan, Jr., DVM[2], Michele Elmore[3], Michelle Hoffman[2], Bradley M. O'Hanlon[1], Chaz Oliver[4], David Printiss[4], David A. Steen[5]
[1] Florida Fish and Wildlife Conservation Commission, 620 South Meridian Street, Tallahassee, Florida 32399
[2] Central Florida Zoo & Botanical Gardens' Orianne Center for Indigo Conservation, 30931 Brantley Branch Road, Eustis, Florida 32736
[3] U.S. Fish and Wildlife Service, Georgia Ecological Services, P.O. Box 52560, Fort Benning, Georgia 31995
[4] The Nature Conservancy, 10394 NW Longleaf Drive, Bristol, Florida 32321
[5] Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, 1105 SW Williston Road, Gainesville, Florida 32601

Repatriation is an important conservation tool which can be used to aid in recovery efforts of extirpated species, particularly on managed conservation lands. The federally Threatened eastern indigo snake (*Drymarchon couperi*) has experienced population declines throughout its range from a combination of factors including habitat loss, fragmentation, and degradation. As part of the species' Recovery Plan, the Florida Fish and Wildlife Conservation Commission, Central Florida Zoo & Botanical Gardens' Orianne Center for Indigo Conservation (OCIC), The Nature Conservancy (TNC), the U.S. Fish and Wildlife Service (USFWS), and other partners collaborate to propagate and release captive-bred snakes on TNC's Apalachicola Bluffs and Ravines Preserve (ABRP) located in Bristol, Florida, where, prior to this effort, they had not been observed since 1982. The OCIC currently manages a breeding colony of eastern indigo snakes for producing snakes and then they are raised by the USFWS Welaka National Fish Hatchery until they are two years old for annual release. The collaborative recovery efforts have thus far resulted in the release of 107 snakes onto ABRP since 2017. In the initial years of the project, individual snakes were tracked with radio-telemetry; currently we are monitoring our recovery efforts by conducting pedestrian surveys, deploying drift fence arrays paired with camera traps, setting camera traps at gopher tortoise (*Gopherus polyphemus*) burrows to capture adult activity and evidence of reproduction, and using automated PIT tag scanners to aid in evaluating survivorship. We are also analyzing the growth rates, movements, habitat use, and survival of eastern indigo snakes reintroduced to both ABRP and Conecuh National Forest.

These investigations will aid in measuring the success of our recovery efforts and provide information to understand how to better manage repatriated eastern indigo snake populations.
Presentation Type: Poster

Habitat Use for Two Heliothermic Lizards in Longleaf Pine Savannas

Jennifer M. Howze[1]* and Lora L. Smith[1]
[1]The Jones Center at Ichauway, 3988 Jones Center Drive, Newton, GA 39870

Heliothermic lizards, like *Aspidoscelis sexlineata* (Six-lined Racerunner) and *Sceloporus undulatus* (Eastern Fence Lizard), use direct solar radiation to maintain high body temperatures needed to fulfill their basic life functions. These lizards are often found in frequently burned *Pinus palustris* (Longleaf Pine) savannas that provide open high quality thermal habitat and foraging opportunities. We examined microhabitat features surrounding 42 drift fence capture locations within Longleaf Pine savannas from March to May 2017 to better understand the fine-scale habitat components important for these two species. We used negative binomial regression, model selection (AICc), and model averaging to identify important variables associated with lizard habitat use. We found both Six-lined Racerunners (n = 52) and Eastern Fence Lizards (n = 38) used microhabitats that were characteristic of open-canopied sites (i.e. more bare ground and grass, and less litter, midstory, and canopy cover). However, their use of sites differed in the forest structure selected. The surface-dwelling Six-lined Racerunner selected sites with more stumps and the arboreal Eastern Fence Lizard selected sites with greater oak basal area. Management for these lizards should include activities that promote their habitat, foraging, and thermoregulatory requirements, such as frequent prescribed fire to maintain savanna-like conditions and the retention of forest structures for basking and refuge.
Presentation Type: Poster

Development of Gopher Tortoise Recipient Site Monitoring Methods: a Scenario-Building and Simulation Approach

Max D. Jones[1]*, Lora L. Smith[2] and Elizabeth A. Hunter[3]
[1]Department of Fish and Wildlife Conservation, Virginia Tech, VA [*maxdoltonjones@vt.edu*]
[2]Jones Center at Ichauway, 3988 Jones Center Drive, Newton, GA
[3]U.S. Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit; Department of Fish and Wildlife Conservation, Virginia Tech, VA

Owed to a suite of global threats, turtle and tortoise populations are declining. The gopher tortoise, endemic to upland habitats of the southeastern United States, is no exception, with ongoing threats including illegal harvesting, disease and habitat loss. In Florida, efforts are being made to curb the negative impacts resulting from the latter, which is particularly prevalent due to rapid urban expansion and development. Specifically, the Florida Fish and Wildlife Conservation Commission (FWC) are translocating tortoises from development sites to permitted recipient sites to preserve and bolster populations. Line transect distance sampling (LTDS) is frequently used to monitor the density of natural gopher tortoise populations, but the efficacy of LTDS is untested amongst the diverse idiosyncrasies at long-term recipient sites. The translocated tortoises are soft-released into silt-fenced pens, which introduces unique spatial-temporal implications to the LTDS method. Furthermore, recipient sites can vary in size, shape and habitat heterogeneity; while populations can be impacted by the permitting process ultimately affecting

the ratio of resident to translocated tortoises and age structure of the population. To investigate the robustness of LTDS to monitor gopher tortoises under these pressures, we used simulations to create real-world scenarios where recipient sites are affected by site, population and sampling idiosyncrasies. On average, we found that LTDS resulted in slight underestimations of density, but were generally robust to our scenarios. Inefficient sampling of pen edges resulted in the greatest estimate discrepancies. However, with careful study design allowing for even sampling of pen edges, these effects can be accounted for. We further show that increasing the number of observers from one to three, and improving detection of burrows on the transect lines can further improve estimates. Our study will directly inform subsequent monitoring of translocated gopher tortoises throughout Florida, by creating a Standard Operating Procedure for FWC.
Presentation Type: Oral

Using Machine Learning to Re-Identify Gopher Tortoise Individuals
Leah Knezevich^, Mark Yamane^, and Michael Hilton*
Natural Sciences Collegium, Eckerd College, 4200 54th Ave S St Petersburg FL 33711
[*hiltonm@eckerd.edu*]
^ undergraduate student

Camera traps are increasingly being used as a research tool in behavioral ecology to observe animals in the field. One challenge of continuous data collection by camera traps is that the amount of data produced can be overwhelming to process manually. Machine learning techniques show promise for becoming important tools to meet this challenge in a time- and cost-effective way. Over the past year, we collected images of over 950 social interactions among gopher tortoises from twelve active tortoise burrows at Boyd Hill Nature Preserve in St. Petersburg, Florida. The individual tortoises in each interaction must be identified to comprehensively analyze this data. To automate the re-identification step, we developed a machine learning algorithm to distinguish between tortoises. It takes a large amount of data to train the machine learning algorithm to recognize patterns. Therefore, we describe how our training dataset was collected and created. We also recount how we trained a Siamese neural network to identify individual tortoises based on their carapace markings in a manner similar to how facial recognition is used on humans. This research demonstrates that machine learning has the potential to be a powerful tool to aid data processing and analysis in behavioral ecology.
Presentation Type: Poster

Gopher Tortoise Nest-Site Selection at Burrows and the Effects of Nest Environment on Hatching Success
Garrett R. Lawson[1]*, Elizabeth A. Hunter[2], Lora L. Smith[3]
[1] Department of Fish and Wildlife Conservation, Virginia Tech
[2] U.S. Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit, Department of Fish and Wildlife Conservation, Virginia Tech
[3] The Jones Center at Ichauway

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 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. Dominated by longleaf pine and wiregrass communities, with variable soils, and heterogeneous landscapes managed with prescribed fire, Ichauway is an excellent system in which to conduct this research because tortoises may select from a variety of nesting sites. From mid-May to mid-July 2022, 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 preliminary data on the relationship between canopy and ground cover and both nest-site selection and hatching success. As vegetative cover likely influences nest factors important to incubation, such as nest temperature and soil moisture, we predict that nest-sites at burrows will be significantly less shaded than random non-nest burrows. Ultimately, we will identify vegetation parameters associated with nest-site selection and hatchling success in gopher tortoises to guide best management practices.
Presentation Type: Poster, Student

Survival Analysis of Carcasses Indicates Limited Role of Geography in Translocated Tortoise Mortality

Kevin J. Loope[1]*, Matt J. Aresco[2], Derek B. Breakfield[2], Rebecca A. Cozad[2], Elizabeth A. Hunter[1,3]
[1]Department of Fish and Wildlife Conservation, Virginia Polytechnic Institute and State University, 310 W. Campus Dr., Blacksburg, VA 24061
[2]Nokuse Plantation, 13292 County Highway 3280, Bruce, FL 32455
[3]U.S. Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit, 310 W. Campus Dr., Blacksburg, VA 24061

Translocation success depends on whether translocated individuals can survive and reproduce in their new environment to ultimately produce a self-sustaining population. Both survival and reproduction may depend on how different the translocation environment is from the origin environment. Translocation and origin sites could differ by climate, soils, and social or population structure. If individuals are locally adapted or habituated, translocation to a novel environment could result in an elevated mortality risk. Here, we present a survival analysis of ~2,200 adult and subadult tortoises translocated to Nokuse Plantation, a large recipient site in the Florida panhandle, from 2006-2022. Tortoises originated from throughout the state, with the majority coming from northeast and central Florida. Individuals were released into temporary pens to prevent initial dispersal. All individuals were marked upon release. We could uniquely identify a total of 517 carcasses, encountered opportunistically during monitoring, management, and some recent systematic surveys. A Cox survival model indicates that zone of origin (either Panhandle, North, Central or South Florida) explained some variation in survival. Central-zone tortoises had the lowest mortality rate, with North and South tortoises experiencing significantly higher mortality (38 and 53% higher than Central tortoises, respectively). We also found significant effects of sex and size, with males and larger individuals experiencing higher apparent mortality, though these latter effects were only present after pen removal, indicating that they may result from differential dispersal of smaller individuals, and possibly females, from the site (to areas where their carcasses could not be found). Given that the recipient site is in the

Panhandle while Central-zone tortoises had highest survival, we find little support for using geographic distance-based rules as means of limiting translocation mortality. Our results suggest intrinsic translocation survival differences between regions of origin that are not driven by environmental similarity to the recipient site.
Presentation Type: Poster

Interspecific Interaction Between an Invasive and Imperiled Reptile
Sean L. McKnight[1]*, Darryl MacKenzie[2], Miguel Acevedo[1], Bryan M. Kluever[3], and Steve A. Johnson[1]
[1]Department of Wildlife Ecology and Conservation, University of Florida, PO Box 110430, Gainesville, FL 32611, USA [*smcknight@ufl.edu*]
[2]Proteus, PO Box 7, Outram 9062, New Zealand
[3]U.S. Department of Agriculture, Wildlife Services, National Wildlife Research Center, Florida Field Station, 2820 East University Avenue, Gainesville, FL 32641, USA

Invasive species are a major driver in the global decline of biodiversity. Invasive herpetofauna cause ecological harm through different mechanisms that vary in scope and severity, and Florida boasts more established nonnative herpetofauna species than any other region in the world. There, black spiny-tailed iguanas (*Ctenosaura similis*) are one of several large invasive reptiles known to occupy the burrows of the imperiled, native gopher tortoise (*Gopherus polyphemus*) and may even exclude tortoises from their burrows. We conducted a field study on Gasparilla Island, Florida, USA using a burrow scope to estimate iguana and tortoise occupancy of tortoise burrows at sites with and without sustained iguana removal efforts and modelled co-occurrence patterns between the two species. We used single- and multi-season occupancy analyses to test four predictions relating to gopher tortoise burrow use. Our results strongly support the hypothesis that gopher tortoises are excluded from their burrows by black spiny-tailed iguanas. The energetic cost to a tortoise of excavating a new burrow is unknown but is likely substantial. In addition, tortoises are more vulnerable to extreme temperatures and predation while constructing a new burrow. Our results also show that sustained iguana removal is effective at reducing iguana occupancy of tortoise burrows. We suggest that other large invasive reptiles and perhaps even some native species typically thought of as "burrow commensals" may have similar deleterious effects on tortoise behavior.
Presentation Type: Oral, Student

The Pursuit of Tangible Results of Gopher Tortoise Recovery on a Military Installation
Vivian H. Porter[1]*, Wade A. Ryberg[1], and Jeremy R. Preston[2]
[1] Texas A&M Natural Resources Institute
[2] Eglin Air Force Base, FL

Eglin Air Force Base, located in the Florida Panhandle, offers the most expansive potential gopher tortoise (*Gopherus polyphemus*) habitat of all Department of Defense lands. Since the species candidacy listing in 2009, multiple research studies have been conducted on the installation to assess population status and trends. Occupancy and long-term monitoring data found tortoises occupying marginal habitat well below carrying capacity with declining population trends in most long-term sites. Eglin leadership recognized that population growth from reproduction alone was insufficient to influence final listing determination, and if listed,

additional regulatory constraints would impact Eglin's military mission. Eglin developed a pre-listing conservation strategy and consulted with the USFWS to write a conference opinion which established a defined recovery goal of 18 minimum viable populations. A plan was drafted with the USFWS and FWC that included both internal and external translocations to establish viable populations in fire-maintained habitat. To date, over 5,900 offsite tortoises have been translocated to Eglin and more than 300 have been relocated from isolated, non-viable populations in unmanaged/highly disturbed habitats on the installation. The tangible results from these efforts will not only help to ensure tortoise viability and avoid additional regulatory constraints, but also benefit at-risk and listed burrow associates.
Presentation Type: Oral

Good Fences Make Good Neighbors: Simple Ramps Allow Anurans to Cross Tortoise Barricades

Vivian Porter[1]* and Mike Sisson[2]
[1]Texas A&M Natural Resources Institute, 578 John Kimbrough Blvd, 2260 TAMU, College Station, TX 77843
[2]Florida Fish and Wildlife Conservation Commission, 3911 Hwy 2321, Panama City, FL 32409

The translocation of tortoises to Eglin Air Force Base is an important step to restoring ecosystem function to the largest remaining tract of longleaf pine forest left anywhere in the world. The return of tortoises on the landscape will likely benefit species like gopher frogs in the future, but the fences associated with temporary tortoise enclosures present immediate barriers to migration for the resident gopher frog population. Although these temporary tortoise enclosures are maintained for only 12-18 months before removal, long-term research suggests that most gopher frogs only survive long enough to reproduce in one or two years. Therefore, gopher frog movements inhibited during this time could potentially result in local population declines. To remedy this problem, an access ramp designed to allow passage by small species was installed on an active tortoise enclosure. A camera positioned over the ramp documented successful use by gopher frog metamorphs and at least one adult, as well as three other species of anurans that otherwise would not be able to cross the fence. FWC and Eglin AFB staff have since constructed and deployed 40 additional ramps on existing tortoise pens thought to contain gopher frogs.
Presentation Type: Poster

Habitat Restoration & Enhancement at Barefoot Beach Preserve, Collier County, Florida using Mechanical Removal as Simulated Fire

Thomas Rocco[1] and Nora E Demers[1]*
[1]Department of Biological Sciences, Florida Gulf Coast University, Fort Myers, FL 33965

Gopher Tortoises (*Gopherus polyphemus*) at Barefoot Beach Preserve are being killed since they reside in very dangerous locations near automobiles due to lack of herbivorous forage being found in safe locations. The current management plan prohibits the use of fire. The objective of the research was to determine if mechanical simulated fire helped increase species richness and biodiversity in areas that received this very labor-intensive treatment. We conducted mechanical removal in areas that were more distant from parking between 2013 through 2019. Two locations were treatment sites: 1. MOUND where the base of the "mound" had mechanical pulling of

beach ragweed (*Ambrosia hispida*) and 2. MEADOW where the students weeded the areas by removing beach ragweed, pruned Sea grapes (*Coccoloba uvifera*) and raked away their leaves to provide more bare ground for herbaceous plants to return. The third site was a control that had near monoculture of beach ragweed and received no mechanical pulling. The fourth site was the verge (area between the road and sidewalk), where many tortoises prefer to forage (but are in harm's way). The verge did not receive treatment. Twenty quarter meter plots were evaluated along 50 m transects at each of four locations. The species richness, biodiversity and evenness were higher in the treatment and mound locations compared to the control and verge. Mechanical simulated fire is an effective way to increase the diversity of forage available in the treatment and mound location. To scale up the work will require significant labor force and collaboration with the land managers including some revisions to the management plan and implementation. This strategy could help Barefoot Beach Preserve to be better managed for Gopher tortoises and serve as a model for the many other locations where fire is not feasible as a management tool.
Presentation Type: Poster

A Microsatellite Assessment of Southeastern Florida's Gopher Tortoise Populations
Olivia Rothberg*
Environmental Sciences, Charles E. Schmitt College of Science, Florida Atlantic University, 777 Glades Rd, Boca Raton FL 33498 [*orothberg2021@fau.edu*]

The Gopher tortoise (*Gopherus polyphemus*) is a threatened chelonian tortoise that is considered a keystone species and ecosystem engineer, making them particularly worthy of protection. Due to increasing urbanization and pressure from anthropogenic habitat fragmentation, this species has suffered significant declines in their population, and in Florida is currently state- listed as threatened. Previous studies have found that geographic barriers such as rivers and ridges have effectively separated populations, leading to genetic differentiation between subpopulations (Richter et al, 2011). Currently Florida's populations of Gopher tortoises are classified into three main assemblages: western Florida (the Panhandle), eastern Florida, and the west central coastal region (Winters, 2017), with genetically distinct subpopulations within those assemblages. I am investigating whether southeast Florida has a genetically distinct subpopulation of Gopher tortoises in the southeastern-most extent of their range. To make this determination, I will use 9 microsatellite loci previously characterized for this species (Schwartz et al. 2003). This approach will allow for the comparison of Gopher tortoise populations across my three study sites in Southeast Florida spanning Martin, Palm Beach, and Miami-Dade counties, which are previously unexamined. Understanding Gopher tortoise genetic assemblages has become especially important in determining population viability and has the potential to better inform current management and relocation practices by Florida Fish and Wildlife Conservation Commission (FWC). The Gopher tortoise range map produced by FWC does not currently include South Florida. The scope of this project is in conjunction with a larger Gopher tortoise working group comprised of researchers from FAU, FIU, Zoo Miami, South Florida Wildlife Center, and Broward County Parks and Recreation, aimed toward garnering recognition of, and in turn, better protecting south Florida's unique population of tortoises.
Presentation Type: Oral, Student

Initial Outcomes of Gopher Tortoise Translocation at a Long-term Recipient Site in Southern Florida

Betsie B. Rothermel[1]*, Rachel B. Fedders[1], Madison Molter[1], and Jared Draxler[1]
[1]Archbold Biological Station, 123 Main Drive, Venus, FL 33960
[*brothermel@archbold-station.org*]

Translocation is a key component of management for threatened Gopher Tortoises (*Gopherus polyphemus*) in southern Florida and other places where upland habitats are being lost to rapid urbanization. The FFWCC recently directed mitigation funds toward assessing translocation outcomes at permitted recipient sites, including the Fort Basinger long-term recipient site in Highlands County. From March to July 2022, we surveyed all suitable habitat within this fenced 71-ha site and attempted to capture all tortoises encountered while walking transects or scoping burrows. The site's pine flatwoods and xeric oak habitats were burned just prior to our census, aiding detection of burrows. We measured, weighed, and assessed health of every captured tortoise. Translocated tortoises were identified by their existing notched IDs. We also collected swab samples from 46 individuals for future pathogen screening using qPCR. Based on annual apparent survival rates reported for natural populations (typically ≥ 0.92 for adults and ≥ 0.75 for immatures), we expected to recapture at least 51 of the 65 tortoises released since October 2018. We recaptured 70.8% of the translocated tortoises, including 33 adults, 9 immatures, and 4 found dead. We also captured an unexpectedly high number of resident tortoises (100). Despite extensive trapping effort, ≥ 45 tortoises evaded capture, thus additional survivors of translocation likely went undetected. Hatchlings, juveniles, and subadults comprised 10.6%, 12.7%, and 22.5% of all captures, respectively. Body condition (mass:volume ratio) did not differ between translocated and resident tortoises or among release cohorts. However, large proportions of translocated (57%) and resident (31%) tortoises exhibited one or more possible symptoms of respiratory illness. Furthermore, 28% of captured tortoises were found within 25 m of the perimeter fence despite this habitat only comprising 17% of the surveyed area. Results of this study will inform management of this site and relevant aspects of FFWCC's permitting guidelines.
Presentation Type: Oral

Demographic Profile of the FAU Gopher Tortoise Preserve - 11 Years Later
Rachel Starck*, Evelyn Frazier
Florida Atlantic University, 777 Glades Road, Boca Raton, FL 33431 USA

Gopher tortoises (*Gopherus polyphemus*) are keystone species that dig burrows which provide shelter to over 300 commensal species. Florida Atlantic Universities' gopher tortoise population inhabits approximately 90 acres of grassy and disturbed scrub habitats at the FAU campus. In 2011, the gopher tortoise population was assessed and approximately 250 burrows were measured and 63 tortoises were captured and marked. The preserve was surveyed in 2011 as this population was previously unexamined and since then the habitat has undergone management by FAU which includes chemical herbicides, bush hogging, and mowing to improve the habitat quality for the burrowing owls and gopher tortoises. My study consists of a reassessment of the gopher tortoise population 11 years later to evaluate population changes. We surveyed the preserve by laying out belt transects and using a double-blind observer method to locate burrows. When all the burrows have been found we will compare our data to the data that was collected 11 years ago to investigate population demographics. Population demographics allow us to know the age distribution of the gopher tortoises in the preserve. Assessing whether the population is

reproducing is important because gopher tortoises are ecosystem engineers and their burrows act as a framework for many commensal species that live in or around their burrows. If the gopher tortoise population declines, the species living in or around their burrows will also decline.
Presentation Type: Oral, Student

Explaining Seasonal and Habitat-specific Growth of Immature Gopher Tortoises: Is This a Job for Drones?

Leyna R. Stemle[1]*, Julie Sorfleet[2], Chelsea L. Moore[2], Jack Christie[2], Christopher A. Searcy[1], and Betsie B. Rothermel[2]
[1]Department of Biology, University of Miami, 1301 Memorial Dr, Coral Gables, FL 33146
[2]Archbold Biological Station, 123 Main Dr, Venus, FL 33960

Although immature growth rates have important demographic consequences in Gopher Tortoises (*Gopherus polyphemus*), no studies have directly compared growth patterns of wild immature tortoises between habitats. In early 2021, we captured, measured, and radio-tagged 27 immature tortoises (14 in sandhill and 13 in ruderal habitat) at Archbold Biological Station. Tagged tortoises were tracked twice weekly and remeasured quarterly until September 2022 to assess seasonal variation in growth rates between habitats. We used quarterly high-resolution, drone-derived imagery to quantify cover of herbaceous vegetation, shrubs, trees, and bare ground neighboring each occupied burrow. We also measured the frequency of occurrence of forage species within these same burrow neighborhoods. Quarterly growth was always higher in ruderal habitat, although not significantly so during early-wet season 2022. In ruderal habitat, tortoise growth was fastest during the dry season, but declined slightly during the wet season. In contrast, immature tortoises in sandhill grew very slowly during the dry season and faster during the wet season. We attribute this significant season*habitat interaction (RM ANOVA, $F_{2,26} = 9.18$, $p < 0.0001$) to earlier availability of forage, particularly non-native bahiagrass (*Paspalum notatum*), in ruderal habitat. Model selection on drone data identified proportion of green herbaceous cover (primarily exotic grasses) and occasionally initial body size as the best predictors of quarterly growth during every season in 2021 (2022 analyses are pending), but with declining explanatory power in the wet season (late-dry season: $R^2 = 0.63$, $p < 0.001$; early-wet: $R^2 = 0.18$, $p = 0.03$; late-wet: $R^2 = 0.28$, $p = 0.03$). Models based on drone-derived data were able to explain similar proportions of variation in growth as those based on ground-collected measures of forage. Ongoing mark-recapture and telemetry will aid in understanding the demographic consequences of the observed between-habitat heterogeneity in growth rates.
Presentation Type: Oral, Student

Space Use, Physiologic Balance, and Immunity in Gopher Tortoises, *Gopherus polyphemus*, within Boyd Hill Nature Preserve, St. Petersburg, FL

William E. Stiffler[1]* and Jeff Goessling[1]
[1]Natural Sciences Collegium, Eckerd College, 4200 54th Avenue South, Saint Petersburg, FL 33711 [*westiffl@eckerd.edu*]

The correlation between spatial ecology and physiology of animals is poorly understood. This study examined this correlation using two methods of quantifying space use (95% MCP and number of burrows used) from an entire year of telemetry data and four measures of physiological investment strategy in adult gopher tortoises (*Gopherus polyphemus*): baseline

plasma corticosterone concentration, plasma lactate concentration, Heterophil: Lymphocyte ratio, and plasma bactericidal ability. It was found that male and female *G. polyphemus* display significant negative correlations between corticosterone and number of burrows used (n = 11, p = 0.04228, correlation = -0.61903), (n = 13, p = 0.04646, correlation = -0.56019). Notably, no correlation was observed between space use and any immune measure. These findings suggest that range of metabolic strategies are present in the population and that these are related to spatial ecology strategies. The lack of relationships between space usage and the immune system indicate that tortoises are effective at balancing energy balance to maintain nearly constant immune output.
Presentation Type: Oral, Student

Consolidation of Gopher Tortoises on Working Forested Lands

Rachel Test[1]*, Leandra Grantham[1], Ericha Shelton-Nix[2], Drew Nix[3], Craig Guyer[4], and Jeff Goessling[1]
[1]Natural Sciences Collegium, Eckerd College, 4200 54th Ave S, St. Petersburg, FL 33711 [*rhtest@eckerd.edu*]
[2]Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries, Nongame Wildlife Program, 64 N Union St, Montgomery, AL 36103
[3]Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries, RF 1614, 64 N Union St, Montgomery, AL 36103
[4]Department of Biological Sciences, Auburn University, 381 Mell St, Auburn, AL 36849

Conversion of lands to working forests in Alabama has caused populations of the gopher tortoise (*Gopherus polyphemus*) to decrease in density to levels which may render them unviable. However, working forests represent a significant portion of the geographic range of gopher tortoises within the state. Therefore, development of viable tortoise populations on working forests is crucial to the regional conservation goals. We describe a project designed to demonstrate how widely scattered tortoises on working forested lands might be consolidated to a smaller reserve area of exceptional quality where densities thought to characterize viable tortoise populations might be maintained. Here, we consolidated 100 tortoises from the Geneva State Forest Wildlife Management Area (GWMA) to a 40-acre pen constructed on the highest quality habitat available within the GWMA. Additionally, 98 hatchlings from the site were head-started between 2020-2022, and released at 4 sites near the 40-acre pen. At each site a pair of 1-acre plots was established, one of which was enclosed with silt fencing (soft release) and the other of which lacked fencing (hard release). After one year of occupancy in the 40-acre pen, adults showed a consistent loss of body mass. For the 2022 field season we affixed radio transmitters to 60 adult (40-acre pen) and 30 head-started (1-acre hard- and soft-release plots) tortoises and monitored them. We found that, on average, adult males moved more frequently and occupied more burrows than adult females. When they moved, adult males and females moved similar distances. For head-started juveniles, penned individuals moved more often and traveled greater distances than those that were unpenned. A winter prescribed fire is scheduled for the study area, which will burn all penning material. Continued monitoring next field season will allow us to compare movement patterns pre- and post-release.
Presentation Type: Poster

DNA Methylation Patterns Differ in Lizards Occupying Unpaved Road Compared to Forest Interior Habitat

David R. Tevs[1]*, Lance D. McBrayer[1], Aaron W. Schrey[2]
[1]Department of Biology, Georgia Southern University Statesboro Campus, 1332 Southern Drive, Statesboro, GA 30458
[2]Department of Biology, Georgia Southern University Armstrong Campus, 11935 Abercorn Street, Savannah, GA 31419

Anthropogenic alterations to natural landscapes are globally ubiquitous and can alter many aspects of species' biology. Unpaved roads may mediate environmental pressures acting on small vertebrates by creating road surfaces with uniform microhabitats and edge effects in the adjacent landscape. DNA methylation may provide the phenotypic plasticity necessary to occupy habitats with different environmental conditions. To understand how small vertebrates may use DNA methylation to respond to environmental pressures, Florida scrub lizards were captured from three unpaved road habitats and two forest interior habitats (≥ 15m from the road edge) in Ocala National Forest. Variation in Florida scrub lizard diet, ectoparasite count, and DNA methylation was compared among 1) all road habitats, 2) all interior habitats, and 3) between road and interior habitats. Several metrics showed that unpaved roads facilitate a more uniform Florida scrub lizard diet, ectoparasite count, and DNA methylation profile. Diet ectoparasite exposure, and habitat type were all correlated with multiple changes in DNA methylation, with three times as many differentially methylated regions detected among lizards from forest interiors compared to lizards from unpaved roads. These results indicate molecular and non-molecular aspects of species biology vary among members of the same population distributed over short distances (15m) between unpaved roads and stand interiors. Consequently, seemingly small landscape modifications, such as unpaved roads, may have a profound impact on local wildlife.
Presentation Type: Oral, Student

Characterizing the Social Interactions and Vocalizations of Gopher Tortoises (*Gopherus polyphemus*) in Southeastern Georgia

Oscar P. Thompson[1]* and Kimberly M. Andrews[1]
[1]Coastal Ecology Lab, Marine Extension and Georgia Sea Grant, University of Georgia
[*oscar.thompson@uga.edu*]

Vocalizations have been documented in several species of turtles and tortoises, yet these behaviors have not been characterized in gopher tortoises. Through ongoing gopher tortoise (*Gopherus polyphemus*) research in southeastern Georgia, we examined vocalizations and social interactions between resident and translocated individuals on state conservation lands. Our goal was to identify the frequencies at which gopher tortoises vocalized, to classify the different vocalizations associated with different behavioral activities, and to assess trends in vocalization rates throughout the year. For two years (2018-2020), we deployed five SM4 Wildlife Acoustic audio recorders at female burrows that demonstrated the most frequent social and copulatory interactions with male tortoises. These recorders were moved in accordance with tortoise movement confirmed through VHF telemetry. To analyze our data, we used Kaleidoscope, an acoustic analysis software that separates and classifies different vocalizations. By pairing game cameras with audio recorders at female burrow aprons, we trained the software using audio files where we had documented known interactions between individuals. To train Kaleidoscope, we

manually identified and labeled vocalization clusters that could then be used as a filter, allowing Kaleidoscope to more accurately screen for tortoise vocalizations in new recordings. We analyzed audio data, pairing the vocalization events with behavioral interactions recorded on the game cameras. We identified at least 10 different vocalizations within the 0-6 kHz range that are associated with courtship, mating, and even solitary behavior. Vocalizations were observed both within and among sexes and varied with social behaviors, escalating with more intense interactions such as copulation.
Presentation Type: Oral

Exploring the Relationship Between the South Florida Burrowing Owl and Gopher Tortoises on the FAU Campus

Martha Torres[1]*, Lauren Melanson M.S.[2], and Evelyn Frazier PhD[3]
[1]Department of Chemistry and Biochemistry Charles E. Schmidt College of Science, Florida Atlantic University
[2]Assistant Director, LEARN®, Office of Undergraduate Research and Inquiry, Florida Atlantic University, 777 Glades Road, Boca Raton, FL 33431
[3]Dept of Biological Sciences, Florida Atlantic University, 777 Glades Road, Boca Raton, FL 33431 USA

Athene cunicularia floridana, also known as the Florida burrowing owl, is an ecosystem engineer. They range from Florida to the Bahamas (Florida Natural Areas Inventories, 2001) and are currently listed as threatened by the state of Florida. Their population has been declining rapidly due to increased urbanization in South Florida (Bowen, 2001). Due to the scarcity of land available, they inhabit ruderal areas such as parks, airports, residential areas and university campuses. The gopher tortoise, also designated as threatened by the state, is a keystone species, or a species that many other species depend upon because it creates and maintains their own ecosystem through their burrows which provides resources and shelter (Florida Fish and Wildlife Conservation Commission). Previous literature introduces information of cohabitation between gopher tortoises and other species (Kent et al., 1997), but little is known about the interactions and the effects of these interactions between species. Since the burrowing owl is a top predator and rarely shares resources it has been observed to take over gopher tortoise burrows after they are abandoned, however at the FAU Preserve, burrowing owls and gopher tortoises appear to be cohabitating (Melanson & Frazier, 2021 [Unpublished Master's Thesis]). For this study, we used Moultrie A25i game cameras to capture the animals interactions at the burrows. We placed the cameras at three burrows where burrowing owl activity has been known to take place from previous studies. We found evidence of burrowing owls cooccurring with gopher tortoises simultaneously as well as using the burrows interchangeably. Our research will provide insight into understanding the relationships between the burrowing owl and gopher tortoise, why they share the burrows, and what impact this behavior has on each species. We hope to take this data and use it to improve species and habitat management plans in areas where these species coexist.
Presentation Type: Poster, Student

Northwest Florida Sentinel Landscape

David Wolfe[1]* and Kent Wimmer[2]
[1] Bonamia, LLC, 3843 E Millers Bridge Road, Tallahassee, FL, 32312
[2] Defenders of Wildlife, 1294 Avondale Way, Tallahassee, FL, 32317

A Sentinel Landscape is a focus area designated by the U.S. departments of Defense, Agriculture and Interior. In sentinel landscapes, these agencies work with other public agencies and private partners to maintain compatible land uses on working lands that conserve listed and at-risk species habitat, and minimize encroachment threats and constraints to military missions. Northwest Florida was designated as a Sentinel Landscape in February 2022. It is supported by a partnership of over four dozen federal and state agencies, NGOs, regional coalitions and private landowners. Through this designation, federal and state agencies, as well as private organizations may give extra priority to conservation proposals within a Sentinel Landscape. Our partnership has three workgroups: private lands stewardship, natural systems and climate resilience, which are all working to implement projects that bolster mission resilience and provide sustainable social, environmental and economic benefits. Many of these projects will benefit the gopher tortoise, which is a keystone species and a priority for conservation in the Northwest Florida Sentinel Landscape.
Presentation Type: Oral