



NEON micrometeorological tower at the Disney Wilderness Preserve ©Ralph Pace

CENTER FOR CONSERVATION INITIATIVES ANNUAL RESEARCH & MONITORING REPORT

2022

A COMPILATION OF RESEARCH AND MONITORING CONDUCTED BY AGENCY, ACADEMIC,
AND OTHER INVESTIGATORS IN COORDINATION WITH
THE NATURE CONSERVANCY'S
CENTER FOR CONSERVATION INITIATIVES
IN 2021



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INTRODUCTION

THE NATURE CONSERVANCY

Founded in the District of Columbia in 1951, The Nature Conservancy (TNC) currently impacts conservation in 79 countries, including all 50 states of the US. We have over one million members and have protected more than 125,000,000 acres of land and thousands of miles of rivers worldwide. TNC also operates more than 100 marine conservation projects globally. Our work focuses on the global priorities of Lands, Water, Climate, Oceans, and Cities. The Nature Conservancy's mission is to conserve the lands and waters on which all life depends.

CENTER FOR CONSERVATION INITIATIVES (CCI)

The Florida Chapter of The Nature Conservancy has established the Center for Conservation Initiatives (CCI) to address the state's environmental issues through four initiatives:

- Public Outreach - Connecting People & Nature
- Conservation Education & Training - Our Future Conservationists
- Science & Strategies - An Environment for Discovery & Solutions
- Natural Resource Stewardship - Advancing Natural Resource Management

Vision: The Center for Conservation Initiatives' vision is for the conservation of nature to be a fundamental and integral value of our community that is informed and underpinned by science and research.

Mission: The Center for Conservation Initiatives' mission is to advance conservation knowledge and action and inspire the next generation of conservation leaders.

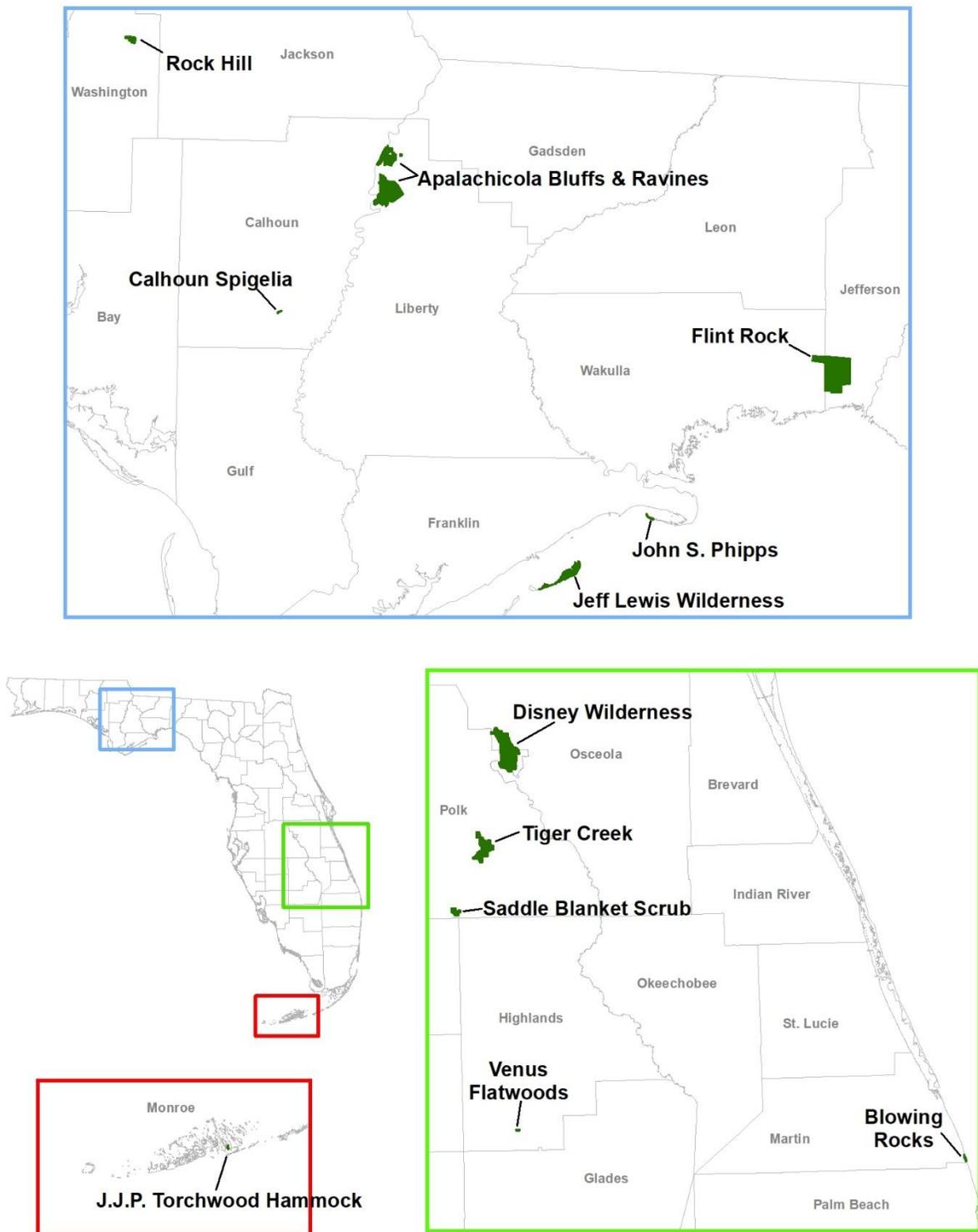
Four of the Chapter's preserves serve as CCI campuses, where most of the Center's on the ground programs, events, and strategies occur. Based on site location, history, and conservation strengths, each campus preserve has a unique conservation focal theme that is emphasized through the four CCI initiatives.

Campus Preserve Focal Themes

- Apalachicola Bluffs & Ravines Preserve: Working Forests
- Disney Wilderness Preserve: Connected Land, Water, and Communities
- Tiger Creek Preserve: Florida's Rare & Ancient Wilderness
- Blowing Rocks Preserve: Marine and Coastal Environment

Research is a critical component of the CCI Science & Strategy Focal Initiative. The goal of this initiative is to serve as a networked, site-based science and strategy platform for TNC and partners to investigate critical conservation questions, demonstrate strategies, and communicate with specific audiences. To achieve this goal, we are working to establish the CCI campuses as notable regional and national research sites by expanding research activity across the campus preserves. To provide access to additional species, ecological, hydrological, and geological research opportunities throughout the state, seven other Conservancy preserves are also open to researchers (Figure 1).

Figure 2. The Nature Conservancy preserves open to research in Florida.



The Conservancy's Florida Chapter has encouraged research and monitoring on its lands by academic, agency, and other investigators for over 30 years. Through 2007, research projects were documented in annual reports. In 2018, near the beginning of the CCI concept development, we identified research tracking and reporting as critical for establishment of the campuses as research hubs. Therefore, in 2021 we began compiling information and updates on the research and monitoring conducted by our conservation and science partners. The first report documented all active, completed, and planned projects on our preserve in 2018-2020. This second annual report documents the research and monitoring ongoing, completed, or planned in January through December 2021.

We have divided this report into three sections. The first section contains brief descriptions of research projects, organized by preserve and then alphabetically by project title. These include 26 total projects, of which 17 are planned or ongoing and 9 have been completed. The researchers are from 8 universities and colleges; 7 federal, state, and local agencies; and 4 other science or conservation organizations.

The second section has descriptions of seven active or planned long-term monitoring projects across six preserves. These are organized by preserve(s) and then by project title. Online links to data are provided where available.

The third section contains a list of all reports and publications generated from research and monitoring on TNC lands in Florida by academic, agency, and other investigators as well as by Conservancy staff since 1982. The list of 336 reports and publications is organized by preserve, then chronologically from most recent to oldest, and then alphabetically by author. Copies of or web links to the reports and publications are available from the Chapter's Florida Research Reports and Published Works online map at <https://tnc.maps.arcgis.com/apps/webappviewer/index.html?id=7e275e0557664ae19894978ebaade8af>.

RESEARCH PROJECTS INITIATED OR CONTINUING IN 2021

Apalachicola Bluffs and Ravines Preserve

Fungi in a warmer world

Morehead State University, Morehead, KY.

Duration: 2021-2022

Objectives: To build better models of past environmental changes and to predict how fungi will respond to changing conditions today. The project will identify and analyze small fungal remains (fungal microfossils) preserved in the sediments from before, during, and after the Middle Miocene Climatic Optimum (MMCO), a gradual warming event that began more than 17 million years ago. Sediments will be sampled and studied for palynology, with a focus on microfungal remains. Samples will be collected from 11 localities worldwide, including Alum Bluff at Apalachicola Bluffs and Ravines Preserve (ABRP).

Methods: Sediments were collected at a 40 cm spacing along the 7.9 m thick Fort Preston Sand exposure of Alum Bluff. The researchers conducted the sampling very carefully to minimize damage to the exposure. Minor trenching (20 cm wide x approx. 30 cm deep into the exposure face) was necessary to reach relatively unweathered sedimentary material. The trench was excavated such that removed material was placed temporarily next to the trench and then replaced in the trench, returning it to the original contours. Samples were taken in 2.5-cm diameter, 15-cm long PVC tubes that were pounded into the trench and then removed with the short cores of sediment intact. Once obtained, the sample tubes were wrapped in aluminum foil and stored on ice until returned to the lab at Morehead S.U. The ice minimized growth of modern microorganisms in the sediments.

The samples are being minimally processed for palynology. Slides of the resultant residues are examined using light and possibly laser confocal microscopy, and fungal remains are used to characterize mid-Miocene fungal assemblages present at the time of deposition. Results will be added to a newly developed global database of mid-Miocene fungal assemblage distributions. Prepared residues and slides will be archived at the University of Florida's Florida Museum of Natural History in Gainesville.

Progress/Results: FIELDWORK COMPLETED. The researchers collected 20 samples from Alum Bluff in June 2021. Lab work and analyses are expected to be completed by March 2022. Processed samples are being examined for fungal spore/conidia/etc. content. Fungal remains are being photo documented and identified.

A poster was presented at the 2022 Geological Society of America meeting: Tarton L., Jones S., Caldwell A., Romero I.C., Nuñez Otaño N.B., Fairchild J., Lennex Stone L., Horsfall T., Warny S., Pound M.J., and O’Keefe J.M.K. Fungi in a Warmer World: Middle Miocene Fungal Assemblages from Alum Bluff. Poster 9-52. Joint Meeting of the NC-SE Sections of the Geological Society of America. 7-8 April 2022.

Completion of a paper documenting Miocene Climate Optimum fungal community dynamics in North America is expected by August 2022.

Fighting extinction of *Torreya taxifolia* through collaborative partnerships

Atlanta Botanical Garden, Atlanta, GA.

Duration: 2021-2023

Objectives: To conduct a post-Hurricane Michael survey, collect cuttings for propagation, and conduct a genetic analysis of the *Torreya taxifolia* population at Apalachicola Bluffs and Ravines Preserve (ABRP). The Atlanta Botanical Garden (ABG) has funding to address several Priority #1 Recovery Actions in the US Fish & Wildlife Service’s Implementation Progress Report for the endangered *T. taxifolia*. The work at ABRP is part of a larger ABG project that includes the only two other protected *T. taxifolia* sites: Angus Gholson Nature Park and Torreya State Park.

Methods:

Post-Hurricane Michael survey: To assess the biological damage to the Apalachicola Bluffs and Ravines Preserve resulting from Hurricane Michael in 2018, Garden staff and partners will survey and assess the condition of known trees. This updated information will allow ABG to provide federal and state partners a post-Hurricane Michael population assessment to be used in the management of all biological preserves.

Collection of cuttings: ABG will collect cuttings from healthy individuals not currently represented in the ABG Safeguarding Collection. Individuals selected for cutting collection will be rated a 4 or higher (on scale from 1-5), determined by the overall size of the individual, presence of leaf spot, and number and size of Fusarium cankers. A maximum of three cuttings, approximately 6-inches in length each, will be collected from each healthy individual. Cuttings will then be sent to the Safeguarding Nursery in Atlanta, Georgia for propagation. Given the extensive damage from Hurricane Michael, it is imperative to collect cuttings from all remaining trees to secure the invaluable genetic diversity found in the wild population.

Population genetics: ABG scientists will use DNA analysis techniques to assess whether conservation safeguarding efforts are properly representing the diversity within the wild population and identify any locations within the population range with unique genetic diversity. A single DNA sample (~2-inch cutting) will be collected from every individual located within the Apalachicola Bluffs and Ravines Preserve. Tangible outcomes from the genetic assessment will

include: 1) determine if there is genetic differentiation among ravines; 2) locate any areas within the *T. taxifolia* range with unique genetic diversity; 3) test for isolation by distance across ravines; and 4) upload all sequences to the Short Read Archive on the National Center for Biotechnology Information database, ensuring that the data is publicly available.

Progress/Results: ONGOING.

Post-Hurricane Michael survey: In May of 2021, 16 known locations of *Torreya taxifolia* were visited across ABRP to relocate the trees, assess their health, and collect DNA samples for genetic analysis. Of the 16 *Torreya taxifolia* visited at ABRP, 12 were located while the remaining 4 trees were searched for but not found (25%). It is likely these trees are either dead from debris caused by Hurricane Michael, were not found due to being covered by vines or other surrounding vegetation, or they are no longer in an above-ground state. The trees could still be alive via their underground root system. It is possible, future surveys may reveal that the trees have re-sprouted, but thorough efforts in 2021 to relocate these individuals were not successful.

Post-hurricane assessments at ABRP have been scheduled for November 28 – December 2, 2022, and January 22nd – 27th, 2023. Results of post-hurricane survey efforts will be reported to TNC no later than fall/winter 2024 (the final overall project completion date).

Collection of cuttings: No vegetative cuttings were collected during the May surveys because vegetative cuttings of *T. taxifolia* have shown lower rooting success during late spring and early summer months. Cuttings will be collected during the post-hurricane surveys planned for 2022/23.

Torreya taxifolia population genetics: Individuals targeted for post-hurricane assessments in May 2021 were selected for inclusion in the genetic analysis because ABG did not have genetic representation of these individuals. The 12 *Torreya taxifolia* trees that were located during the search efforts, as well as additional trees from past field work at ABRP, were included in the genetic analysis. To-date, DNA has been extracted from over 200 *T. taxifolia* individuals and the extractions have been sent for processing to an external laboratory. Results will be analyzed by ABG to determine the genetic diversity between and within ravine systems.

Gopher tortoise survey

Florida Natural Areas Inventory, Tallahassee, FL.

Duration: 2021

Objectives: To determine the gopher tortoise population size at Apalachicola Bluffs and Ravines Preserve.

Methods: Florida Natural Areas Inventory (FNAI) conducted two line-transect distance sampling (LTDS) surveys for gopher tortoises at the Bluffs Tract of Apalachicola Bluffs and Ravines Preserve (ABRP) during the summer and early fall of 2021. The second survey included transects used in a LTDS survey conducted by the Jones Center at Ichauway in 2014. The Jones Center transects ran north to south throughout the Bluffs Tract. The first FNAI survey was along transects running east-west throughout the tract.

FNAI scientists traversed the transects using a double observer approach with one observer navigating the transects with a Trimble Geo7 GPS unit and the second observer following closely behind looking for burrows the first observer may have missed. All usable burrows (non-collapsed) observed were searched with a burrow scoping camera to determine occupancy. At each scoped burrow the visual status was recorded as either active (shows signs of recent activity such as tracks or digging) or inactive. The actual status was recorded as occupied, unoccupied, or undetermined (a burrow was recorded as undetermined if it was unable to be completely scoped; this may have been because it curved too sharply, was waterlogged, or the scope was not long enough to reach the end). The width of the burrow was measured to the nearest 0.5 cm with calipers inserted 50 cm inside the burrow.

Rapid habitat assessments were conducted to determine habitat structure and quality. Two types of points were used for the habitat assessments: 1) random points generated in ArcMap, and 2) burrow points with signs of recent activity. At each point observations were recorded for gopher tortoise habitat suitability, basal area, canopy cover, overstory composition, percent midstory, midstory composition, shrub height, ground cover composition, percent herbaceous cover, percent bare sand, and woody encroachment. A north-facing georeferenced photo was taken at each point (Figure 3).

Progress/Results: COMPLETED. The tortoise surveys were conducted in June, August, and September 2021. The June surveys were along east-west transects and resulted in a population estimate of 269, which was much lower than the population estimate of 834 from a 2014 survey of the Bluffs Tract by the Jones Center (Table 1).

To obtain a better estimate, FNAI conducted a second survey in August and September using the same transects used during the Jones Center survey in 2014 (Figure 2). During this second survey a total of 71 burrows were scoped, 33 gopher tortoises were recorded, and burrow occupancy was 47.1%. FNAI determined the estimated total population to be 726 tortoises at a density of 0.61 tortoises per hectare (FNAI 2021a). Because of the high % coefficient of variability (CV) of the FNAI estimate, the difference between the two estimates may not be real. For the statistical power, confidence, and ability to detect population trends, FNAI recommends that sampling intensity should produce a CV of 20% or less (FNAI 2021a).

During the August – September surveys, FNAI collected a total of 39 rapid habitat assessment points, 21 of which were random and 18 were at burrows (Figure 3). They reported 85.7% of the random points as good and 14.3% as fair for gopher tortoises. Of the burrow points, they reported 100% as good for gopher tortoises (FNAI 2021a).

Table 1. Names and dates of surveys, population estimates, density, total transect length, and %CV (coefficient of variation) of the different gopher tortoise LTDS surveys at Apalachicola Bluffs and Ravines Preserve (modified from FNAI 2021a).

Survey at ABRP	Population estimate	Density (gt/ha)	Total transect length (m)	%CV
Jones Center 2014	834	0.70	32,914.03	18
FNAI June 2021 (east-west transects)	269	0.24	39,717.99	24.48
FNAI August-September 2021 (using Jones Center's north-south transects)	726	0.61	32,839.75	24.65

Figure 2. Locations of transects, scoped gopher tortoise burrows, and habitat types at ABRP (Aug-Sep 2021 survey).
Figure courtesy of FNAI (FNAI 2021a).

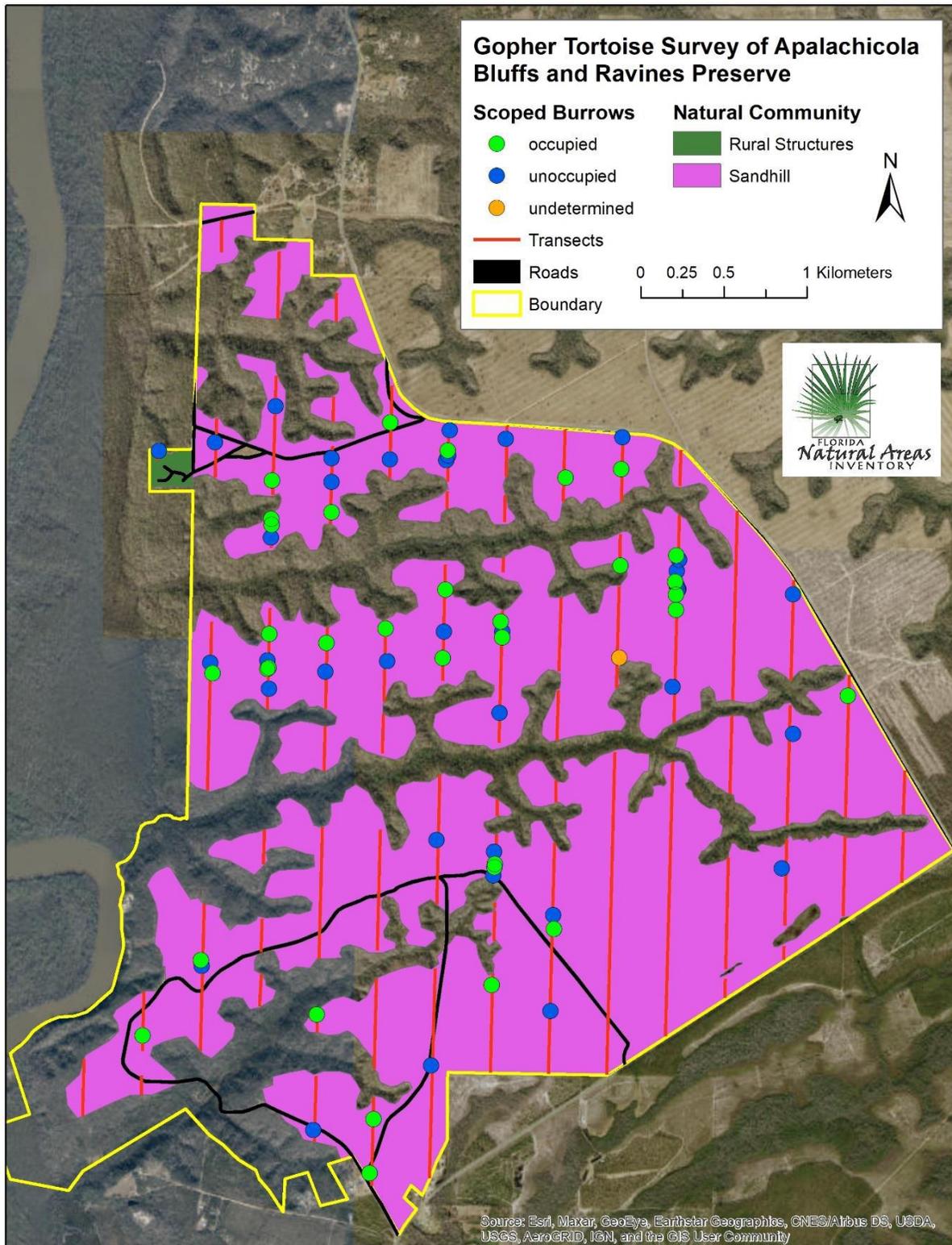
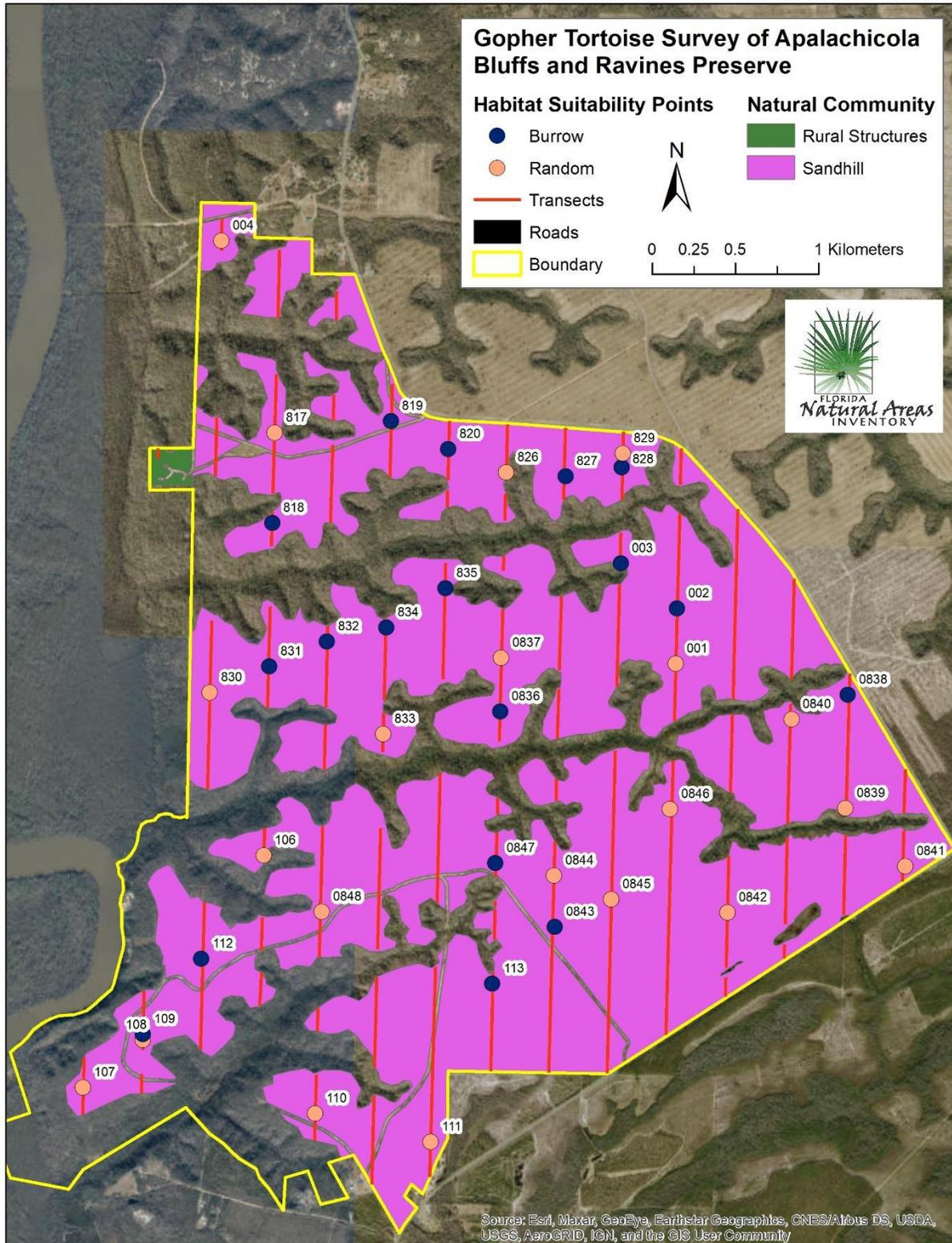


Figure 3. Habitat types and location of habitat suitability points with corresponding photo ID at APRP (Aug-Sep 2021 survey). Figure courtesy of FNAI (FNAI 2021a).



Survey for FNAI-tracked butterflies at Apalachicola Bluffs and Ravines

Florida Natural Areas Inventory, Tallahassee, FL.

Duration: 2020-2021

Objectives: To survey Apalachicola Bluffs and Ravines Preserve (ABRP) for the common roadside-skipper (*Amblyscirtes vialis*), the dotted skipper (*Hesperia attalus slossonae*), and the pepper and salt Skipper (*Amblyscirtes hegon*), and to evaluate the current suitability of the habitat at ABRP for the three butterfly species listed above.

Methods: Florida Natural Areas Inventory (FNAI) volunteers survey suitable habitat for the butterflies during the appropriate times of the year when the adult butterflies should be flying. When one is found, they collect a GPS point and attempt to photograph the butterfly for confirmation. Confirmed sightings are incorporated into the FNAI's Biotic Database in Tallahassee, Florida.

Progress/Results: COMPLETED. On 5 April 2021, FNAI volunteers found four dotted skippers, two on the main service road from the main parking lot towards Kelly Branch and the other two in the wiregrass areas to the west of the service road. Both sexes were found. No road or pepper and salt skippers were found. The survey results were provided to FNAI.

On the same day, the volunteers found one pepper and salt skipper at Torrey State Park. This species is a S1-tracked butterfly species, with the state park being the only known extant population in the entire state of Florida. Due to ABRP's proximity to the park, the volunteers may decide to conduct additional surveys for the pepper and salt skipper at ABRP in the near future.

Blowing Rocks Preserve

Anastasia formation documentation

Florida Geological Survey, Florida Department of Environmental Protection, Tallahassee, FL.

Duration: 2019-2021

Objectives: To document the occurrence of outcrops of the Anastasia Formation at Blowing Rocks Preserve for the Florida Geological Survey's (FGS) ongoing mapping of the state's geological features.

Methods: FGS collected samples from the outcrops on the northwestern edge of the preserve. These outcrops were recently exposed by Hurricane Dorian and had not been previously documented by FGS.

Progress/Results: COMPLETED. FGS conducted the sample collection at Blowing Rocks in September 2019 and May 2021. Samples were catalogued and added to the FGS database of surficial outcrops of geologic formations ([KYRA \(kyrasolutions.com\)](http://KYRA.kyrasolutions.com)).

Leatherback sea turtle tagging

Kelly Martin. Florida Leatherbacks Inc., Palm Beach Gardens, FL.

Duration: 2014-

Objectives: To mark, recapture, satellite track, and conduct genetic studies on leatherback sea turtles to better understand the size and health of the population as well as nest frequency, individual size, migratory pattern, and survival rates in Martin County. The project has four study areas: Jupiter Island/Blowing Rocks Preserve, Hutchinson Island, St. Lucie Inlet State Park, and Hobe Sound National Wildlife Refuge.

Methods: During the nesting season (March through June), nighttime surveys are conducted to locate nesting leatherbacks. Individuals are identified, tagged, and measured while nesting. Individuals not previously tagged are fitted with flipper and PIT tags, measured, and have a skin biopsy taken. Previously tagged leatherbacks are identified, checked for tag integrity, and measured. Tagging data is submitted to the Archie Carr Center for Sea Turtle Research at the University of Florida.

Progress/Results: ONGOING. Awaiting 2021 report. In 2020, Florida Leatherbacks Inc. (FLI) encountered a total of 313 leatherbacks in Martin County. At Jupiter Island/Blowing Rocks, FLI encountered 192 leatherbacks, of which 178 were recaptures, and 14 were new (untagged) individuals. Tracked individuals can be followed on FLI's website at <https://www.floridaleatherbacks.com/track-our-turtles>.

Miami blue butterfly habitat assessment

Dr. Jaret Daniels. Florida Museum of Natural History, University of Florida, Gainesville, FL.

Duration: 2021- 2025

Objectives: To assess Blowing Rocks Preserve and several other locations in coastal Florida for potential conservation actions for the endangered Miami blue butterfly (*Cyclargus thomasi bethunbakeri*). These assessments will inform ongoing conservation and population restoration efforts for this butterfly. Based upon these assessments, a prioritized list of sites for habitat restoration and/or potential future conservation reintroductions of this butterfly will be created.

Methods: Staff from Fairchild Tropical Garden and Zoo Miami conducted visual surveys to identify all plant species present in appropriate habitat patches and quantify plant abundance for target species (*Pithecellobium* spp., *Guilandina* spp., *Cardiospermum* spp., and nectar plant species).

Because Miami blue butterfly (MBB) larvae are tended by ants, which provide protection from natural enemies in exchange for the larvae's sugar-rich secretions, ant surveys were conducted to help identify potential MBB habitat. Arboreal ants were surveyed by tapping a stick against plants to dislodge ants from targeted plants (*Pithecellobium keyense* and *Guilandina bonduc*). Depending on the abundance and extent of *P. keyense* and/or *G. bonduc* at the preserve, 1-10 ant sampling locations will be collected. A white sheet was laid underneath plants, and specimens were collected with a small hand-held aspirator. Non-ant bycatch were immediately returned unharmed to the plant. Ant specimens were preserved in ethanol and transported to the University of Florida for species identification. All specimens were deposited and retained by the Florida State Collection of Arthropods (Gainesville, FL).

Progress/Results: COMPLETED. Vegetation surveys were completed April 2021 at Blowing Rocks Preserve. Two species of MBB host plants, *Guilandina bonduc* and *Pithecellobium keyense*, were found in various areas. Maggy's trail had both species of host plants near one another and a large patch of the MBB nectar plant *Borrchia frutescens*. The most abundant nectar plant species relevant to MBB on the preserve were *Coccoloba uvifera*, *Sabal palmetto*, *Serenoa repens*, and *Sesuvium portulacastrum*. The researchers concluded that Blowing Rocks Preserve is a good candidate for future MBB releases.

Calhoun Spigelia Preserve

Status survey of gentian pinkroot (*Spigelia gentianoides*) and damage assessment following Hurricane Michael; Jackson, Washington, and Calhoun Counties

Florida Natural Areas Inventory, Tallahassee, FL.

Duration: 2020-2021

Objectives: The original 2020 project objective was to estimate population size of gentian pinkroot for each conservation land where it is known to occur (Three Rivers State Park, Apalachee Wildlife Managed Area, Calhoun Spigelia Preserve, and Rock Hill Preserve). The Florida Natural Areas Inventory (FNAI) plan to incorporate the census data into its conservation database and utilize the data to update the global and state ranking of this species using the NatureServe Conservation Rank Calculator.

Because the population estimates had large confidence intervals, likely resulting from the low percentage (0.3%) of habitat surveyed, the project objective was modified in 2021 to measure

change in the density of gentian pinkroot stems over time along with habitat structure and composition.

Methods: In May and June 2020, FNAI conducted population counts within 2.5 m radius plots randomly distributed in known historical and current *S. gentianoides* locations and in other areas with suitable habits. Plants outside of plots were documented but did not contribute to population estimates. Two plots were placed at Calhoun Spigelia and 11 at Rock Hill.

In 2021, FNAI established three permanent monitoring plots at Rock Hill and one at Callhoun Spigelia (Figure 4). The plots are 20-m radius circular plots (Figure 5) placed within known current or historic populations of gentian pinkroot. The center point of each plot was permanently marked and mapped with a submeter GPS unit. The plots were censused and habitat metrics for canopy (cover, height, DBH of trees rooted in the plot) and overall shrub structure (cover and height) were recorded at the 20-m plot level. Three smaller subplots (2.5m radius) within the 20-m plot were established, where additional shrub and herbaceous cover and structure data were recorded. The three subplots were placed 10 m from the center of the plot at 0, 120, and 240° (Figure 5). All shrub and herbaceous species within these subplots were identified; if it was not possible to identify a plant to species, FNAI recorded genus or family. Photos were taken at each plot.

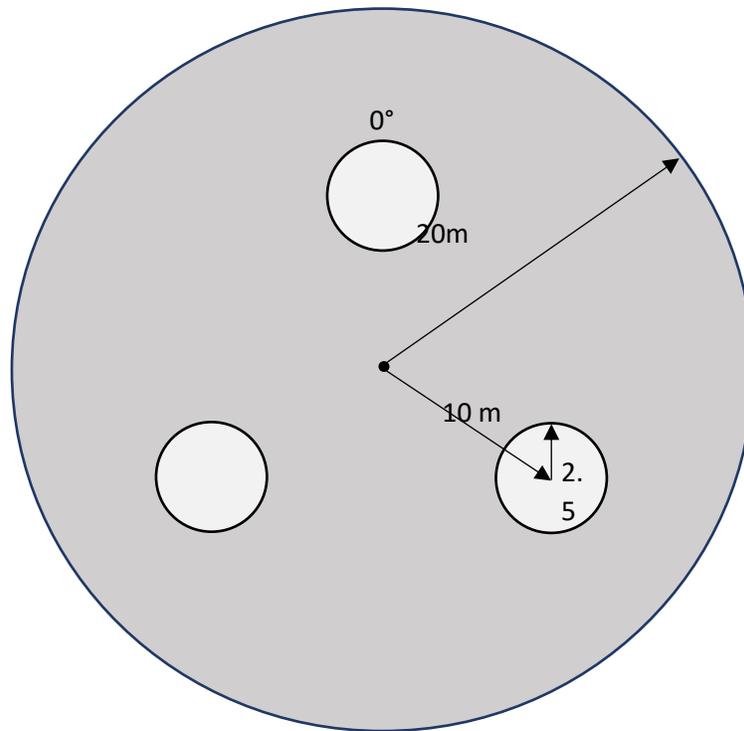
Establishing permanent larger plots allowed for better density estimations within the known habitat and as well as change assessments in both gentian pinkroot density and habitat characteristics. These larger plots incorporated the edge of the known gentian pinkroot populations and would therefore provide better insights into expansion and contraction of population distribution through time (FNAI 2021b).

Progress/Results: ONGOING. In 2020, no plants, neither within nor outside of plots, were found at Calhoun Spigelia. Numerous plants were counted within the plots at Rock Hill, resulting in 0.64 stems/plot with a 95% CI of -0.58-1.85 and a population estimate of 1536 (\pm 2926).

In 2021, within the permanent plots, FNAI found a mean of 264 plants (SD=160.730) within the 3 plots at Rock Hill and at total of 5 plants within the one plot at Calhoun Spigelia.

Across the four study sites, plots that received a prescribed burn in the months immediately preceding this survey had on average a higher number of gentian pinkroot individuals per plot than those that did not receive a spring prescribed fire (FNAI 2021b). While several habitat metrics that were collected such as canopy cover and herbaceous cover varied by site, their overlapping confidence intervals indicated no significant patterns, especially in terms of explaining the variability of gentian pinkroot abundance (FNAI 2021b). Following their initial monitoring period in 2021, FNAI plans to monitor the plots again in 2023 and 2025. While the conclusions that can be drawn from this initial monitoring event are limited, over time and subsequent prescribed fire applications, meaningful conclusions about annual abundance

Figure 5. 20-meter radius plot for gentian pinkroot, with 3 – 2.5meter subplots located at 0°, 120°, and 240° at Calhoun Spigelia (From FNAI 2021b).



Disney Wilderness Preserve

Change detection of wetlands from 1941-2018 using remote sensing to understand landscape scale changes in the wetland ecosystems

Sarah Parker. Master's student, Department of Biology, University of Central Florida, Orlando, FL.

Duration: 2018 – 2021

Objectives: To use digitized land cover categories based on aerial photography (1941-2019) and 35 years of Landsat satellite imagery (1985-2019) to analyze landscape and spectral properties of DWP to better understand the trajectories of bayhead, cypress, and marsh wetland types before and after the eco-hydrological restoration.

Methods: Aerial imagery was preprocessed, segmented, and indexed (*i.e.*, Normalized Vegetation Index (NVDI)), and FRAGSTATS was used to evaluate the patch, class, and landscape scale dynamics of the preserve. Spectral trajectories from 1984-2018, around several years before and 20+ years after the hydrological restoration, were analyzed from multispectral Landsat Thematic Mapper imagery. The spectral properties of the wetlands were analyzed using nonmetric multidimensional scaling to elucidate patterns within and among the wetland types (*i.e.*, cypress, bayhead, marsh) before and after the restoration.

Progress/Results: COMPLETED. After restoration, the areal extent of cypress and mixed hardwood swamps and marsh lands slightly increased, while the area of the bayhead swamps slightly decreased. From the spectral trajectory analyses, the initial responses to the enhancement varied among wetland communities and more overall variability among patches was observed through the post-enhancement periods compared to pre-enhancement periods. Post-enhancement trajectories returned to similar levels to pre-enhancement for the majority of the wetlands. This study illustrates the opportunities and challenges associated with monitoring complex wetlands systems for future planning and adaptive management by conservation managers and scientists (Parker 2021).

Ms. Parker presented at the 2019 Fall Meeting of the American Geophysical Union and completed her thesis in 2021 (Parker 2021).

Combining NEON and remotely sensed habitats to determine climate impacts on community dynamics

Dr. James Clark. Nicholas School of the Environment, Duke University, Durham NC.

Dr. Roland Kays. College of Natural Resources, North Carolina State University, Raleigh, NC.

Duration: 2018 – 2022

Objectives: To determine the impacts of climate change on forest seed production at three National Ecological Observatory Network (NEON) sites: the Disney Wilderness Preserve (DWP), Ordway-Swisher Biological Station, and the Talladega National Forest.

Methods: The Clark lab established six seed rain plots within each of three NEON plots in longleaf stands at DWP in June of 2018, amounting to 18 traps total. Each year a census is taken of trees greater than 2m tall in the 40x40 meter NEON plots surrounding the seed rain traps. Census includes growth measurements and cone production. To determine the wildlife that may be dependent upon seed production, 49 motion-activated trail cameras were deployed by Dr. Kays lab throughout DWP for the month of May 2019 and processed using eMammal.

Progress/Results: ONGOING. Beginning in 2019, seed traps have been collected annually along with crop counts of longleaf found within the NEON plots. A final seed collection and crop count is planned for fall of 2022.

In 2019 at DWP, the trail cameras collected 15,510 photos, capturing 1,038 animal detections. Seventeen species in total were photographed, with white-tailed deer by far the most abundant species at 58%. Wild boar appeared in 12% of the photographs and wild turkey in 10%. The camera surveys will not be repeated at DWP.

Seed and cone data from the three study sites were contributed to the continental Masting Interference and Forecasting (MASTIF) network, set up to evaluate how climate, habitat, and individual tree traits affect maturation and fecundity in trees. Using Disney and other MASTIF data from across the US, Dr. Clark led an analysis to determine how climate indirectly effects tree fecundity that comes through variation in tree size and growth (climate-condition interactions). A biogeographic divide was found, with the climate-condition interactions reducing fecundity in the western US and increasing it in the eastern US (Clark et al. 2021).

Four papers have been published using data from this project: Sharma et al. 2022, Clark et al. 2021, Qui et al 2021a, and Qui et al.2021b.

The epidemiology of reptile hosts and *Borreliaburgdorferi sensu lato* in Florida

Carrie de Jesus. PhD. student, Wildlife Ecology and Conservation Department, University of Florida, Gainesville, FL.

Duration: 2020

Objectives: To determine the role of native lizards in Florida in the epidemiology of Lyme disease in Florida by determining whether the lizards meet two criteria for host competency:

1. Are dog ticks (*Ixodes scapularis*) feeding on lizards in Florida?
2. Can lizards in Florida maintain a *B. burgdorferi s.l.* infection?

Methods: Lizards from two locations at the Disney Wilderness Preserve were collected using drift fences, pitfall traps, funnel traps, cover boards, and hand trapping in June of 2020. Caught lizards were mechanically constrained so that tail snips could be taken for blood and tissue samples. These samples will be examined for evidence of whether the Lyme disease bacterium disseminates throughout the lizard body. Lizards with ticks had their ticks removed with fine tipped forceps. Removed ticks were placed in molecular grade ethanol to preserve the DNA for pathogen testing. A scale sample was also taken from the tick attachment site. Scale samples will be used to determine if bacterium infections are localized after tick feeding. Lizards were released back into their environment after tissue, blood and tick samples were taken.

Progress/Results: FIELDWORK COMPLETED. Over a two-week survey period in 2020, 10 southeastern five-lined skinks and 2 eastern glass lizards were collected. One of the lizards had a tick attached. Lab work is currently in progress to determine presence of Lyme disease or other pathogens.

Evaluations of herbicide efficacy and selectivity on invasive *Scleria macrocarpa* in Florida wetlands

Alexandra Onisko. Master's student, Department of Agronomy, University of Florida, Gainesville, FL.

Duration: 2018 – 2021.

Objectives: To investigate efficacy, selectivity, and non-target damage of 10 herbicides on invasive *Scleria* species.

Methods: COMPLETED. The Disney Wilderness Preserve (DWP) was one of three locations for this study. At one location on the preserve, 10 different herbicides were tested within 44 10x20 ft plots. They were compared to a control, and Induce® was the only surfactant used. Each application, including the control, was replicated 4 times. Line transect data was taken to document the impact of each treatment on the cover of *Scleria* and native vegetation. Data was collected 30 days, 60 days, 90 days, 6 months, and 1 year after treatment.

Progress/Results: At DWP, there were significant differences in effectiveness against *S. macrocarpa*, with the herbicides imazapic, imazomox, glyphosate, imazapyr, and diquat providing the best control. There were no observed differences in impacts to native vegetation cover, but imazomox resulted in the best native species recovery and recruitment. Based on the results of the study, treatments should take place in the spring after germination. Ms. Onisko completed her thesis in 2021 (Onisko 2021).

Insect services and disservices: impacts of dung beetles and fire ants on central Florida ranchlands

Dr. Roisin Stanbrook. Department of Biology, University of Central Florida, Orlando, FL.

Duration: 2019 – 2022

Objectives: To describe the distribution and abundance of dung beetles in central Florida and clarify their potential economic impact in ranchlands and grasslands across the state.

Methods: Uses data collected by the National Ecological Observatory Network's ground beetle trapping protocol using unbaited pitfall traps from 2014 to present.

Progress/Results: ONGOING. Fourteen species of dung beetle have been collected from Disney Wilderness Preserve thus far.

Potential mechanisms of population decline: anuran responses to prescribed fire in central Florida flatwood-marsh complexes

Ian Biazzo. Master's student, Department of Biology, University of Central Florida, Orlando, FL.

Duration: 2019-2022

Objectives: To test the effects of prescribed fire on anuran populations and examine the potential mechanisms of post-fire population decline in pine flatwoods and embedded depression wetlands. The research focuses on two levels of ecological hierarchy using a before-after-control-impact design: 1) the immediate and short-term mechanisms of changes in anuran populations after a burn using mark-recapture techniques, and 2) species composition at the assemblage level and effects of prescribed burns on diversity and abundance of frogs in the flatwoods and marshes.

Methods: In 2020, eight burn units with depression marshes were randomly selected for permanent study plots, four as control plots in units burned in 2018, and four as treatment plots in units to be burned in 2020. Within each plot, 1-meter-long PVC pipes were nailed vertically at 1.5 m high to trees surrounding wetlands to act as temporary refugia for frogs. The pipes are checked weekly for frogs. All frogs are identified to species, measured from snout to urostyle, sexed if possible, and given unique Visible Implant Elastomer (VIE) tags. The PVC pipes are removed 1-2 days before fires and replaced 1-2 days afterwards.

In 2021, a vertical occupancy study was added to test if different treefrogs partition habitat space and how fire impacts these partitions. For this study, PVC tree frog refugia pipes were set at 3 m, 6 m, and 9 m high on large pine trees in four of his study sites.

Progress/Results: ONGOING. Approximately 20 visits are planned for 2022. To supplement the treefrog data, visual and auditory surveys will be conducted throughout the spring and summer. Additional data will include size (DBH) and GPS location of pine trees in the experimental plots and estimates of treefrogs breeding at marshes.

This project equipment will be removed at the end of the project summer 2022. An estimated end date for fieldwork and project overall is September 2022.

Mr. Biazzo has 3,000 data points from his mark-recapture study on treefrogs in pine flatwoods, 99% of which are pinewoods treefrogs *Dryophytes femoralis*. He has concluded from these data that pinewoods treefrogs climb up larger trees to escape the direct and indirect effects of fires and reenter the shrub layers in the following weeks as shrubs regreen. This work also suggests that this species shows high site fidelity, with individuals often returning to the same tree for several consecutive months. Local survival for populations in this study are between 70-85% (Biazzo 2022). A paper is in development.

Presentations: International Fire Ecology and Management Congress, Dec 2021 (virtual); Southeast Partners in Amphibian and Reptile Conservation (SEPARC), Feb 2022 (virtual); and Student Scholar Symposium, University of Central Florida, April 2022

Resolving controls on lignin decomposition at the continental scale to reconcile classical and modern paradigms of soil organic matter

Dr. Steven Hall. Department of Ecology, Evolution, and Organismal Biology, Iowa State University, Ames, IA.

Dr. Samantha Weintraub. National Ecological Observatory Network (NEON), Boulder, CO.

Duration: 2019-2020

Objectives: To assess the biogeochemical controls on the decomposition of lignin vs. other litter constituents in soils spanning NEON core terrestrial sites. This research was funded by the NSF Macrosystems Biology and the Early NEON Science programs.

Methods: All field work was conducted by NEON field technicians within existing NEON plots. In August 2019, soil samples (approx. 5 g) were collected from NEON plots and then shipped to Dr. Hall's lab at Iowa State University. The lab team then mixed the soil with a small amount of ^{13}C -labeled lignin (5 mg ^{13}C at 99 atom percent) mixed with leaf litter. The small stable C isotope is measurable at the scale of the sample but undetectable at the ecosystem scale. The soil/lignin mixtures were each placed in a small bag and shipped back to NEON. Back at the preserve, the NEON field team placed each soil bag in the location from which it was collected. In August 2020, the soil bags were collected by NEON field staff and sent to Dr. Hall's lab for analysis.

Progress/Results: COMPLETED. A paper is in review.

Survivorship and productivity of Florida sandhill cranes on conservation lands and suburban areas in central Florida

Tim Dellinger, Florida Fish & Wildlife Commission, Tavares, FL.

Duration: 2019 – 2022

Objectives: This project had three objectives:

1. To identify threats cranes face in suburban and conservation areas in Marion to Highlands Counties.
2. To determine adult survivorship, productivity, and habitat use on conservation lands and suburban areas.
3. To determine vegetation associations used by Florida sandhill cranes in suburban habitats and conservation lands using movement data from radio-tagged individuals.

Methods: Adult Florida sandhill cranes were captured, fitted with a USFWS band and GSM cellular transmitter, and then released at the capture site. The transmitters collected up to 47 GPS locations during a 24-hour period with previous days' data available on demand. Mr. Dellinger used a dynamic movement model to calculate utilization distributions (UDs) for all marked cranes and determine home range and core use areas for each transmitter-marked bird. Survival rates were calculated with the Kaplan-Meier estimator. Productivity data (e.g., laying date, hatching, brood size, fledging) were collected by examining daily movements of transmitter-marked birds and through occasional site visits during the breeding season.

Progress/Results: ONGOING. FWC radio-tagged 19 cranes in conservation areas, including one at the Disney Wilderness Preserve (DWP). They also color-banded 80 cranes and attached transmitters to 23 adults and 23 juveniles in suburban areas. One juvenile radio-tagged in Poinciana in November 2020 was the chick of the radio-tagged DWP adult.

At DWP, an adult crane was captured and fitted with a backpack transmitter on 12 December 2019 on the east side of the shop. Based on voice and behavior, the individual was a male. It was with its mate and colt at the time of capture. The transmitter was deployed 370 days before detaching sometime after 17 December 2020. Throughout 2020, the tagged crane and its mate regularly roosted and foraged on DWP, using depression marshes, dry prairie, and mowed areas around the office and shop. The cranes also made daily foraging forays into the suburban area west of DWP almost daily and forayed to the conservation easement and private ranchlands between DWP and Lake Tohopekaliga (Figure 6.). Based on movement locations, FWC suspected that the tagged crane and its mate nested on DWP in 2020 but that the nest failed during incubation. The crane has not been observed since September 2021.

The radio-tagged chick of the DWP adult dispersed from the natal area and has been exploring the pastureland around Lake Tohopekaliga and areas to the west and south of the natal area (Figure 7).

FWC continues to collect survival, productivity, and movement data from the radio-tagged and banded cranes, and is currently analyzing survival, productivity, movement, and habitat use data. A final report is due to the granting agency in May 2022. Research will continue beyond this date through other funding as many transmitters remain operational.

Figure 6. Movements from December 2019–December 2020 of an adult Florida sandhill crane radio-tagged on Disney Wilderness Preserve, Florida. Map courtesy of Tim Dellinger, FWC.

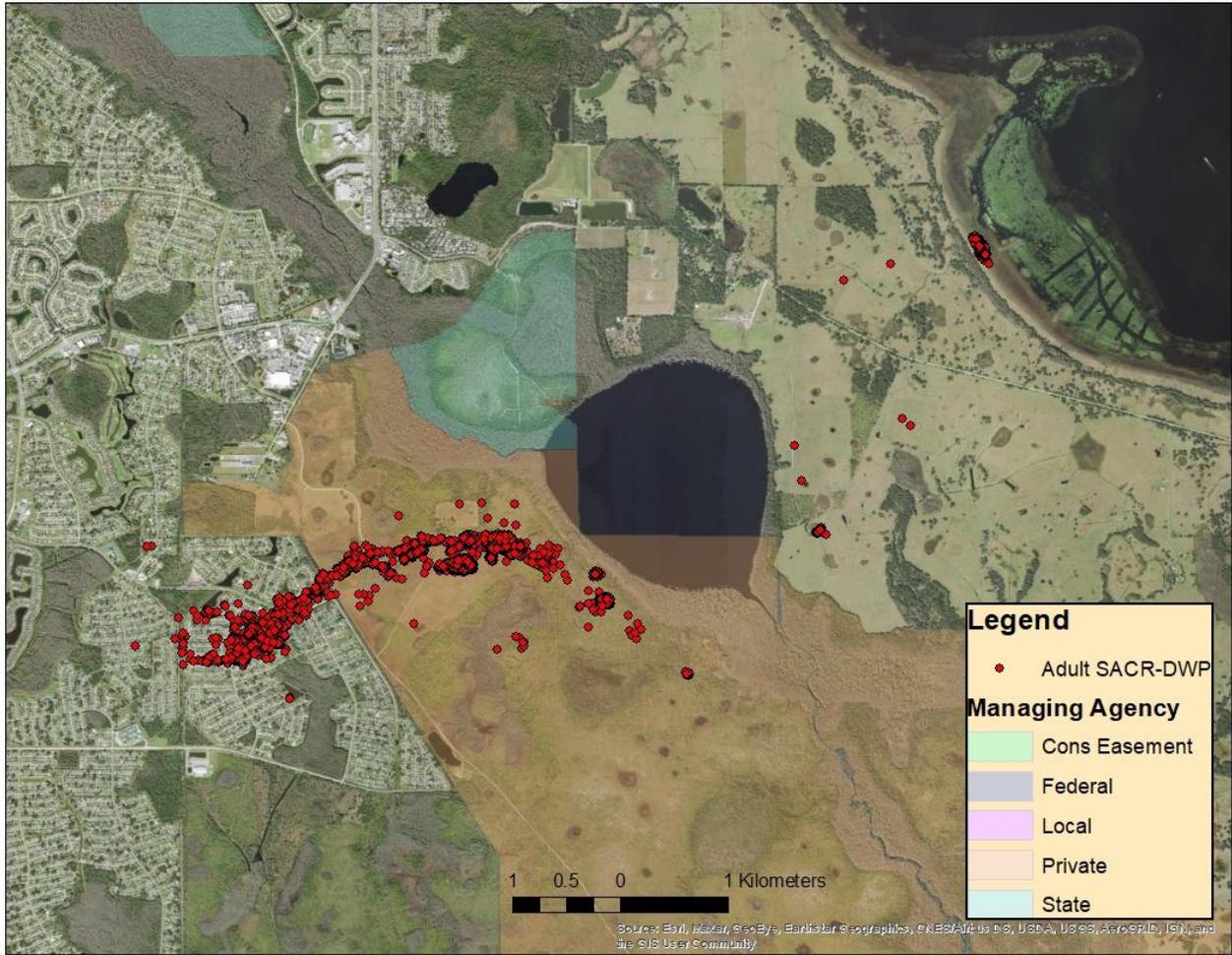
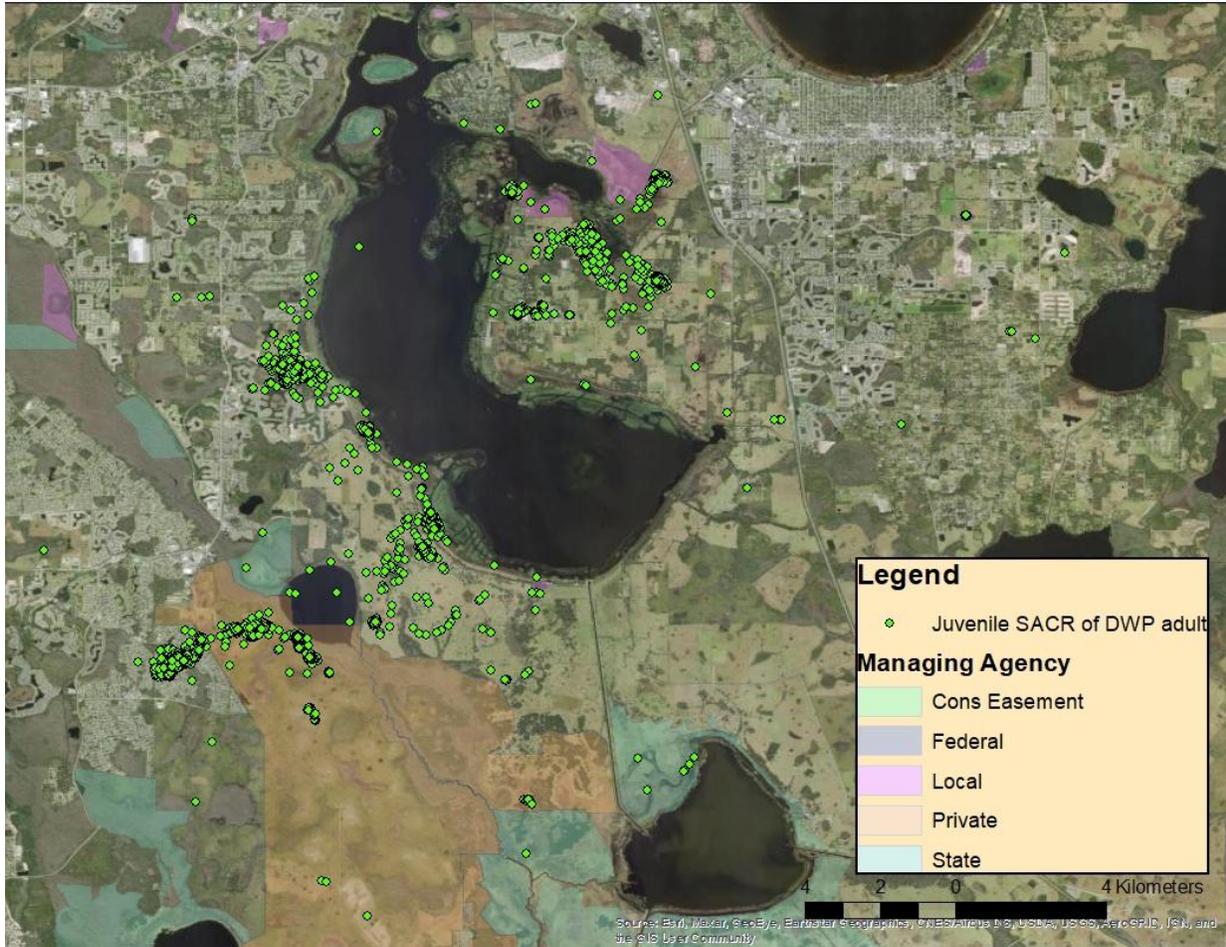


Figure 7. Movements from 2020-2021 of a juvenile Florida sandhill crane that hatched from a nest on Disney Wilderness Preserved but was captured and radio-tagged while with its parents in a Poinciana, Florida suburban area in November 2020. Map courtesy of Tim Dellinger, FWC.



Understanding the disease dynamics of an emergent protistan pathogen (*Dermomycooides* sp.) in Florida's amphibians

Matthew Atkinson. PhD. student, Department of Biology, University of Central Florida, Orlando, FL.

Duration: 2017 – 2021

Objectives: To assess the prevalence, intensity, and consequences of *Dermo* infections in Florida amphibian populations. It was predicted that disease dynamics would vary across wetland type and wetland community composition. This project was conducted at Disney Wilderness Preserve, Florida Forever (private), Gold Head Branch State Park (DEP), UCF Arboretum, and Rock Springs Run State Park (DEP).

Methods: Eight wetlands across central Florida were included in the study, including two at the Disney Wilderness Preserve (DWP). The selected wetland sites were based on previous disease work conducted and/or the presence of gopher frogs (*Rana capito*) on the site. Dip-netting surveys were conducted to collect tadpoles at each wetland. At each of the two DWP study sites, five tadpoles per species per sampling trip were randomly selected for removal of tail clips to non-destructively sample for disease. Five of the ten individuals collected per site per species were destructively sampled to directly compare the detection and quantity of *Dermo* from liver samples compared to tail clip samples. Adults were also collected at the sample site. Toe clips were taken from all available individuals, and whole-body specimens were taken from every fifth individual captured during the sampling occasions. All whole-body specimens were then necropsied where mouth parts, tail/toe clips, intestine, skin swabs, spleen and liver from each specimen were collected. Animals were euthanized using an injection of MS-222 into the coelomic cavity, which is generally considered to be the most humane way of euthanizing amphibians. Additionally, only toe clips were taken of the adults for the following species: gopher frogs (*Rana capito*) and ornate chorus frogs (*Pseudacris ornata*). In addition to frogs, water samples were collected to determine the amount of *Dermo*, *Bd* and FV3 within the water column. While ponds were sampled, pH, water temperature, water level, hydroperiod type, canopy cover, soil type and other additional pond characteristics were taken. Up to five adult frogs per site per sampling trip were sampled, with toe clips and blood collected if possible, to test for the presence of *Dermo* in metamorphosed individuals.

Progress/Results: FIELDWORK COMPLETED. Field work is complete at the Disney Wilderness Preserve and other study areas. The presence of *Dermomycooides* at the preserve was confirmed from samples taken from the first field visit. Data analysis is in progress. Mr. Atkinson expects to complete his dissertation in the spring of 2023.

Flint Rock Preserve

Management of titi in restoration of ephemeral wetlands

Dr. Pat Minogue. North Florida Research and Education Center, UF/IFAS, Quincy, FL.

Dr. Ajay Sharma. West Florida Research and Education Center, UF/IFAS, Milton, FL.

Duration: 2018-2021

Objectives: To identify herbicide treatments that provide acceptable titi (*Cyrilla racemiflora* L.) control without significant adverse effects on amphibians or their habitat.

Methods: The researchers implemented seven uniform replicated field studies at Flint Rock and the Apalachicola National Forest. They compared the effectiveness of selective herbicides (Rodeo, Habitat, Garlon 3A), applied alone or in mixes of different concentrations, with or without adjuvant, using three different application methods (foliar spray, cut-stump, and cut-stem) in controlling titi. Treatments at both sites were each replicated 10 times and included non-treated controls. After one year of treatment, they measured percent titi control at both preserves. At Apalachicola National Forest, they also assessed herbicide injury to non-target vegetation, particularly plants important to ephemeral amphibians.

Progress/Results: COMPLETED. A final report was submitted in June 2021 (Minogue 2021a). Based on the treatment results, the researchers have provided the following recommendations for the most effective herbicide or mix for each of the three application methods:

1. Direct foliar: Foliar sprays of 5% Rodeo herbicide with 1% MSO gave 80% titi rootstock mortality and 90% live height reduction; whereas the standard 4% Garlon 3A had the least reduction of total vegetation cover and critical grass and forb species but gave poor control with foliar treatment (Minogue et al. 2021a).
2. Cut stump: Cut stump treatments with 50% Garlon 3A gave the best control with 60% rootstock mortality and 87% basal area reduction. Because of the use of small amounts of herbicide and placement directly to the cut stems, damage to desired plants was not observed (Minogue et al. 2021a).
3. Cut stem: Cut stem treatment gave superior titi control than other approaches, regardless of herbicide. Use of 50% Rodeo provided 100% mortality at 2 years after treatment. Because of the use of small amounts of herbicide and placement directly into the stems, damage to desired plants was not observed with herbicide treatments (Minogue et al. 2021a).

Jeff Lewis Wilderness Preserve

Changes to soil carbon cycling caused by mangrove encroachment of salt marsh

Dr. Josh L. Breithaupt. Coastal and Marine Laboratory, Florida State University, St. Teresa, FL.

Duration: 2020-2021

Objectives: This project consisted of two studies:

1. Encroachment impacts on soil organic carbon storage at mangrove range limits in Apalachicola Bay, FL. This project was conducted at the Jeff Lewis Wilderness Preserve (JLWP) on Dog Island, St. George Island, and Little St. George Island. The objective of this research was to quantify soil organic carbon (OC) density beneath both mangrove species and compare results with soils beneath two commonly adjacent native tidal saltmarsh species: *Juncus roemerianus* and *Spartina alterniflora*.
2. An improved framework for estimating organic carbon content of mangrove soils using loss-on-ignition and coastal environmental setting. This project was conducted using an empirical soil sample dataset from 17 mangrove regions in North (including JLWP), Central and South America.

Methods: The work at JLWP was conducted in present day mangrove and marsh locations to establish a historical context via soil core dating. A total of six soil cores were collected on the eastern end of the preserve, three from marsh and three from mangrove locations. In addition to radiometric dating (using ^{210}Pb), the soil cores were analyzed for content of total organic matter, organic carbon, total nitrogen, $\delta^{13}\text{C}$, and $\delta^{15}\text{N}$.

Soil cores were collected using a gouge augur (2 cm diameter x 50 cm length) or with polycarbonate tubes (7 cm diameter x 50 cm length). The type of coring device depended on the quality and cohesion of the soils at each site. Cores were collected to a depth of 50 cm maximum, or to the depth of significant resistance (typically sand or bedrock).

Progress/Results: COMPLETED. Dr. Breithaupt collected all soil cores in 2021. A paper has been submitted to *Frontiers in Forests and Global Change* and another is in preparation.

Results for Study 1: Soil samples were collected from beneath the four primary dominant plant taxa at each of the three study sites. Dominant plant taxa were not a significant predictor of soil organic carbon (OC) density, highlighting the relative importance of site-specific environmental attributes as controls on soil properties. Soil profile $\delta^{13}\text{C}$ compositions included a range of values reflective of C3 and C4 plant inputs, suggesting that shifts in plant taxa, both from marsh to mangroves and between marsh species, have been occurring at all sites in this study. These findings support much of the literature on mangrove encroachment, which indicates mangrove soil OC concentrations, densities, or stocks are less than or equal to that of co-located tidal marsh habitats (Breithaupt 2022).

Results for Study 2: Numerous conversion equations exist for using loss-on-ignition (LOI) measurements of soil organic matter (SOM) to estimate organic carbon (OC) content in Blue Carbon ecosystems. The OC content of SOM (OC:SOM) represented by these equations varies widely from 23 – 87%. No framework exists to explain this variability or advise users how to select an equation. The researchers evaluated published equations and an empirical dataset of 1,246 soil samples from 17 mangrove regions in North, Central, and South America. Soil organic matter content as well as sedimentary and geomorphic setting were significant predictors of OC:SOM variation. Terrigenous setting mangrove soils had less than 30% SOM and OC:SOM that ranged from 24 – 46%. Carbonate setting mangrove soils generally had greater than 26% SOM and OC:SOM ranging from 43 – 52%. Conversion equations unique to six types of mangrove coastal environmental setting have been developed. The researchers have also provided a predictive model for selecting a conversion term using a site’s mean SOM content that will enable users to estimate soil OC content based on the characteristics of their research sites (Breithaupt 2022).

Rock Hill Preserve

A dendroecological investigation into spatial and temporal patterns of longleaf pine (*Pinus palustris*) growth in Florida

Nicole Zampieri. PhD student, Department of Geography, Florida State University, Tallahassee, FL.

Locations: Rock Hill Preserve and Tiger Creek Preserve

Duration: 2018-2022

Objectives: This study has four objectives:

1. Determine the patterns of longleaf pine forest structure (density, size structure, age distribution) and how growth rates differ across natural communities.
2. Determine how a strong tropical cyclone (Hurricane Michael) affected forest structure in different natural communities.
3. Determine the relative effects of community type and interannual climatic variability on longleaf pine growth rates.
4. Determine the current and historical above-ground carbon storage potential of longleaf pines across their Florida range.

Methods: Sites were selected from the list FNAI’s designated exemplary sites. Exemplary sites were chosen as excellent historically representative examples of the communities, based on fire regime, canopy structure, regeneration, and groundcover quality. Twenty-two sites in total were sampled, two of which were on Conservancy preserves (Rock Hill and Tiger Creek Preserve). Rock Hill was selected for its Upland Pine exemplary site and Tiger Creek for

Sandhill.

Data was collected on the density, size, and age structure of longleaf pine trees using modified variable area transects at each site. Within the transects, each tree was mapped with GPS and dbh, height, crown measurements were taken. Cores were collected from 13 trees at Rock Hill and 8 at Tiger Creek.

Surveys were conducted post-Hurricane Michael on several of the panhandle research sites to assess damage caused by the storm. Rock Hill was not included in the assessments.

Progress/Results: FIELDWORK COMPLETED. Data analysis is in progress. Preliminary results of this study are presented in Tables 1 and 2 below (Tables provided by N. Zampieri).

Table 1. Density estimates (in trees/ha) of longleaf pine at TNC preserves

Site Name	Site Number	Natural Community	Grass Stage	Juveniles (<15 cm DBH)	Younger Mature (15-30 DBH)	Mature (30-45 cm DBH)	Older Mature (45+ cm DBH)	Overall Density (trees/ha)
Rock Hill	10	Upland Pine	113	22	19	65	11	229
Tiger Creek	18	Sandhill	6	0	9	19	0	34

Table 2. Age range of cored trees at TNC preserves.

Size Classes	Rock Hill	Tiger Creek
Younger Mature (15-30 cm DBH)	25-74	24-43
Mature (30-45 cm DBH)	51-80	46-101
Older Mature (45+ cm DBH)	86-88	NA

Survey for *Lobelia boykinii* in the Florida Panhandle

Florida Natural Areas Inventory, Tallahassee, FL.

Duration: 2021

Objectives: To determine potential threats and protections needed for this species through the following: 1) range-wide surveys of the state-listed critically imperiled Boykin’s lobelia by revisiting all known extant and historical populations; 2) expanded searches for new plants/populations and determine population size (if possible); and 3) population of FNAI’s Biotics database with spatial data of known occurrences.

Methods: FNAI acquired historic records to prepare preliminary maps of known historical and recent occurrences of Boykin’s lobelia in the state. FNAI used resources such as soil maps, rare species locations, and the Cooperative Landcover to identify the most likely areas to search. Field surveys were conducted between May and August 2021 to survey during the flowering season for the species. Data was collected on Trimble GPS units and exported to ESRI shape

files. Survey tracks were recorded so that all search areas where negative data were obtained can be identified for future efforts.

Progress/Results: COMPLETED. Locations searched by FNAI include Tall Timbers, Kirk Edwards WEA, Eglin Air Force Base, Blackwater River State Forest, Joe Budd Wildlife Management Area, Lake Talquin State Forest, Adventures Unlimited Outdoor Resort, and Rock Hill Preserve. Volunteers searched Pine Log State Forest, Apalachee WEA, Apalachicola National Forest, and roadsides in Jackson County, Washington County, Bay County, Calhoun County, Liberty County, and Leon County. No Boykin's lobelia was found in any of the Florida surveys. The Element Occurrence records were updated in Biotics, and the subnational Element Characterization, Element Ranking, and Element Tracking Records were all updated to reflect new information more general to the species as opposed to the occurrences. This includes data on habitat, threats, distribution, number of populations, trends, among others. The updated data was used to evaluate the state ranking for Boykin's lobelia, resulting in the species being re-ranked as SH (Presumed extirpated) in Florida, replacing its previous rank of S1 (FNAI 2021c).

Status survey of gentian pinkroot (*Spigelia gentianoides*) and damage assessment following Hurricane Michael; Jackson, Washington, and Calhoun Counties

Amy Jenkins. Florida Natural Areas Inventory, Tallahassee, FL.

Duration: 2020-2021

Objectives: The original 2020 project objective was to estimate population size of gentian pinkroot for each conservation land where it is known to occur (Three Rivers State Park, Apalachee Wildlife Managed Area, Calhoun Spigelia Preserve, and Rock Hill Preserve). The Florida Natural Areas Inventory (FNAI) plan to incorporate the census data into its conservation database and utilize the data to update the global and state ranking of this species using the NatureServe Conservation Rank Calculator.

Because the population estimates had large confidence intervals, likely resulting from the low percentage (0.3%) of habitat surveyed, the project objective was modified in 2021 to measure change in the density of gentian pinkroot stems over time along with habitat structure and composition.

Methods: In May and June 2020, FNAI conducted population counts within 2.5 m radius plots randomly distributed in known historical and current *S. gentianoides* locations and in other areas with suitable habits. Plants outside of plots were documented but did not contribute to population estimates. Two plots were placed at Calhoun Spigelia and 11 at Rock Hill.

In 2021, FNAI established three permanent monitoring plots at Rock Hill (Figure 8) and one at Callhoun Spigelia. The plots are 20-m radius circular plots (Figure 9) placed within known

current or historic populations of gentian pinkroot. The center point of each plot was permanently marked and mapped with a submeter GPS unit. The plots were censused and habitat metrics for canopy (cover, height, DBH of trees rooted in the plot) and overall shrub structure (cover and height) were recorded at the 20-m plot level. Three smaller subplots (2.5m radius) within the 20-m plot were established, where additional shrub and herbaceous cover and structure data were recorded. The three subplots were placed 10 m from the center of the plot at 0, 120, and 240° (Figure 9). All shrub and herbaceous species within these subplots were identified; if it was not possible to identify a plant to species, FNAI recorded genus or family. Photos were taken at each plot.

Establishing permanent larger plots allowed for better density estimations within the known habitat and as well as change assessments in both gentian pinkroot density and habitat characteristics. These larger plots incorporated the edge of the known gentian pinkroot populations and would therefore provide better insights into expansion and contraction of population distribution through time (FNAI 2021b).

Progress/Results: ONGOING. In 2020, no plants, neither within nor outside of plots, were found at Calhoun Spigelia. Numerous plants were counted within the plots at Rock Hill, resulting in 0.64 stems/plot with a 95% CI of -0.58-1.85 and a population estimate of 1536 (\pm 2926).

In 2021, within the permanent plots, FNAI found a mean of 264 plants (SD=160.730) within the 3 plots at Rock Hill and at total of 5 plants within the one plot at Calhoun Spigelia.

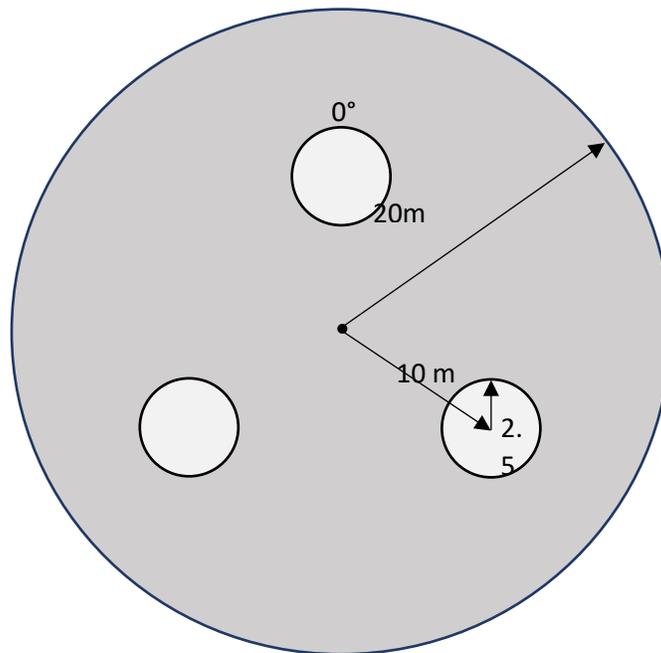
Across the four study sites, plots that received a prescribed burn in the months immediately preceding this survey had on average a higher number of gentian pinkroot individuals per plot than those that did not receive a spring prescribed fire (FNAI 2021b). While several habitat metrics that were collected such as canopy cover and herbaceous cover varied by site, their overlapping confidence intervals indicated no significant patterns, especially in terms of explaining the variability of gentian pinkroot abundance (FNAI 2021b). Following their initial monitoring period in 2021, FNAI plans to monitor the plots again in 2023 and 2025. While the conclusions that can be drawn from this initial monitoring event are limited, over time and subsequent prescribed fire applications, meaningful conclusions about annual abundance fluctuation and habitat conditions, especially as they respond to prescribed fire, will be examined (FNAI 2021b).

Reports were submitted to the US Forest Service (FNAI 2021b) and to the Florida Forest Service (FNAI 2021d).

Figure 8. Map of gentian pinkroot plots at Rock Hill (From FNAI 2021b)



Figure 9. 20-meter radius plot for pinkroot gentian, with 3 – 2.5-meter subplots located at 0°, 120°, and 240° (From FNAI 2021b).



Saddle Blanket Scrub Preserve

Ecology, habitat requirements and conservation of two ultra-rare Florida bees

Dr. Chase Kimmel. Florida Museum of Natural History, University of Florida, Gainesville, FL.

Duration: 2021-2022.

Objectives: This project will focus on two bee species: the blue calamintha bee (*Osmia calaminthae*), previously only known from four locations in Highlands County, and the giant scrub plasterer bee (*Caupolicana floridana*), a species previously known only from two Florida counties. This project seeks to better understand the distribution, ecology, and habitat requirements through the following:

1. Determination of the current status and distribution of the blue calamintha bee and its known floral host, *Conradina brevifolia*, in Florida. Survey areas include Saddle Blanket Scrub Preserve.
2. Determination of the current status and distribution of the giant scrub plasterer bee. Survey areas include Tiger Creek Preserve.
3. Increased understanding of the key natural history characteristics and habitat requirements of each bee (including host density, potential additional floral hosts, nesting and foraging behavior, etc.).
4. Evaluation of the future distribution and vulnerability of the blue calamintha bee and its floral host.
5. Development of basic species monitoring and habitat management recommendations to help safeguard existing populations.

Methods: Bee surveys will be conducted in areas where high densities of host plants occur. Bees will be hand netted, contained in a small enclosure, photographed, have hair samples removed from them for genetic work, and released at the point of capture. Pollen remnants left in the container will be analyzed to confirm host plant as well as determine if additional host plant pollen is present. If non-destructive genetic sampling procedures do not yield sufficient DNA, one bee will be taken as a voucher specimen towards the end of the season.

In addition to bee surveys, researchers will also look for a nest of each bee. If a nest is found, whisker stakes or flagging will be temporarily used to mark the nest location. If a nest excavation is warranted, The Nature Conservancy will be contacted for permission for ground disturbance activities.

A habitat assessment will be conducted in areas where there are high densities of host plants as well as in areas where the bees are found.

Progress/Results: ONGOING. *Osmia calaminthae* surveys at Saddle Blanket- only one preliminary survey of the area has taken place during ideal flight conditions with adequate *Conradina brevifolia* blooms. No bees were collected and identified. *Caupolicana floridana* surveys at Tiger Creek – no surveys took place during the 2021 field season. Surveys at both preserves are planned for 2022.

Tiger Creek Preserve

A dendroecological investigation into spatial and temporal patterns of longleaf pine (*Pinus palustris*) growth in Florida

Nicole Zampieri. PhD student. Department of Geography, Florida State University, Tallahassee, FL.

Locations: Rock Hill Preserve and Tiger Creek Preserve

Duration: 2018-2022

Objectives: This study has four objectives:

1. Determine the patterns of longleaf pine forest structure (density, size structure, age distribution) and how growth rates differ across natural communities.
2. Determine how a strong tropical cyclone (Hurricane Michael) affected forest structure in different natural communities.
3. Determine the relative effects of community type and interannual climatic variability on longleaf pine growth rates.
4. Determine the current and historical above-ground carbon storage potential of longleaf pines across their Florida range.

Methods: Sites were selected from the list FNAI's designated exemplary sites. Exemplary sites were chosen as excellent historically representative examples of the communities, based on fire regime, canopy structure, regeneration, and groundcover quality. Twenty-two sites in total were sampled, two of which were on Conservancy preserves (Rock Hill and Tiger Creek Preserve). Rock Hill was selected for its Upland Pine exemplary site and Tiger Creek for Sandhill.

Data was collected on the density, size, and age structure of longleaf pine trees using modified variable area transects at each site. Within the transects, each tree was mapped with GPS and dbh, height, crown measurements were taken. Cores were collected from 13 trees at Rock Hill and 8 at Tiger Creek.

Surveys were conducted post-Hurricane Michael on several of the panhandle research sites to assess damage caused by the storm. Rock Hill was not included in the assessments.

Progress/Results: FIELDWORK COMPLETED. Data analysis is in progress. Preliminary results of this study are presented in Tables 1 and 2 below (Tables provided by N. Zampieri).

Table 1. Density estimates (in trees/ha) of longleaf pine at TNC preserves

Site Name	Site Number	Natural Community	Grass Stage	Juveniles (<15 cm DBH)	Younger Mature (15-30 DBH)	Mature (30-45 cm DBH)	Older Mature (45+ cm DBH)	Overall Density (trees/ha)
Rock Hill	10	Upland Pine	113	22	19	65	11	229
Tiger Creek	18	Sandhill	6	0	9	19	0	34

Table 2. Age range of cored trees at TNC preserves.

Size Classes	Rock Hill	Tiger Creek
Younger Mature (15-30 cm DBH)	25-74	24-43
Mature (30-45 cm DBH)	51-80	46-101
Older Mature (45+ cm DBH)	86-88	NA

Ecology, habitat requirements and conservation of two ultra-rare Florida bees

Dr. Chase Kimmel. Florida Museum of Natural History, University of Florida, Gainesville, FL.

Duration: 2021-2022

Objectives: This project will focus on two bee species: the blue calamintha bee (*Osmia calaminthae*), previously only known from four locations in Highlands County, and the giant scrub plasterer bee (*Caupolicana floridana*), a species previously known only from two Florida counties. This project seeks to better understand the distribution, ecology, and habitat requirements through the following:

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5. Development of basic species monitoring and habitat management recommendations to help safeguard existing populations.

Methods: Bee surveys will be conducted in areas where high densities of host plants occur. Bees will be hand netted, contained in a small enclosure, photographed, have hair samples

removed from them for genetic work, and released at the point of capture. Pollen remnants left in the container will be analyzed to confirm host plant as well as determine if additional host plant pollen is present. If non-destructive genetic sampling procedures do not yield sufficient DNA, one bee will be taken as a voucher specimen towards the end of the season. In addition to bee surveys, researchers will also look for a nest of each bee. If a nest is found, whisker stakes or flagging will be temporarily used to mark the nest location. If a nest excavation is warranted, The Nature Conservancy will be contacted for permission for ground disturbance activities. A habitat assessment will be conducted in areas where there are high densities of host plants as well as in areas where the bees are found.

Progress/Results: ONGOING. *Osmia calaminthae* surveys at Saddle Blanket- only one preliminary survey of the area has taken place during ideal flight conditions with adequate *Conradina brevifolia* blooms. No bees were collected and identified. *Caupolicana floridana* surveys at Tiger Creek – no surveys took place during the 2021 field season. Surveys at both preserves are planned for 2022.

National Wetland Condition Assessment

HT Odum Center for Wetlands, University of Florida, Gainesville, FL.

Duration: 2021

Objectives: Conduct a wetland survey of Tiger Creek Preserve as part of the US Environmental Protection Agency (EPA) National Aquatic Resource Survey's National Wetland Condition Assessment (NWCA) to assess the condition of the nation's lakes, rivers, streams, coastal waters, and wetlands.

Methods: Staff from UF's HT Odum Center for Wetlands is completing the data collection for all Florida NWCA wetlands. In Florida, 48 randomly selected wetlands areas were identified by the US EPA using the US Fish & Wildlife Service's Status and Trends framework. One point, at latitude 27.838623 N, longitude -81.475647, fell within the eastern half of the Tiger Creek Forest Management Area of Tiger Creek Preserve. Observations were recorded within a 40m circular plot on vegetation, soils, and water. The following samples were collected for lab analysis: 1) 9 soil cores measuring 2.2 cm diameter by 10 cm deep for isotope and enzyme analysis; 2) 1-2.5L of soil for chemistry and analysis; 3) 9 soil cores measuring 6.5 cm diameter by 4.5 cm deep for bulk density analysis; and 4) 1.5-2 L surface water for chemical analysis. In addition, five plant samples were collected for further laboratory review as part of the vegetation quality assurance/quality control. No threatened, endangered, or species of special concern were collected.

Progress/Results: COMPLETED. The Tiger Creek Preserve wetland point was sampled on June 2, 2021. Information from this assessment will be used by the US EPA in support of the nationwide evaluation of wetland condition. The NWCA uses a probability-based sample design, resulting in a statistically valid estimate of condition for wetlands throughout each region and

nationally. Tiger Creek Preserve was one of 1000+ wetland points sampled in 2021. All field sampling is complete and lab sample processing is underway. Results are expected by the end of 2022. A final report will be developed after the lab data has been reviewed and released by the EPA.

LONG-TERM MONITORING PROJECTS

Statewide

Florida Automated Weather Network (FAWN) stations on TNC preserves

University of Florida's Institute of Food and Agricultural Sciences (UF/IFAS), Gainesville, FL.

Duration: 2021-

Objectives: To obtain real-time weather from automated weather towers at Apalachicola Bluffs & Ravines Preserve, Disney Wilderness Preserve, and Tiger Creek Preserve. These towers will be installed and maintained by UF/IFAS as part of their state-wide FAWN network, which provides weather data from 42 stations to support the agricultural and research communities. In addition to the FAWN standard sensors, the towers will include equipment to provide KBDI and other data useful for prescribed fire and other preserve management.

Methods: A 30' fixed tower supporting sensor arrays and associated infrastructure including power and communication installation and use, to provide the following comprehensive data at each of the three preserves:

- Soil temperature at 10 cm
- Air temperature at 60 cm, 2 meters, and 10 meters
- Wind speed and direction at 10 meters; wind direction standard deviation, and min/max wind speed
- Global solar radiation
- Barometric pressure
- Wet bulb temperature at 2 meters
- Dewpoint temperature at 2 meters
- Vapor pressure, saturated vapor pressure, and vapor pressure deficit at 2 meters
- Fuel temperature and moisture at 30 cm
- Keetch-Byrum Drought Index (KBDI) sensors at 2 meters

Progress/Results: PLANNED. Installations of the towers and sensors at the three preserves is planned for 2022. The proposed locations at each of the three preserves are shown in Figures 10-12. The Conservancy has applied for a Town of Jupiter permit to include Blowing Rocks Preserve in the project.

Figure 10. Location of the proposed FAWN weather station at Apalachicola Bluffs and Ravines Preserve.

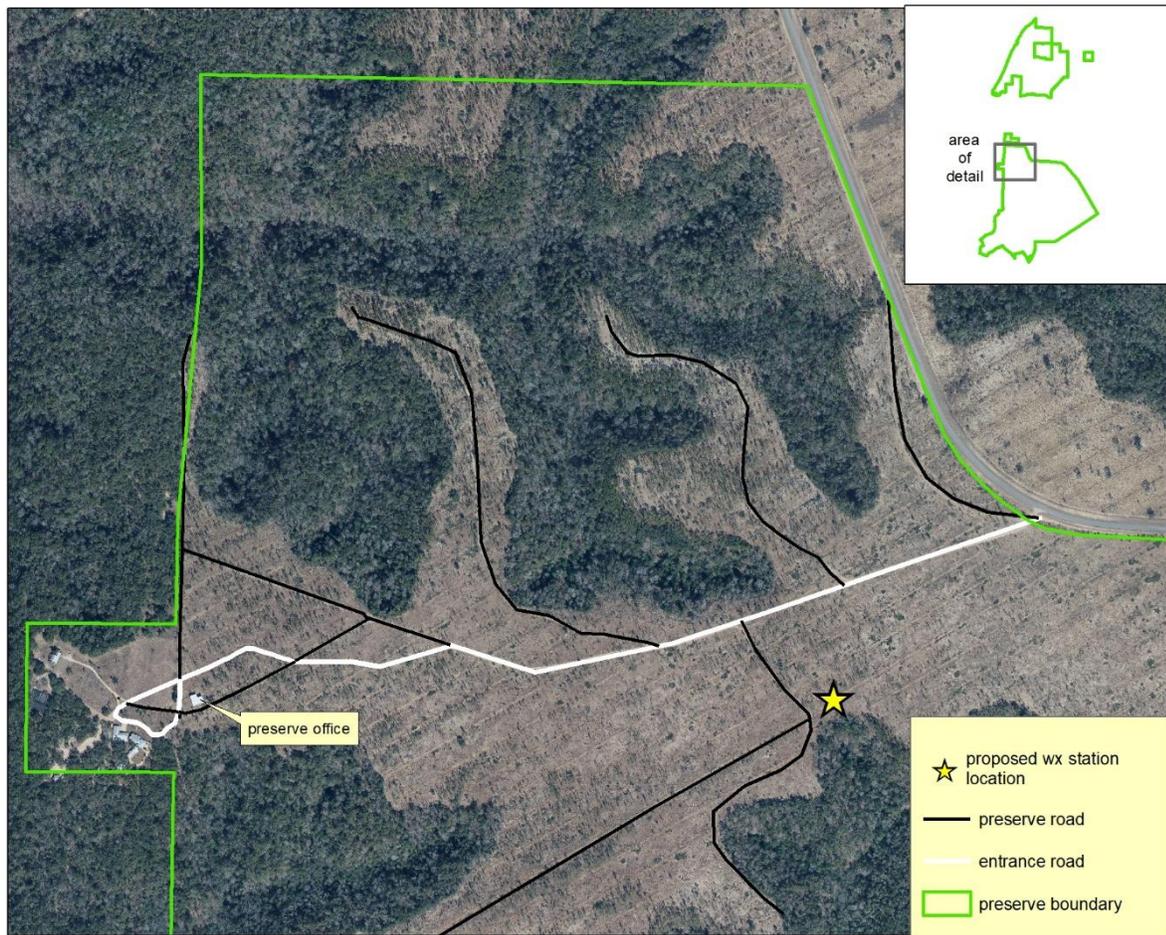


Figure 11. Location of the proposed FAWN weather station at Disney Wilderness Preserve.

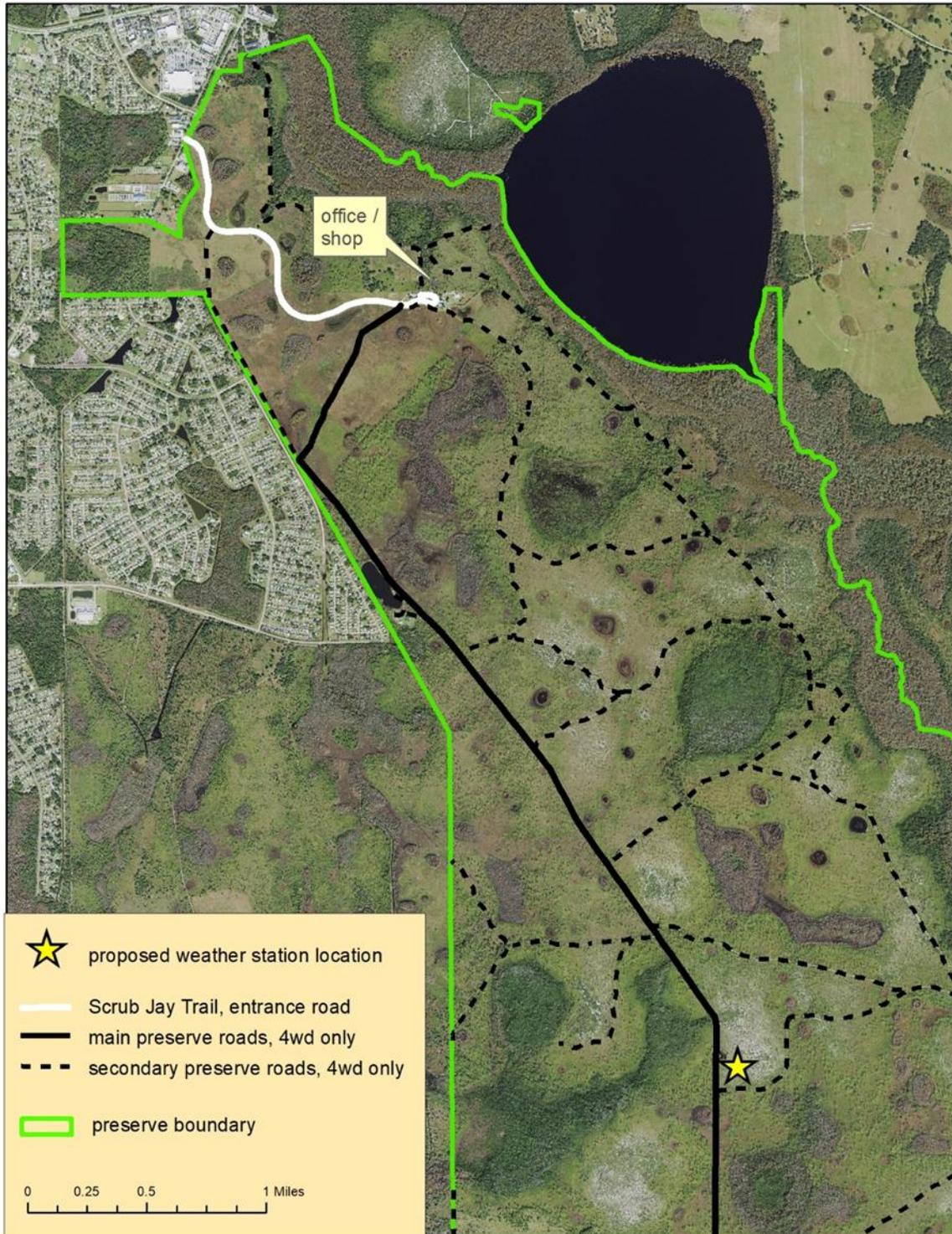


Figure 12. Location of the proposed FAWN weather station at Tiger Creek Preserve.



Disney Wilderness Preserve

Long-term isolated wetland monitoring on the Disney Wilderness Preserve

South Florida Water Management District, West Palm Beach, FL.

Duration: 1995-present

Objectives: To document isolated wetland hydrology and the natural variation in hydroperiods and water levels due to seasonal and climatic changes. These wetland monitoring sites serve as reference sites for comparison with wetlands influenced by groundwater withdrawals from water supply well fields. The Disney Wilderness Preserve (DWP) is one of seven such sites that have been established throughout south Florida.

Methods: The project includes: 1) aerial photography analysis to determine past changes in vegetation communities in the vicinity of the wetland monitoring sites; 2) biological characterization involving field inventories of plants, macroinvertebrates, fish, and amphibians; 3) shallow groundwater monitoring wells that assess each wetland's hydrology; 4) water level recorders within each wetland monitoring well; 5) a complete weather station on the preserve; and 6) weather and water level data collection and compilation.

Six wetlands were selected for study at the preserve in 1995 (Figure 13). Initial sampling began in 1996, including the biological inventories. Installation of shallow groundwater monitoring wells, water level recorders and satellite feed weather station occurred in 1997. Surface water, groundwater and weather data continue to be collected at the Disney Wilderness Preserve (DWP). The weather data include rainfall, humidity, temperature, air pressure and light.

Additional water level monitoring wells were installed at deeper levels in the aquifer to further characterize the groundwater dynamics on a regional scale. These wells were constructed to depths of 10 ft, 36 ft and 90 ft in the surficial aquifer; 122 ft and 184 ft in the Mid Hawthorn; and 450 ft in the upper Floridan aquifer. Aquifer performance tests were conducted to determine interactions between the levels.

The water level data from these wells and others monitored by the South Florida Water Management District (SFWMD) are being used to develop a groundwater/surface water interaction model. This model will estimate impacts of future groundwater withdrawals occurring in metro-Orlando on the wetlands being monitored on the preserve. Results of the modeling will be incorporated into regional planning for the Kissimmee Valley.

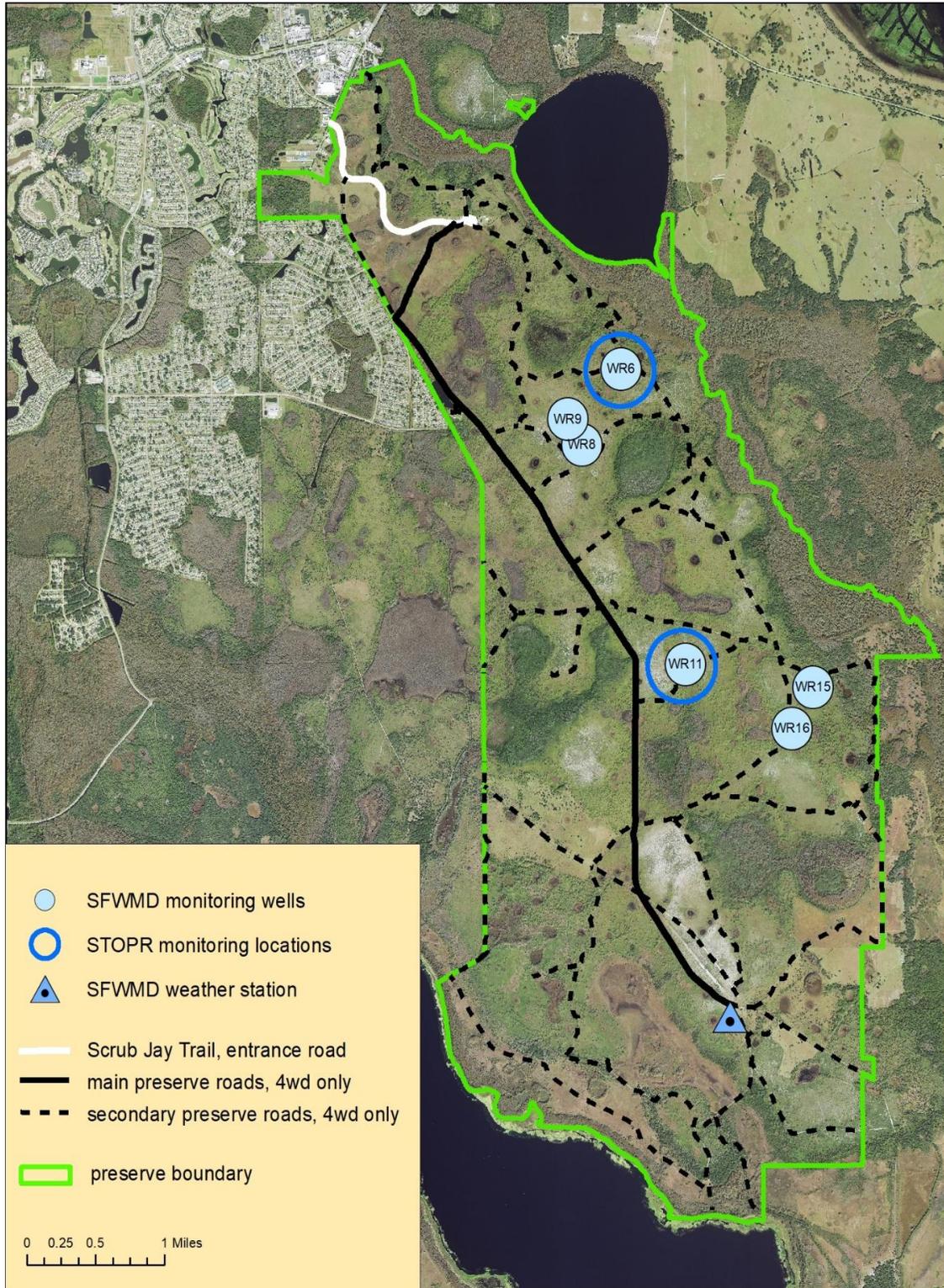
In 2007, the SFWMD issued five different public water supply permits to five utility companies (collectively known as the STOPR Group) in the central Florida region and required the utility companies to construct a total of 39 monitoring wells throughout the Central Florida region. Two of these reference monitoring sites are located on DWP. The SFWMD agreed to allow the

STOPR group to use the existing well facilities within two wetlands (WR 6 and WR 5) that have continued to be monitored by the District under the “Isolated Wetlands Program.”

Monitoring site WR 6 (a.k.a. Site 21 by the STOPR Group) is an herbaceous wetland located in Osceola County. WR 15 (a.k.a. Site 10 by the STOPR Group) is a cypress dome with a wet prairie fringe located in Polk County. The SFWMD continues to collect the water level data, and the STOPR Group is responsible for one vegetative transect within each wetland. In the event that the SFWMD budget for continued monitoring within these wetlands is not approved in the future, then it will be the STOPR Group’s responsibility to collect the water level data from these two sites.

Progress/Results: ONGOING. Well and vegetation monitoring data from the South Florida Water Management District is available by request. Weather data is publicly available at [DBHYDRO Browser \(sfwmd.gov\)](http://dbhydro.sfwmd.gov). The DWP weather station ID is WRWX.

Figure 13. SFWMD and STOPR well and SFWMD weather station locations at Disney Wilderness Preserve.



National Ecological Observatory Network (NEON)

Battelle. NEON Program HQ, Boulder, CO.

Duration: 2012 – present

Objectives: The National Science Foundation’s National Ecological Observatory Network (NEON) is a continental-scale observation facility operated by Battelle to collect long-term open access ecological data to better understand how ecosystems are changing throughout the US. The Disney Wilderness Preserve (DWP) is one of NEON’s 47 terrestrial field sites across 20 ecoclimatic domains. NEON has an additional 34 aquatic sites throughout the US.

Methods: NEON uses standardized data collection and processing methods at all field sites. As at all NEON terrestrial field sites, data is collected via three different methods: 1) airborne remote sensing, 2) automated instruments, and 3) observational sampling. NEON’s data collection methods can be found at <https://www.neonscience.org/data-collection>.

Airborne remote sensing: Using payload sensors on light aircraft, surveys are conducted annually at each site during peak greenness to provide quantitative information on land cover and changes to ecological structure and chemistry (NeonScience.org). The primary sensors include

1. Discrete and full-waveform LiDAR, which provides three-dimensional structural landscape information.
2. Imaging spectrometer, which allows discrimination of land cover types and vegetation chemical content.
3. High-resolution digital camera for spatially accurate and detailed contextual information (NeonScience.org).

Automated instruments: A micrometeorological tower at all terrestrial sites, including DWP, collects continuous weather and climate data, including fluxes of carbon, water, and energy between the terrestrial ecosystem and the atmosphere (NeonScience.org). The tower location at the DWP is shown in Figure 14. Phenocams are mounted at the top and bottom of each tower to capture above- and below-canopy phenology (NeonScience.org). Soil sensors in an array near the tower measure soil chemical and physical properties at various depths and at the soil surface (NeonScience.org).

Observational sampling: Throughout the year, NEON scientists collect field data from permanent plots at DWP (Figure 14) and all other terrestrial sites. Data focuses on sentinel taxa that indicate ecosystem health and provide data relevant to public health (NeonScience.org). The sentinel taxa fall into six groups:

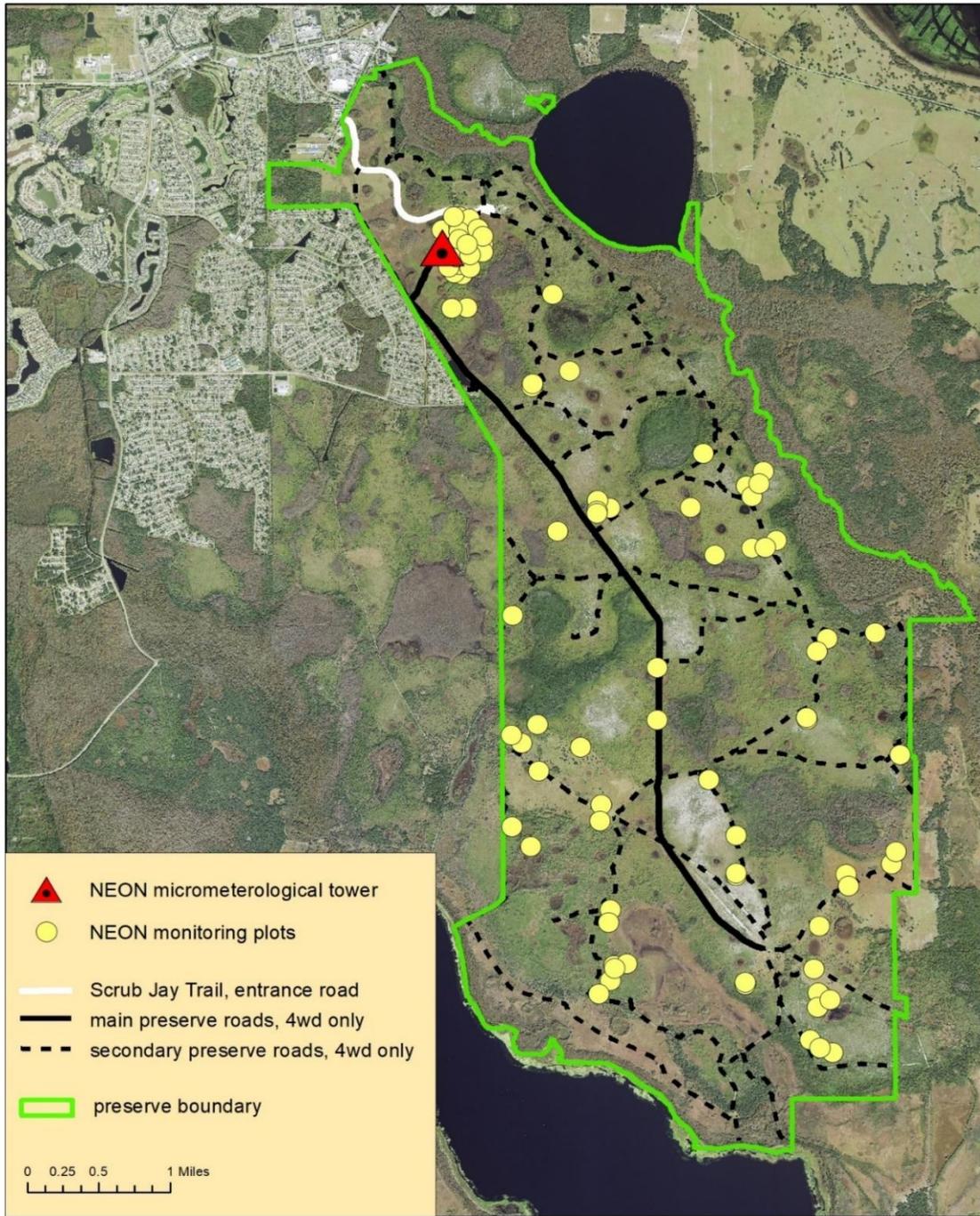
1. Breeding land birds: Bird observations are made to capture interannual variation in avian abundance, diversity, and distribution (NeonScience.org). All bird species observed are recorded using point count methods

2. Ground beetles: NEON field scientists collect beetles with pitfall traps distributed across the site. Traps are deployed every two weeks during the time of year when beetles are most active. Each beetle is identified to species or morphospecies. A subset of the beetles is DNA barcoded.
3. Terrestrial plants: NEON collects data on plant biomass and productivity, plant diversity, plant phenology, and plant chemical properties within permanent 40 x 40-meter plots distributed across terrestrial field sites. NEON field scientists conduct field sampling annually, but data frequency and schedule vary among the data types, reflecting the requirements of specific data products and protocols (Neonscience.org).
4. Small mammals: NEON defines small mammals as nocturnal, flightless, above-ground foragers, and weighing 5-600 grams. NEON uses Sherman box traps deployed for one-three consecutive nights for at least four times per year. For each captured small mammal, species, sex, age, reproductive status, weight, hind foot length and other species-specific measurements are recorded. Blood is drawn from some individuals for pathogen testing, and the presence and abundance of ticks on each individual is determined. Individuals are tagged, using either ear tags or Passive Integrated Transponder (PIT) tags. All data collection is conducted in the field for quick release of the animals after capture. NEON collects a subset of the trapped animals for use as voucher specimens. All handling and processing have been approved by Battle' Institutional Animal Care and Use Committee (IACUC). After field collection, NEON scientists conduct lab analyses for DNA sequencing and rodent-borne pathogen status.
5. Soil microbes: NEON collects different types of soil data at different frequencies (1-5 years) depending on the data type. For each sampling, three soil cores are taken from 10 permanent plots. Up to three sampling periods may occur within a sampling year during peak greenness and during seasonal transitions. Data collection and analyses produce the following data products: soil temperature, litter depth, moisture, pH, stable isotopes, and inorganic nitrogen pools and transformations; and soil microbe biomass, marker gene sequences, community composition, and metagenome sequences.
6. Ticks: NEON field scientists collect ticks using 1 m² drag cloths dragged around the perimeter of each 40x40m vegetation plot. Ticks that cling to the cloth are counted and categorized by species, sex, and life stage (neonscience.org). Testing for pathogens is conducted on a subset of the ticks, and a smaller subset are archived.

Progress/Results: ONGOING. NEON is a 30-year project with data collection at the Disney Wilderness Preserve proposed for the entire project period. All data collected from DWP and other NEON sites is publicly available online at <https://data.neonscience.org/data-products>.

As of March 2022, least 38 papers have been published on studies using NEON data from DWP: Atkins et al. 2022a, Atkins et al. 2022b, Donnelly et al. 2022, Gobron et al. 2022, Rishmawi et al. 2022, Sharma et al. 2022, Tang et al. 2022, Waterman et al. 2022, Ayres et al. 2021, Brown et al. 2021, Clark et al. 2021, Delwiche et al. 2021, Fiorella et al. 2021, Hantak et al. 2021, Kang et al. 2021, Messer and Raber 2021, Qui et al. 2021a, Qui et al. 2021b., Parker 2021, Parra 2021, Patel et al. 2021, Stachewicz et al. 2021, Weinstein et al. 2021, Brown et al. 2020, Fisher et al. 2020, Ritter 2020, Shu et al. 2020, Wang et al. 2020, Weinstein et al. 2020a, Weinstein et al. 2020b, Ayres 2019, Nave et al. 2019, Ritter et al. 2019, Sorensen 2019, Weiglen 2019, Gaynor et al. 2018, Hoekman et al. 2017, Ghabbour et al. 2015, and Loescher et al. 2014.

Figure 14. NEON tower and monitoring plot locations at Disney Wilderness Preserve.



USGS seismic station at the Disney Wilderness Preserve

US Geological Survey, Albuquerque Seismological Laboratory, Albuquerque, NM.

Duration: 1997-present

Objectives: To maintain a seismic station in central Florida as part of the Global Seismograph Network (GSN). The objectives of the GSN are to provide real-time earthquake information for emergency response personnel, provide engineers with information about building and site response to strong shaking, and provide scientists around the world with high-quality data needed to understand earthquake processes and structure and dynamics of the solid earth.

Methods: The Disney Wilderness Preserve has one of over 100 GSN stations worldwide. The station ID is IU/DWPF and is located at the southern end of the Dorm Pond (Figure 15). Installation was conducted in 1997, and operation began in 1998. USGS installed IRIS Type II seismic sensors over a 162 m borehole. Data is transmitted real-time using satellite telemetry. Station data is available from the Incorporated Research Institutions for Seismology (IRIS) website: <https://ds.iris.edu/ds/nodes/dmc/data/#requests>.

Progress/Results: ONGOING. At least 15 publications have been produced using data from the DWPF station: Baer 2020, Ringler et al. 2020, Sobolev et al. 2020, Heyburn et al. 2018, Ritzwoller and Feng 2018, Tary et al. 2018, Ye et al. 2016, Ringler 2015, Groos et al. 2012, Ringler et al. 2012, Gonzalez et al. 2011, Liang 2008, Bensen et al. 2007, Gonzalez et al. 2007, and Fnais 2004.

Figure 15. Location of the USGS seismic station at Disney Wilderness Preserve.



Water quality monitoring on Reedy Creek and Lake Russell at the Disney Wilderness Preserve

Reedy Creek Improvement District (RCID), Lake Buena Vista, FL.

Duration: 1998-present

Objectives: Water quality monitoring for routine ecological health and urban impact assessment. Sampling is part of RCID's program for is watershed analysis, total maximum daily load, National Pollutant Discharge Elimination System, and surface water monitoring.

Methods: RCID Environmental Services performs water quality monitoring on two sampling sites, collected quarterly at the Disney Wilderness Preserve (Figure 16). Analyses include chlorophyll, bacteria, general chemistry, metals, pesticides, volatile organic compounds, semi-volatile organic compounds, and field parameters.

Progress/Results: ONGOING. Data is available from the Reedy Creek Improvement District by request.

Figure 16. Location of RCID water quality monitoring at Disney Wilderness Preserve.



Jeff Lewis Wilderness Preserve and John S. Phipps Preserve

Shorebird and seabird monitoring

Florida Fish & Wildlife Commission, Tallahassee, FL.

Duration: 2013 - present

Objectives: To determine the distribution, status, and trends of the 20 species of shorebirds and seabirds in Florida through long-term monitoring across the state. This project is part of FWC's Florida Shorebird Alliance, which consists of regional partnerships that work locally to survey and monitor important shorebird and seabird nesting sites.

Methods: FWC conducts monthly site visits in May through August of each year to determine the numbers of breeding pairs, nest locations, and outcomes as well as to determine the locations of brood-rearing habitat. Monitoring is conducted following FWC's Breeding Bird Protocol for Florida's Shorebirds and Seabirds (<https://public.myfwc.com/crossdoi/shorebirds/PDF-files/BreedingBirdProtocol.pdf>).

Progress/Results: ONGOING. Data is publicly available from FWC's Florida Shore Bird Database at <https://public.myfwc.com/crossdoi/shorebirds/>.

Saddle Blanket Scrub Preserve and Tiger Creek Preserve

Central Florida Water Initiative (CFWI) long-term wetland monitoring

Southwest Florida Water Management District, Bartow, FL.

Duration: 2021 - present

Objectives: To collect ground water and wetland vegetation data to inform regional water supply planning and regulations. The Central Florida Water Initiative (CFWI) is a collaborative water supply planning effort among the Florida Department of Environmental Protection, the Florida Department of Agriculture and Consumer Services, water management districts, water utilities, and other stakeholders in Orange, Osceola, Polk, Seminole, and Lake Counties. Southwest Florida Water Management District (SFWMD) is the CFWI monitoring lead for Polk County. SFWMD personnel will maintain the recorders at Tiger Creek Preserve and conduct the vegetation and soil monitoring. The project is currently planned for a duration of twenty years or more.

Methods: Tiger Creek and Saddle Blanket Scrub are two of 107 sites to be established in the CFWI monitoring by 2025. Two surficial aquifer wells with continuous water level and rainfall recorders will be installed at each preserve, all four in uplands and within 50m of a wetland

(Figures 17 and 18). In addition, vegetation and soil data will be collected every five years along transects extending across the wetlands. The soils and vegetation data will be used in conjunction with the surficial aquifer water level and rainfall data to determine trends in wetland boundaries and for calibration and verification of regional water models.

Progress/Results: ONGOING. SWFWMD completed installation of the wells in 2021. The vegetation monitoring transects will be established in 2022.

Figure 17. Location of CWFI monitoring wells at Saddle Blanket Scrub Preserve.

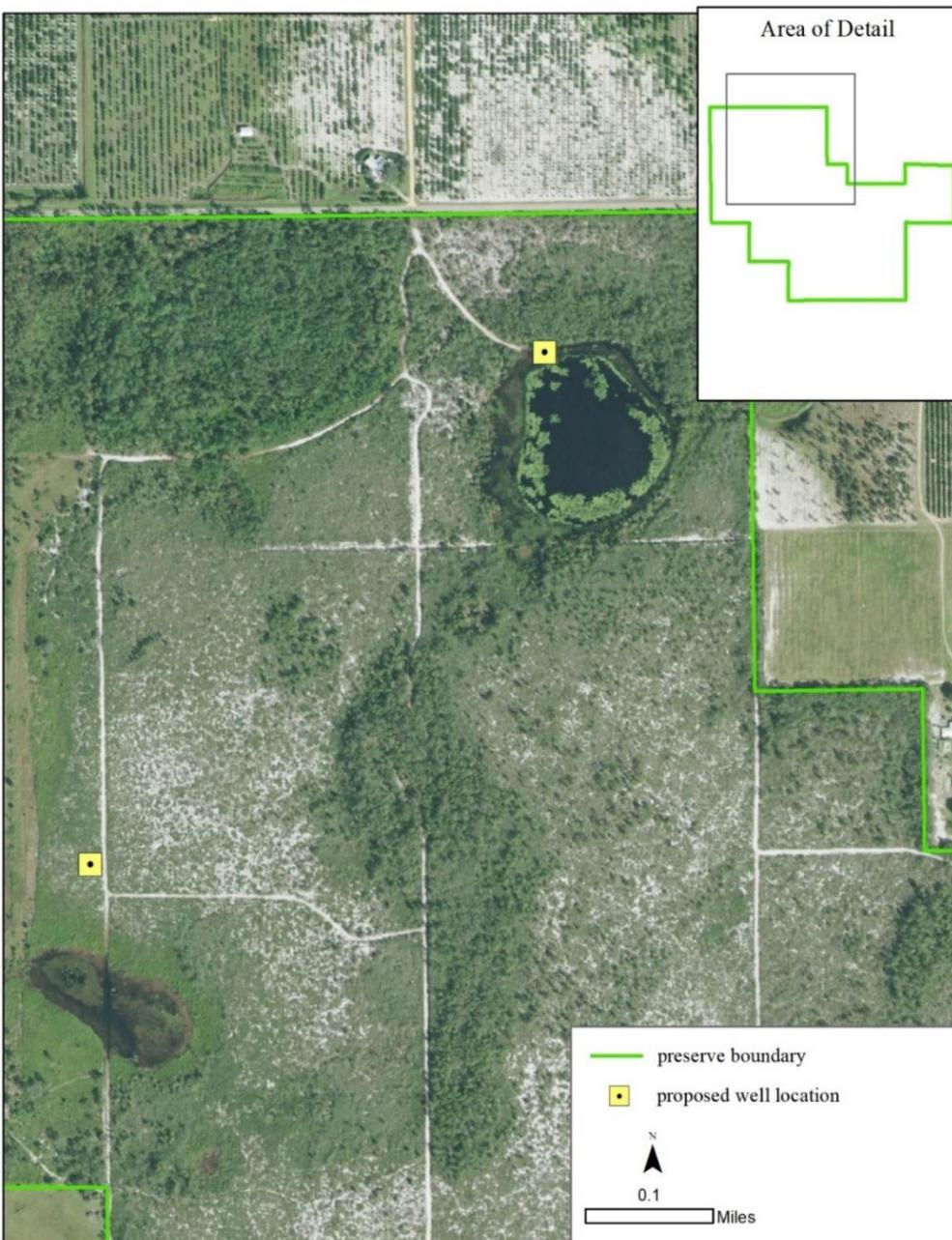
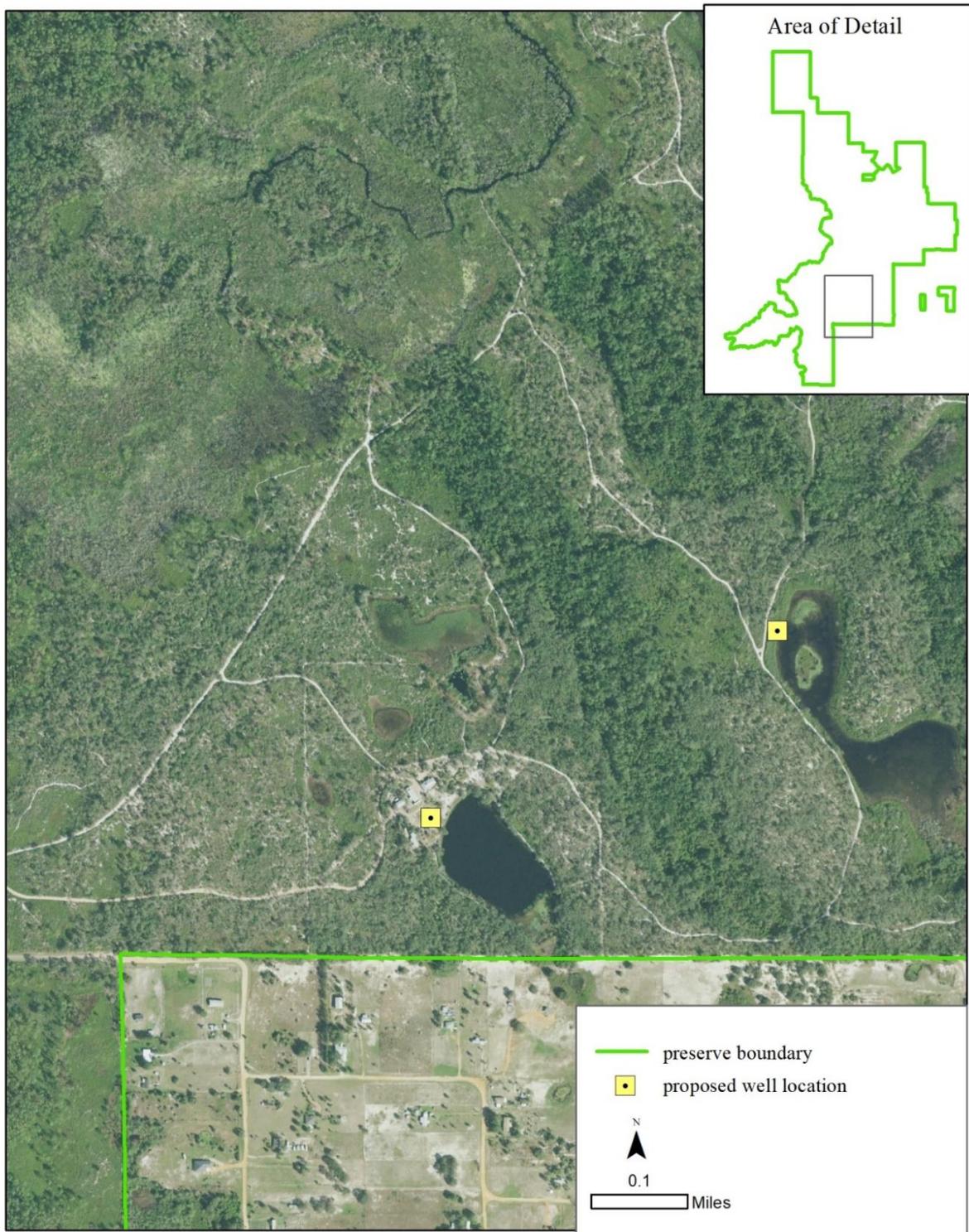


Figure 18. Location of CFWI monitoring wells and vegetation transects at Tiger Creek Preserve.



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Florida Natural Areas Inventory. 2021a. **Gopher tortoise survey of Apalachicola Bluffs and Ravines Preserve. Revised report to the Florida Fish and Wildlife Conservation Commission.** Florida Natural Areas Inventory, Tallahassee, FL.

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