



Terrestrial Vegetation Monitoring at Timucuan Ecological and Historic Preserve

2019 Data Summary—Version 2.0

Natural Resource Data Series NPS/SECN/NRDS—2022/1344





ON THIS PAGE

Circular fruit of hop-tree (*Ptelea trifoliata*) in a coastal shell midden forest at the Cedar Point unit of Timucuan Ecological and Historic Preserve. NPS photo / M. Forbes Boyle.

ON THE COVER

Elizabeth Rico (left) from the Southeast Coast Network, and Tyler Walker from Timucuan Ecological and Historic Preserve, monitoring terrestrial vegetation at the Thomas Creek unit of Timucuan Ecological and Historic Preserve following the 2019 Yellow Bluff fire. NPS photo / M. Forbes Boyle.

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Southeast Coast Inventory and Monitoring Network

National Park Service

Cumberland Island National Seashore

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The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible and technically accurate.

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Contents

	Page
Figures	v
Tables	vi
Appendices	vi
Acknowledgments	vii
Executive Summary	viii
List of Terms	ix
Introduction	1
Overview	1
Monitoring Objectives	1
Methods	2
Study Area	2
Sampling Design	4
Nomenclature Standard, Growth Form Determination, and Conservation Status	8
Sampling Methodology	8
Results and Discussion	11
Coastal Plain Nonalluvial Wetlands	12
Species Diversity and Abundance	12
Woody Stem Metrics	16
Disturbance and Threats	19
Geomorphology and Soil	20
Coastal Plain Open Uplands and Woodlands	22
Species Diversity and Abundance	23
Woody Stem Metrics	23
Disturbance and Threats	25
Geomorphology and Soil	25
Maritime Upland Forests and Shrublands	26
Species Diversity and Abundance	27
Woody Stem Metrics	27
Disturbance and Threats	29
Geomorphology and Soil	29

Contents

	Page
Fuel Load Estimates	30
Cedar Point	30
Theodore Roosevelt	32
Thomas Creek	34
Literature Cited	36

Figures

Page

Figure 1.	Location of Timucuan Ecological and Historical Preserve in Duval County, Florida.	3
Figure 2.	Southeast Coast Network terrestrial vegetation monitoring plot locations within the Cedar Point land parcel of the Timucuan Ecological and Historical Preserve.	5
Figure 3.	Southeast Coast Network terrestrial vegetation monitoring plot locations within the Theodore Roosevelt land parcel of the Timucuan Ecological and Historical Preserve.	6
Figure 4.	Southeast Coast Network terrestrial vegetation monitoring plot locations within the Thomas Creek land parcel of the Timucuan Ecological and Historical Preserve.	7
Figure 5.	The layout of the sampling plot for the Southeast Coast Network, which is a modified version of the standard Level 5 Carolina Vegetation Survey plot.	9
Figure 6.	Several species were added to the Timucuan plant list due to this monitoring effort, including Florida hobblebush (<i>Agarista populifolia</i>)—a native shrub in the Ericaceae Family observed in several plots on the Theodore Roosevelt land parcel.	11
Figure 7.	A total of six nonalluvial wetland sites were sampled during this monitoring effort.	12
Figure 8.	Relative proportion of species groups across three woody stem strata—trees, saplings, and seedlings—within Coastal Plain Nonalluvial Wetland vegetation monitoring plots of Timucuan Ecological and Historic Preserve.	17
Figure 9.	Health status of woody stems greater than or equal to 10 centimeters (3.9 in) DBH (trees) measured on Coastal Plain Nonalluvial Wetland vegetation monitoring plots of Timucuan Ecological and Historic Preserve.	18
Figure 10.	A total of seven open uplands and woodlands were sampled during this monitoring effort.	22
Figure 11.	Relative proportion of species groups across three woody stem strata—trees, saplings, and seedlings—within Coastal Plain Open Upland and Woodland vegetation monitoring plots of Timucuan Ecological and Historic Preserve.	24
Figure 12.	Health status of woody stems greater than or equal to 10 centimeters (3.9 in) DBH (trees) measured on Coastal Plain Open Upland and Woodland vegetation monitoring plots of Timucuan Ecological and Historic Preserve.	25
Figure 13.	A total of 10 maritime upland forest and shrubland sites were sampled during this monitoring effort.	26
Figure 14.	Relative proportion of species groups across three woody stem strata—trees, saplings, and seedlings—within Maritime Upland Forest and Shrubland vegetation monitoring plots of Timucuan Ecological and Historic Preserve.	28
Figure 15.	Health status of woody stems greater than or equal to 10 centimeters (3.9 in) DBH ('trees') measured on Maritime Upland Forest and Shrubland vegetation monitoring plots of Timucuan Ecological and Historic Preserve.	29
Figure 16.	Fuel load estimates from vegetation monitoring plots located on the Cedar Point land parcel of Timucuan Ecological and Historic Preserve.	31
Figure 17.	Fuel load estimates from vegetation monitoring plots located on the Theodore Roosevelt land parcel of Timucuan Ecological and Historic Preserve.	33
Figure 18.	Fuel load estimates from vegetation monitoring plots located on the Theodore Roosevelt land parcel of Timucuan Ecological and Historic Preserve.	35

Tables

	Page
Table 1. Vascular plant cover metrics of the Carolina Vegetation Survey (Peet et al. 1998) and used by the SECN Terrestrial Vegetation Monitoring protocol.	10
Table 2. Vascular plant species, subspecies, or varieties not reported from Zomlefer et al. (2007), Byrne et al. (2012), or NPSpecies (2019) but found at Timucuan Ecological and Historical Preserve in 2019 through this current monitoring effort.	11
Table 3. Vascular plant species richness across multiple spatial scales on Southeast Coast Network vegetation plots located on Timucuan Ecological and Historic Preserve.	13
Table 4. Woody stem abundance and canopy metrics on Southeast Coast Network vegetation plots located on Timucuan Ecological and Historic Preserve.	16
Table 5. Disturbance observations and abundance (% cover) measured on vegetation monitoring plots of Timucuan Ecological and Historic Preserve.	19
Table 6. Local landform and hydrologic condition from vegetation monitoring plots of Timucuan Ecological and Historic Preserve.	20
Table 7. Soil nutrient status from vegetation monitoring plots of Timucuan Ecological and Historic Preserve.	21
Table A-1. Vascular plant species present in 23 vegetation monitoring plots at Timucuan Ecological and Historic Preserve, May–June 2019.	39
Table B-1. Constancy and average cover class for all vascular plant species observed in 23 Southeast Coast Network vegetation monitoring plots.	47
Table B-2. Basal area (BA, m ² /ha) and density (Den, count/ha) of woody vascular plant species observed in 23 Southeast Coast Network vegetation monitoring plots.	50

Appendices

	Page
Appendix A. Vascular Plants Observed During the 2019 Southeast Coast Network Terrestrial Vegetation Monitoring Effort on Timucuan Ecological and Historical Preserve	38
Appendix B. Species Diversity, Abundance, and Woody Stem Metrics Summarized by Broadly Defined Habitats of Timucuan Ecological and Historical Preserve	45

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Former Southeast Coast Network (SECN) intern Kelsey Mack (right) also provided field assistance. Carl Nordman (Vegetation Ecologist, NatureServe) provided field support for the first two weeks of the monitoring field season, lending his knowledge and experience from years working with the Cumberland Piedmont Network's forest monitoring protocol. Carl's support was funded through an agreement funded by the Southeast Coast Network.

Finally, thanks go to SECN Physical Geographer Stephen Cooper for assisting with the development of study site and fuel map templates used in this report.



Former Southeast Coast Network Intern Kelsey Mack provided field assistance. NPS photo / SECN staff.

Executive Summary

The Southeast Coast Network (SECN) conducts long-term terrestrial vegetation monitoring as part of the nationwide Inventory and Monitoring Program of the National Park Service (NPS). The vegetation community vital sign is one of the primary-tier resources identified by SECN park managers, and it is currently conducted on 15 network parks (DeVivo et al. 2008). Monitoring plants and their associated communities over time allows for targeted understanding of ecosystems within the SECN geography, which provides managers information about the degree of change within their parks' natural vegetation.

2019 marks the first year of conducting this monitoring effort on four SECN parks, including Timucuan Ecological and Historic Preserve (TIMU). A total of 23 vegetation plots were established in the park in May and June. Data collected in each plot include species richness across multiple spatial scales, species-specific cover and constancy, species-specific woody stem seedling/sapling counts and adult tree (greater than 10 centimeters [3.9 inches (in)]) diameter at breast height (DBH), overall tree health, landform, soil, observed disturbance, and woody biomass (i.e., fuel load) estimates.

This report summarizes the baseline (year 1) terrestrial vegetation data collected at Timucuan Ecological and Historic Preserve in 2019. Data were stratified across three dominant broadly defined habitats within the park (Coastal Plain Nonalluvial Wetlands, Coastal Plain Open Uplands and Woodlands, and Maritime Upland Forests and Shrublands) and three land parcels (Cedar Point, Theodore Roosevelt, and Thomas Creek). Noteworthy findings include:

- A total of 157 vascular plant taxa (species or lower) were observed across 23 vegetation plots, including nine species not previously known from the park.
- Three plots were located in the footprint of the Yellow Bluff Fire, and were sampled only two weeks following the fire event.
- Muscadine (*Muscadinia rotundifolia*), cat greenbrier (*Smilax glauca*), water oak (*Quercus nigra*), and swamp tupelo (*Nyssa biflora*) were the most frequently encountered species in Coastal Plain Nonalluvial

Wetland habitat; saw palmetto (*Serenoa repens*), slash pine (*Pinus elliottii*), and gallberry (*Ilex glabra*) were the most frequently encountered species in Coastal Plain Open Upland and Woodland habitat; and Darlington oak (*Quercus hemisphaerica*), Spanish moss (*Tillandsia usenoides*), and red bay (*Persea borbonia*) were the most frequently encountered species in Maritime Upland Forests and Shrublands.

- There were no exotic species of the Florida Exotic Pest Plant Council list of invasive plants (FLEPPC 2020) observed on any of these plots.
- Both red bay and swamp bay (*Persea palustris*) were largely absent from the tree stratum in these plots; however, they were present (occasionally in high abundance) in the seedling and sapling strata across all habitat types.
- Buckthorn bully (*Sideroxylon lycioides*)—listed as Endangered in the state of Florida by the Florida Department of Agriculture and Consumer Services (FDACS 2020)—was observed in three Maritime Upland Forest and Shrubland plots.
- The tree strata in each broadly defined habitat were dominated by the following species:
 - Coastal Plain Nonalluvial Wetlands-loblolly bay (*Gordonia lasianthus*)
 - Coastal Plain Open Uplands and Woodlands-longleaf pine (*Pinus palustris*)
 - Maritime Upland Forests and Shrublands-oaks (*Quercus* sp.)
- Most stems within the tree strata exhibited healthy vigor and only moderate dieback across all habitat types. However, there was a large amount of standing dead trees in plots within Maritime Upland Forests and Shrublands.
- Downed woody biomass (fuel loads) were highest in the Cedar Point and Thomas Creek land parcels.

List of Terms

Aspect: The compass direction that a slope faces.

Basal Area (BA): The cross-sectional area of woody stems at DBH; used to describe the amount of area occupied by a single or group of stems. BA is expressed in this report as m²/ha (square meters per hectare).

Coarse Woody Debris (CWD): Downed woody stems on the ground that are either lying prone on the ground, or at least one end of the broken bole of a dead tree is touching the ground at an angle of greater than 45° from vertical. Coarse woody debris includes pieces of wood greater than 8 centimeters (3.1 inch [in]) in diameter (approximately 1,000-hour fuel class).

Constancy: The percentage of plots in a given dataset in which a species occurs.

Cover: The vertical projection of vegetation from the ground as viewed from above, and in this protocol is estimated as a percentage of area that covers the ground above the ground surface (areal cover).

Density: The number of individual woody stems in a given area.

DBH: Diameter at breast height of an individual woody stem, or 1.37 meters (4.5 feet [ft]) above the ground surface.

Duff: An organic fuel layer that lies below the litter layer and above mineral soil. It is made up of litter material that has decomposed to the point where individual pieces are no longer identifiable. In general, the duff layer is darker than the litter layer.

Fine Woody Debris (FWD): Pieces of wood less than 8 centimeters (3.1 in) in diameter. They are either (1) not attached to the woody stem where they once grew and have fallen to the ground, (2) not attached to the stem where they once grew and are supported off the ground by live or dead material, or (3) attached to stems of woody material that are themselves considered 'dead' and 'down.' Fine woody debris is composed of the following fire size classes: 1-hour fuels (0–0.64 centimeters [0–0.2 in]), 10-hour fuels (0.64–2.54 centimeters [0.2–1 in]), and 100-hour fuels (2.54–8.1 centimeters [1–3.2 in]).

Global / State Status: Conservation status assessment ranks developed by NatureServe and individual state Natural Heritage Programs used to determine the extinction risk of species and ecosystems at the global and state scales. Global codes are as follows:

- G1: Critically imperiled-very high risk of extinction
- G2: Imperiled-high risk of extinction
- G3: Vulnerable-moderate risk of extinction
- G4: Apparently Secure-fairly low risk of extinction
- G5: Secure-very low risk of extinction

Growth Form: The shape and physical appearance of a species, reflecting site conditions and genetics. In this report, the following growth forms, following definitions set by USDA (2020), are used:

- Tree: a perennial, woody plant with a single stem (trunk), normally greater than 4–5 meters (13.1–16.4 ft) in height
- Shrub: a perennial, multi-stemmed woody plant that is usually less than 4–5 meters (13.1–16.4 ft) in height
- Vine: a twining or climbing plant with relatively long stems; can be woody or herbaceous
- Herb/Forb: a plant without significant woody tissue and lacking significant thickening by secondary woody growth
- Graminoid: a grass or grass-like plant; includes grasses (Poaceae), sedges (Cyperaceae), and rushes (Juncaceae).

Litter: An organic fuel layer made up of twigs, dead grasses, recently fallen leaves, and pine or other needles where the individual pieces are still identifiable and not altered by decomposition.

Sapling: Any live woody stem more than 1.37 meters (4.5 ft) in height but less than 10 centimeters (3.9 in) in diameter at breast height (DBH).

Seedling: Any live woody stem with at least two true leaves that are less than 1.37 meters (4.5 ft) tall.

Slope: The rise and fall of a land surface.

Species Richness: The overall number of species, or group of species, within a defined area.

Terrain Shape Index (TSI): A quantitative expression of the geometric shape (ranging from concave to convex) of the land surface. Negative TSI values indicate convex shape, positive

values indicate concavity, and values around 0 indicate flat surfaces.

Tree: Any woody stem more than 1.37 meters (4.5 ft) in height and greater than or equal to 10 centimeters (3.9 in) in diameter at breast height (DBH). This term is also used to describe a specific growth form (see Growth Form above).

Introduction

Overview

Vegetation communities are the primary drivers of a range of ecological processes and are integral to the proper function of park ecosystems. Moreover, vegetation communities integrate the biological and physical environment—they serve as the foundation for food webs, provide wildlife habitat for many species, function as a carbon sink, produce oxygen, and cycle nutrients and energy through an ecosystem. Parks within the Southeast Coast Network (SECN) host a diverse assemblage of plants and terrestrial communities. Vegetation communities vary widely across network parks. Approximately 180 vegetation associations (i.e., fine-resolution floristic description), as defined by the National Vegetation and Classification Standard, Version 2.0 (FGDC 2008), occur in SECN park units. A diversity of vegetation resources is found in these parks, including dry grassland dunes, maritime oak and pine dominated forests, pyrogenic pine flatwoods, black and brown water floodplain forests, and Piedmont upland forests.

Vegetation communities are dynamic entities whose species composition, abundance, distribution, and structure are influenced by environmental factors and the impacts over time by natural and anthropogenic disturbances. For communities to be considered ‘natural,’ native species must be predominately distributed across the landscape as a consequence of disturbance factors (i.e., stressors) or site condition (i.e., environmental factors; e.g., soil nutrients, landform; Comer et al. 2003). The timing, type, and extent of a disturbance generally evoke a distinguishable response in vegetation across the landscape (Turner et al. 1990; Foster et al. 1998). Natural disturbance processes in SECN parks include those brought about by fire regimes and weather patterns (e.g., hurricanes and drought), while anthropogenic influences include landscape fragmentation, fire suppression, altered hydrology, shifts in seasonal weather patterns, and non-native species introduction.

Determining trends in vegetation communities over time and identifying plant stressors is vital to understanding the ecological health of terrestrial ecosystems within SECN parks. Collectively, this information can be used to guide management actions that sustain park’s ecological integrity and support plant conservation across a diversity of spatial scales. The Southeast Coast Network collects long-term data on vegetation communities within its parks using a protocol that is largely based on the forest monitoring approaches

used by the Cumberland Piedmont Network and Gulf Coast Network.

This report provides an annual summary of data collected in May and June 2019 at Timucuan Ecological and Historic Preserve (TIMU) as part of the SECN’s terrestrial vegetation monitoring effort. This report is intended to provide TIMU resource managers and partners with (a) baseline information on the composition, abundance, and structure of vegetation across broad habitat types, (b) documentation of observable stressors to park vegetation resources, and (c) a summary of ancillary data associated with terrestrial ecosystems (e.g., soil nutrient status and fuel abundance).

Monitoring Objectives

The overall objective of this effort is: *to detect meaningful changes in species composition and vegetation structure within natural and semi-natural vegetation communities of SECN parks and determine whether these changes are correlated with trends in key stressors.*

The data presented herein are from the first iteration of sampling activities in Timucuan Ecological and Historic Preserve utilizing the recently published SECN terrestrial vegetation monitoring protocol (Boyle et al. 2019). For this ‘baseline’ status report, 2019 data were synthesized to answer the following questions across broad habitat types within the park:

- How does species richness vary across terrestrial vegetation communities?
- What is the status of composition and abundance among native versus non-native, invasive species?
- What are the most common plants encountered during the monitoring effort, and conversely, were there rare species detected?
- In forests, woodlands, and shrublands, what is the relative frequency of woody seedlings, saplings, and subcanopy or canopy species?
- Do observable stressors appear to impact vegetation communities?
- What is the current condition of soil nutrient chemistry and fuel volume?

Methods

Study Area

Timucuan Ecological and Historical Preserve (TIMU) covers approximately 18,600 hectares (46,000 acres [ac]) and is located within the city limits of Jacksonville, Duval County, Florida, between the St. Johns and Nassau Rivers (Figure 1). The two rivers form a vast estuarine system dominated by tidally influenced salt marsh and coastal hammock habitat, with 75% of the Preserve made up of tidal wetlands and open water. The Preserve is composed of multiple landowners—federal, state, city parks, and private—and is the largest cooperative park system within the United States. Total area of Timucuan Ecological and Historic Preserve lands under federal ownership is approximately 3,440 hectares (8,500 ac). The Preserve consists of large areas of salt marsh that vary in degrees of salinity but are generally dominated by smooth cordgrass (*Spartina alterniflora*) and needlegrass rush (*Juncus roemerianus*), some freshwater streams, ponds, and wetlands, and adjacent uplands. The uplands are a mosaic of maritime hammock that contain species such as live oak (*Quercus virginiana*) and cabbage palmetto (*Sabal palmetto*); xeric hammock and coastal scrubs that contain sand live oak (*Quercus geminata*), saw palmetto (*Serenoa repens*), and rusty fetterbush (*Lyonia ferruginea*); and slash pine (*Pinus elliottii*) and restored longleaf pine (*Pinus palustris*) flatwoods.

During the past several decades, the areas adjacent to Timucuan Ecological and Historic Preserve have experienced some of the most rapid growth and development in Florida. While the shared border between the park and other conservation-minded organizations within the Preserve provides opportunities for landscape-scale collaboration, the wildland-urban interface across most of the Preserve has brought in a number of external stressors impacting vegetation and other ecological resources. Land-use change and other external stressors adjacent to the park have altered ecosystem function—hydrology (brought on by dredging on the St. Johns River) and seral dynamics (brought on by fire suppression). Other stressors to vegetation resources include competition from invasive species and effects of contaminants accrued through the St. Johns River. Invasive

plants listed as Category 1 (the ability to alter native plant communities by displacing native species, changing community structure/function, or hybridizing with natives) by the Florida Exotic Plant Pest Plant Council (FLEPPC 2020) that were observed on the park during its most recent floristic survey in 2005 include asparagus fern (*Asparagus aethiopicus*), camphor-tree (*Camphora officinarum*), air potato (*Dioscorea bulbifera*), cat's-claw vine (*Dolichandra unguis-cati*), water-hyacinth (*Eichhornia crassipes*), shrub verbena (*Lantana depressa*), Japanese honeysuckle (*Lonicera japonica*), Japanese climbing fern (*Lygodium japonicum*), and Chinese tallow-tree (*Triadica sebifera*; Zomlefer et al. 2007). Another noted threat to a significant native species within the park is due to the invasion of an exotic insect—the redbay ambrosia beetle (*Xyleborus glabratus*)—which impacts species within the Lauraceae Family, including red bay (*Persea borbonia*) and swamp bay (*Persea palustris*). The insect and its associated fungal pathogen, laurel wilt (*Raffaelea lauricola*), were discovered on the park in 2005; in less than two years the pathogen killed over 92% of red and swamp bay individuals greater than 7.6 centimeters (3 in) in diameter at breast height (DBH; Fraedrich et al. 2008).

Despite these stressors, Timucuan Ecological and Historic Preserve hosts a diverse flora, and plays a crucial role in providing habitat for many rare species, including the state listed shell mound prickly pear (*Opuntia stricta* var. *dillenii*) and hooded pitcherplant (*Sarracenia minor* var. *minor*) and the commercially exploited American royal fern (*Osmunda spectabilis*), cinnamon fern (*Osmundastrum cinnamomeum*), Piedmont azalea (*Rhododendron canescens*), and saw palmetto (Zomlefer et al. 2007; FDACS 2018). Timucuan Ecological and Historic Preserve has 537 known native vascular plant species, subspecies, and varieties according to records accessed through NPSpecies (2020). Zomlefer et al. (2007) recorded 480 vascular plant taxa in their 2005 floristic survey of the park. In a pilot vegetation monitoring effort conducted by the Southeast Coast Network (SECN), 137 taxa were detected across 26 sites within Timucuan Ecological and Historic Preserve (Byrne et al. 2012).

Timucuan Ecological & Historical Preserve Vegetation Sampling Locations

Southeast Coast Network
National Park Service
U.S. Department of the Interior



Figure 1. Location of Timucuan Ecological and Historical Preserve in Duval County, Florida. The map also shows the location of targeted land parcels within the park.

Sampling Design

The Southeast Coast Network monitors vegetation in long-term plots located in natural and semi-natural habitats of targeted parks, including Timucuan Ecological and Historic Preserve. Sample size (i.e., number of plots) is determined by a combination of factors, including (1) priority plots are located in broadly defined habitats that cover more than 30% of the total area of park's natural and semi-natural vegetation (i.e., dominant and co-dominant habitat); (2) the number of priority plots is scaled according to the overall size of dominant/co-dominant mapped polygons, such that the distribution of plots is between 1 and 25 per 100 hectares (247 ac) of these habitat types; (3) the secondary sample target is any broadly defined habitat that cover between 1 and 30% of a park's natural and semi-natural vegetation; (4) each of the secondary sample target habitat types is allotted four plots.

A total of 23 vegetation plots were established and sampled on the Cedar Point, Theodore Roosevelt, and Thomas Creek land parcels of Timucuan Ecological and Historic Preserve from May through June 2019 (Figures 2, 3, and 4). These plots were located in the following broadly defined habitats of the park: Coastal Plain Nonalluvial Wetlands (6 plots), Coastal Plain Open Uplands and Woodlands (7 plots), and Maritime Upland Forests and Shrublands (10 plots). Plot locations were determined using the generalized random-tessellation stratified (GRTS) sampling methodology, which creates a spatially balanced array of sample points across an area of interest while maintaining flexibility in a project's sample size (Stevens and Olsen 2004).

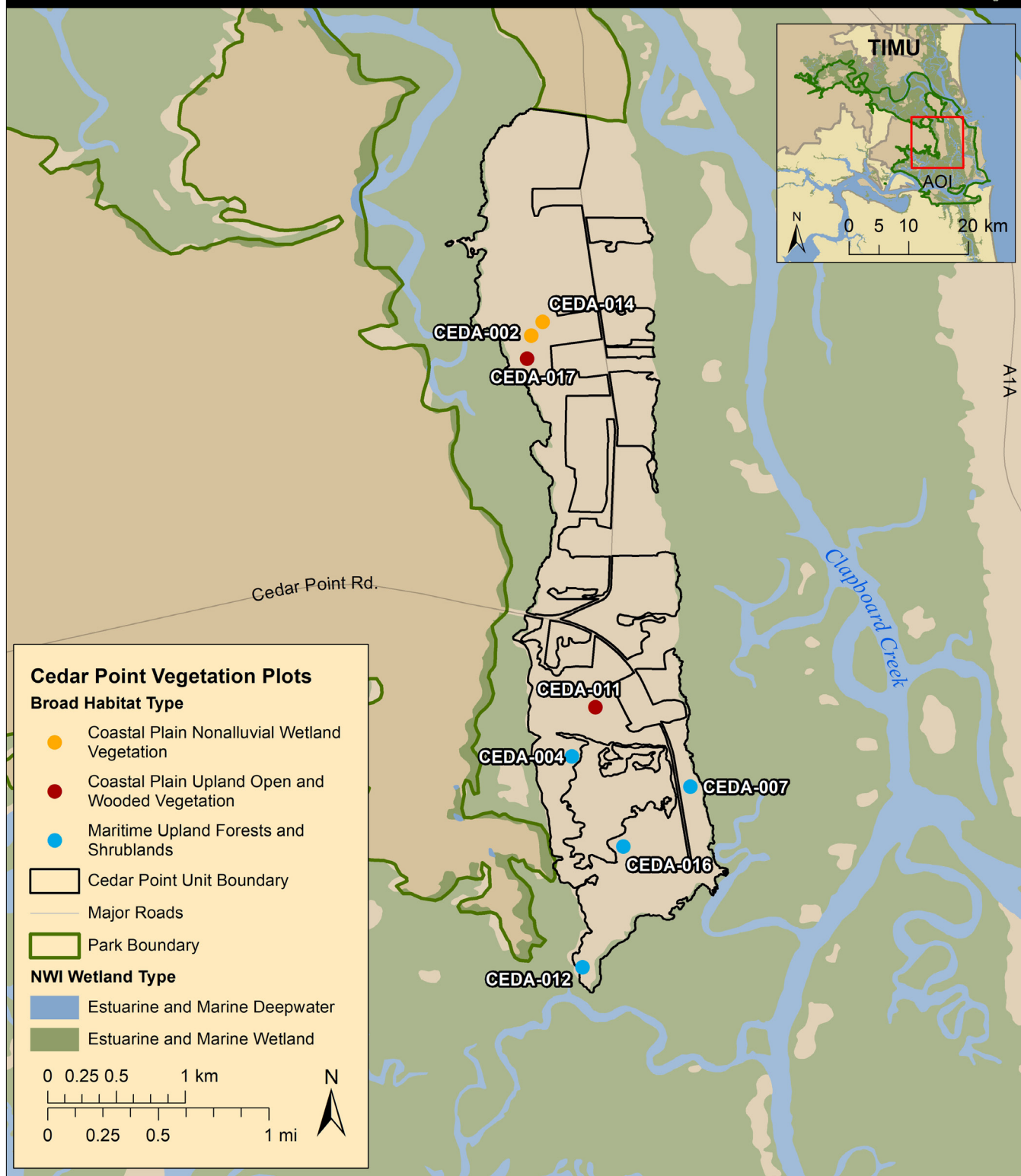


Figure 2. Southeast Coast Network terrestrial vegetation monitoring plot locations within the Cedar Point land parcel of the Timucuan Ecological and Historical Preserve.

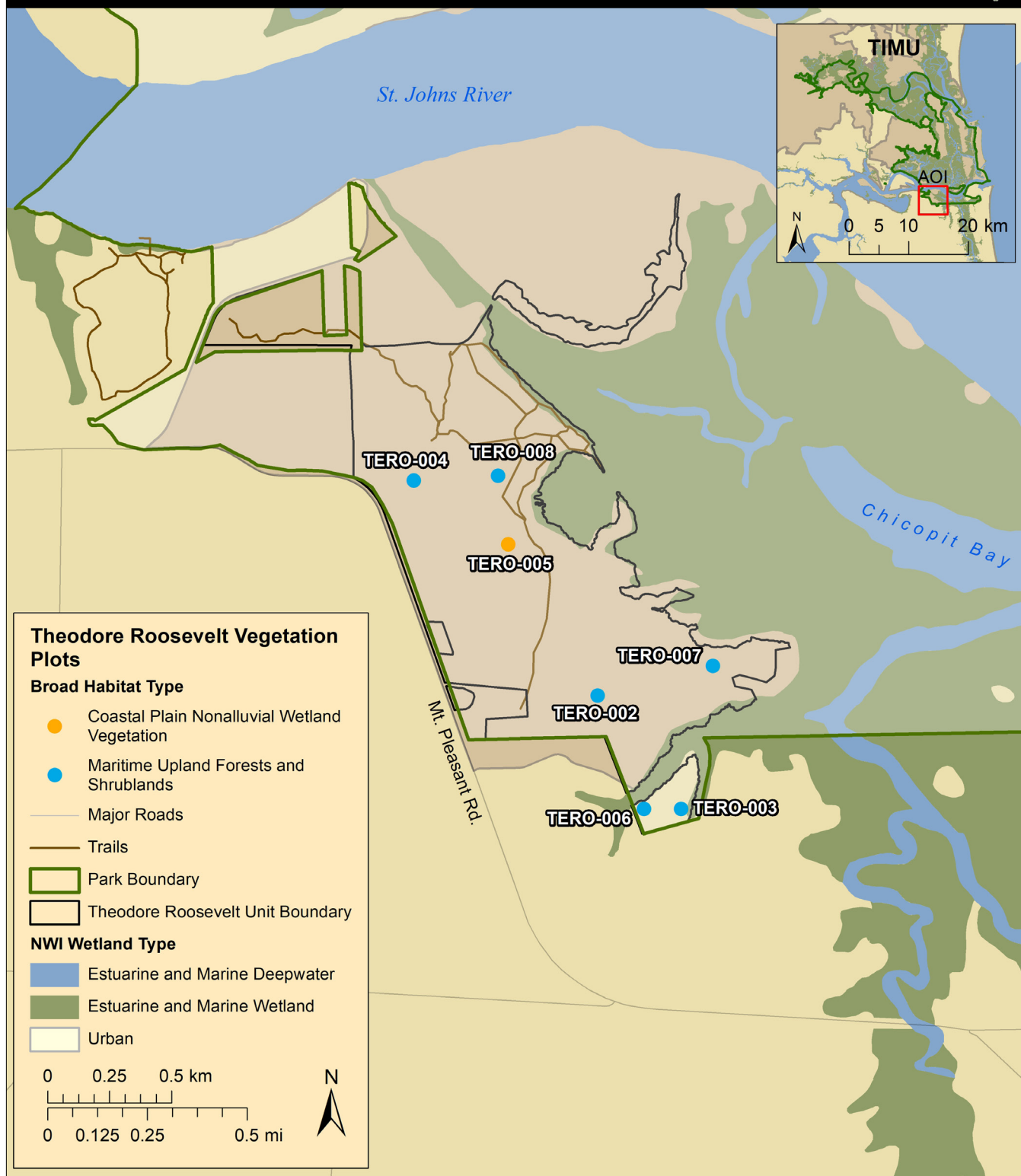


Figure 3. Southeast Coast Network terrestrial vegetation monitoring plot locations within the Theodore Roosevelt land parcel of the Timucuan Ecological and Historical Preserve.



Figure 4. Southeast Coast Network terrestrial vegetation monitoring plot locations within the Thomas Creek land parcel of the Timucuan Ecological and Historical Preserve.

Nomenclature Standard, Growth Form Determination, and Conservation Status

Species nomenclature for this report follows the *Flora of the Southern and Mid-Atlantic States* (Weakley 2019). Every attempt was made to identify all plants to species, variety, or subspecies; when this was not possible, the lowest level of identifiable taxa (e.g., genera, family) was used. Occasionally, a taxonomic concept was created by ‘lumping’ several species of the same genus of known occurrence within a park. For example, both southern red cedar (*Juniperus silicicola*) and eastern red cedar (*J. virginiana*) occur on the park; both species occur in abundance in the natural and semi-natural habitats targeted by this monitoring effort; the species can often be difficult to distinguish based on vegetative features; and, finally, no other species within the genus *Juniperus* are known to occur within the park. A taxonomic concept was created—*Juniperus [silicicola + virginiana]*—that combined the two species into a single concept. This ‘lumped’ taxon is of finer scale taxonomic resolution than if these records had been identified as *Juniperus* sp. Once the final list was determined, each species was cross-referenced with the USDA Plants

Database (USDA 2020) to determine growth form, native status, federal/state noxious status, and to provide a unique common name. When a single taxon linked to multiple growth forms, the lead author subjectively chose a single growth form to link with the taxa. The species list was also cross-referenced with the 575 protected plants in Florida to determine the state and federal conservation status (e.g., Endangered, Threatened, Commercially Exploited) of each species.

Sampling Methodology

The vegetation plot layout for this monitoring effort is based upon the plot design used by the Carolina Vegetation Survey (Peet et al. 1998; Lee et al. 2008) and the Cumberland Piedmont Network (White et al. 2011). The plot array consists of a 20 × 20 meters (65.6 × 65.6 ft) bounded square with multiple nested sampling frames ranging from 1 square meter (10.8 square feet [ft²]) to 400 square meters (4,305.5 ft²), three 25 meters (82.0 ft) fuel transects that cross both inside and outside the bounded square, and three soil sample frames located adjacent to the bounded square (Figure 5).

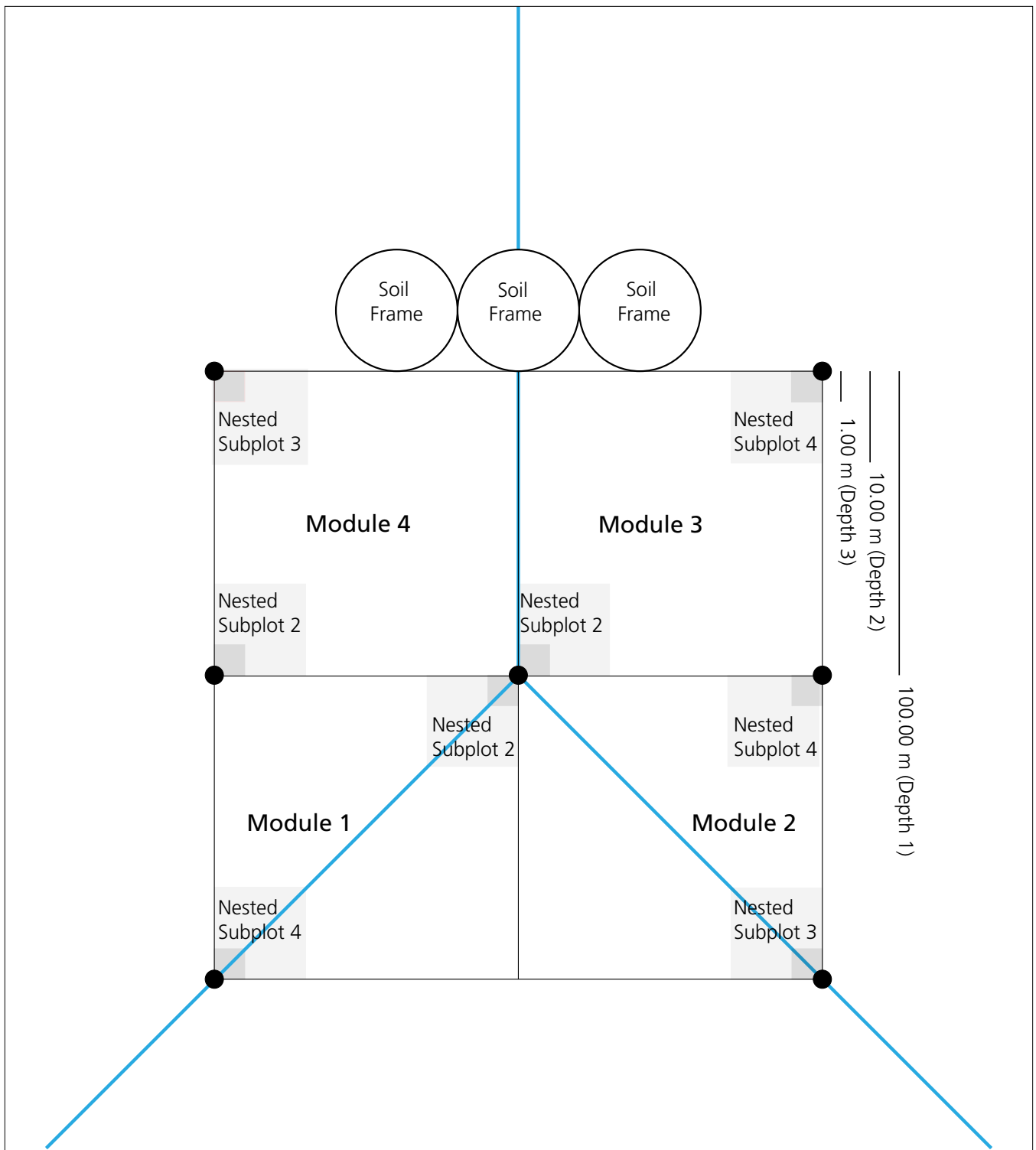


Figure 5. The layout of the sampling plot for the Southeast Coast Network, which is a modified version of the standard Level 5 Carolina Vegetation Survey plot. Ideal location of rebar used as permanent structures to monument the plot are black shaded circles. Blue lines represent location of the 3 25-meter (82-ft) fuel transects.

Vascular plant species presence was determined at three scales within each of the four 100 square meters (1,076.4 ft²) modules: the 1 square meter (10.8 ft²) nested depth, the 10 square meters (107.6 ft²) nested depth, and the full modular depth. The nested depth ‘quadrats’ were located in two of four corners within each module. For each species either rooted in or overhanging a module, an areal cover value was assigned using the cover class codes developed by the Carolina Vegetation Survey (Peet et al. 1998; Table 1).

Table 1. Vascular plant cover metrics of the Carolina Vegetation Survey (Peet et al. 1998) and used by the SECN Terrestrial Vegetation Monitoring protocol.

Cover Class	Cover Range (%)	Geometric Mean
1	0–0.1	0.03
2	0.1–1.0	0.32
3	1.0–2.0	1.41
4	2.0–5.0	3.16
5	5.0–10.0	7.07
6	10.0–25.0	15.81
7	25.0–50.0	35.36
8	50.0–75.0	61.24
9	75.0–95.0	84.41
10	95.0–100.0	97.47

Individual woody stem data were also calculated within each module. For each stem greater than or equal to 10 centimeters (3.9 in; tree) in diameter at 1.4 meters (4.5 ft) linear distance from the ground layer, its species, DBH, and health status was recorded. Within the two 10 square-meter (107.6 ft²) nested depth ‘quadrats’ used for detecting overall species presence (see above), each woody stem that reached 1.4 meters (4.5 ft) in linear distance from the ground layer but was less than 10 centimeters (3.9 in) in diameter at this height (sapling) was identified to species and DBH was determined. Finally, each

woody stem less than 1.4 meters (4.5 ft) in linear distance from the ground layer (seedling) was identified to species and a height class was determined (5–15 centimeters [2–5.9 in]; 15–30 centimeters [5.9–11.8 in]; 30–50 centimeters [11.8–19.7 in]; or 50–137 centimeters [19.7–53.9 in]) within the two 1 square meter (10.8 ft²) nested depth ‘quadrats’ used for detecting overall species presence (see above).

Surface fuels were assessed at each plot site using the planar transect method for the standard fuel size classes (1-hour [0–0.6 cm], 10-hour [0.6–2.5 cm], 100-hour [2.5–7.6 cm], and 1000-hour [> 7.6 cm]), and duff and litter depths (Brown 1974). Counts of each fuel size class were tallied across three fuel transects, with diameter and decay class recorded for each piece of 1000-hour fuel.

Additional site characteristics were also measured at each plot. Elements taken from the center of each plot included dominant slope, aspect, and terrain shape; basic hydrological condition; and presence and abundance of disturbance indicators. General canopy conditions were assessed, including canopy closure and average height. Closure was measured from the center of each module using a spherical densiometer, and height was taken from three representative trees within (or just outside) the plot. Soil samples were collected from the upper 10 centimeters (0.3 ft) of mineral soil in three sampling frames located adjacent to each vegetation plot. These samples were combined by plot upon return from the field and dried prior to shipping to a soil testing laboratory for standard nutrient analysis. Each plot was qualitatively assigned to one or two National Vegetation Classification (NVC) vegetation association types that best matched the sample site. Finally, two-dimensional photo points were taken with a point and shoot camera at the western and eastern center edge of each plot; a third photo point was made from the plot center using a 360-degree camera.

Results and Discussion

A total of 157 vascular plant species were detected during this monitoring effort (Appendix A), including nine species, subspecies, or varieties not detected in previous lists documented in Zomlefer et al. (2007), Byrne et al. (2012), or NPSpecies (2020; Table 2, Figure 6). Native richness ranged from seven to 51 species/plot; exotic plants were not encountered in 21 of the 23 plots and neither of the observed exotic taxa (*Citrus* [*Citrus* sp.]) and Oriental false hawksbeard (*Youngia japonica*) are listed in the Florida Exotic Pest

Plant Council list of invasive plants (FLEPPC 2020). In the southeastern Coastal Plain, small-scale vegetation diversity patterns are largely influenced by complex edaphic factors, those factors' associated relationship with steep environmental gradients (e.g. hydrology and substrate texture), and the variability of timing and impact from disturbance events (e.g., fire; Sorrie and Weakley 2001). What follows is a synopsis of vegetation and environmental data stratified by each of the broadly defined habitats sampled within the park.

Table 2. Vascular plant species, subspecies, or varieties not reported from Zomlefer et al. (2007), Byrne et al. (2012), or NPSpecies (2019) but found at Timucuan Ecological and Historical Preserve in 2019 through this current monitoring effort.

Scientific Name	Common Name ^a	Growth Form ^a	Federal/State Noxious Status ^a	Native Status ^a	Global Rank ^b	State Rank ^b (Florida)
<i>Agarista populifolia</i>	Florida hobblebush	Shrub	–	Native	G4	SNR
<i>Carya cordiformis</i>	bitternut hickory	Tree	–	Native	G5	SNR
<i>Dichanthelium dichotomum</i>	cypress panicgrass	Graminoid	–	Native	G5	SNR
<i>Galium circaeazans</i>	licorice bedstraw	Subshrub, Forb/herb	–	Native	G5	SNR
<i>Ilex coriacea</i>	large gallberry	Tree, Shrub	–	Native	G5	SNR
<i>Smilax walteri</i>	coral greenbrier	Shrub, Vine	–	Native	G5	SNR
<i>Styrax grandifolius</i>	bigleaf snowbell	Tree, Shrub	–	Native	G5	SNR
<i>Tilia americana</i>	American basswood	Tree	–	Native	G5	SNR
<i>Vitis vulpina</i>	frost grape	Vine	–	Native	G5	SNR

^a Information obtained from the PLANTS database (USDA 2020)

^b Conservation Status (G4: Apparently Secure; G5: Secure; SNR: Not Yet Accessed) obtained from NatureServe Explorer 2.0 (NatureServe 2020)



Figure 6. Several species were added to the Timucuan plant list due to this monitoring effort, including Florida hobblebush (*Agarista populifolia*)—a native shrub in the Ericaceae Family observed in several plots on the Theodore Roosevelt land parcel.

Coastal Plain Nonalluvial Wetlands

These wetlands include swamps and small, closed basins hydrologically controlled by rainfall, slope seepage, or groundwater seepage (Figure 7). Timing of standing water on these sites can vary from perennial to seasonal. Unlike alluvial forests, Coastal Plain Nonalluvial Wetlands do not experience flooding from river systems. Vegetation associations sampled in Timucuan Ecological and Historic Preserve that belong to this broadly defined habitat type include (descriptions from NatureServe 2020):

- Loblolly-Bay Swamp Forest (CEGL7044) (4 plots): Forests that occur on peat-filled seepage depressions with infrequent flooding and a highly acidic soil substrate. (Global Status: G4—Apparently Secure; State (FL) Status: No Status Rank)
- South Atlantic Coastal Nonriverine Swamp Forest (CEGL7848) (2 plots): Forests located on small depressions within low oak flats. (Global Status: G2—Imperiled; State (FL) Status: No Status Rank)

This broadly defined habitat was located on all three land parcels (Cedar Point, Theodore Roosevelt, and Thomas Creek) in Timucuan Ecological and Historic Preserve.

Species Diversity and Abundance

Native species richness ranged from 22 to 36 (mean = 30.3), and collectively tree species represented the most diverse growth form across all spatial scales of this broadly defined habitat type (Table 3). There were no non-native species observed in any of the six Coastal Plain Nonalluvial Wetland modules in Timucuan Ecological and Historic Preserve. A complete species list, along with constancy and average cover per species, is located in Appendix B, Table B-1. Species with high constancy in this habitat are listed below, by growth form:

Trees

- Water oak (*Quercus nigra*; 100%)
- Swamp tupelo (*Nyssa biflora*; 100%)
- Swamp bay (83%)
- Sweetbay (*Magnolia virginiana*; 83%)
- Dahoon (*Ilex cassine*; 67%)
- Loblolly bay (*Gordonia lasianthus*; 67%)
- Slash pine (67%)



Figure 7. A total of six nonalluvial wetland sites were sampled during this monitoring effort. These forest ‘swamps’ occurred in closed basins and were typified by some duration (seasonal or perennial) of standing water.

Table 3. Vascular plant species richness across multiple spatial scales on Southeast Coast Network vegetation plots located on Timucuan Ecological and Historic Preserve. The data are summarized by total number of native versus non-native species/plot, and by vegetative growth forms (T: tree, S: shrub, V: vine, H: herbs/forbs, G: graminoids). Growth form information was obtained from the USDA Plants Database (USDA 2020).

Broadly Defined Habitat	Plot	Native ^a	Non-native ^a	Unknown ^a	T ^a	S ^a	V ^a	H ^a	G ^a	T ^b	S ^b	V ^b	H ^b	G ^b	T ^c	S ^c	V ^c	H ^c	G ^c	T ^d	S ^d	V ^d	H ^d	G ^d
Coastal Plain Nonalluvial Wetlands	CEDA002	25.0	0.0	0.0	8.0	6.0	6.0	4.0	1.0	4.8	4.0	3.3	1.3	0.3	1.9	2.0	1.3	0.4	0.0	0.8	0.8	0.5	0.4	0.0
	CEDA014	22.0	0.0	0.0	12.0	6.0	3.0	1.0	0.0	5.0	4.0	1.8	1.0	0.0	1.4	2.5	0.6	0.0	0.0	0.4	1.3	0.4	0.0	0.0
	TERO005	36.0	0.0	0.0	11.0	10.0	8.0	7.0	0.0	6.5	6.3	6.0	2.8	0.0	3.3	3.3	3.8	1.0	0.0	0.8	2.4	1.5	0.5	0.0
	THCR007	31.0	0.0	0.0	11.0	4.0	3.0	7.0	6.0	9.0	2.8	1.3	3.3	3.8	5.4	1.3	0.6	1.0	1.3	2.6	0.9	0.4	0.1	0.4
	THCR008	36.0	0.0	0.0	12.0	5.0	4.0	5.0	10.0	7.8	2.8	2.3	3.3	4.8	3.3	1.0	0.8	1.9	1.0	0.8	0.4	0.5	0.6	0.4
	THCR009	32.0	0.0	0.0	13.0	7.0	5.0	3.0	4.0	7.5	5.0	4.8	2.3	2.5	2.9	2.9	2.4	1.3	1.0	1.4	1.3	1.1	0.3	0.3
	average	30.3	0.0	0.0	11.2	6.3	4.8	4.5	3.5	6.8	4.1	3.2	2.3	1.9	3.0	2.1	1.6	0.9	0.5	1.1	1.1	0.7	0.3	0.2
	standard deviation	5.8	0.0	0.0	1.6	1.9	1.8	2.1	3.6	1.5	1.2	1.7	0.9	1.9	1.3	0.8	1.2	0.6	0.5	0.7	0.6	0.4	0.2	0.2
Coastal Plain Open Uplands	CEDA011	29.0	0.0	0.0	10.0	9.0	3.0	6.0	1.0	5.5	6.3	3.0	3.0	1.0	2.4	2.3	2.3	1.3	0.8	1.0	0.9	1.6	0.4	0.5
	CEDA017	30.0	0.0	0.0	15.0	8.0	4.0	2.0	1.0	9.0	3.8	3.3	0.5	0.3	2.8	2.3	2.3	0.1	0.1	1.4	1.5	1.4	0.0	0.1
	THCR001	7.0	0.0	0.0	3.0	2.0	1.0	1.0	0.0	1.3	1.3	1.0	1.0	0.0	0.3	1.0	0.5	0.5	0.0	0.0	0.5	0.3	0.3	0.0
	THCR002	8.0	0.0	0.0	2.0	2.0	2.0	2.0	0.0	1.3	2.0	1.5	1.5	0.0	0.9	1.4	0.6	1.1	0.0	0.0	0.8	0.1	0.6	0.0
	THCR003	18.0	0.0	0.0	6.0	4.0	5.0	2.0	1.0	3.0	3.0	3.8	1.3	0.3	0.9	1.6	2.4	1.1	0.1	0.3	1.1	0.9	1.0	0.1
	THCR004	22.0	0.0	0.0	7.0	7.0	7.0	1.0	0.0	4.8	4.3	5.5	1.0	0.0	2.1	1.5	3.3	0.5	0.0	0.4	1.3	1.4	0.0	0.0
	THCR005	15.0	0.0	0.0	4.0	3.0	3.0	2.0	3.0	2.5	2.3	2.0	2.0	1.5	1.0	1.4	0.9	1.8	0.5	0.1	0.6	0.4	1.3	0.4
	average	18.4	0.0	0.0	6.7	5.0	3.6	2.3	0.9	3.9	3.3	2.9	1.5	0.4	1.5	1.6	1.7	0.9	0.2	0.4	0.9	0.9	0.5	0.2
	standard deviation	9.2	0.0	0.0	4.5	2.9	2.0	1.7	1.1	2.8	1.7	1.5	0.8	0.6	0.9	0.5	1.1	0.6	0.3	0.5	0.4	0.6	0.5	0.2

^a Total species richness at the full plot (400 square meters [4,305.6 ft²]) depth

^b Mean species richness at the modular (100 square meters [1,076.3 ft²]) depth

^c Mean species richness at the nested 10 square meters (107.6 ft²) depth

^d Mean species richness at the nested 1 square meter (10.8 ft²) depth

Table 3 (continued). Vascular plant species richness across multiple spatial scales on Southeast Coast Network vegetation plots located on Timucuan Ecological and Historic Preserve. The data are summarized by total number of native versus non-native species/plot, and by vegetative growth forms (T: tree, S: shrub, V: vine, H: herbs/forbs, G: graminoids). Growth form information was obtained from the USDA Plants Database (USDA 2020).

Broadly Defined Habitat	Plot	Native ^a	Non-native ^a	Unknown ^a	T ^a	S ^a	V ^a	H ^a	G ^a	T ^b	S ^b	V ^b	H ^b	G ^b	T ^c	S ^c	V ^c	H ^c	G ^c	T ^d	S ^d	V ^d	H ^d	G ^d
Maritime Upland Forests and Shrublands	CEDA004	28.0	0.0	0.0	13.0	4.0	5.0	4.0	2.0	6.8	3.5	4.3	2.8	0.5	2.6	2.1	2.1	1.4	0.0	1.1	1.0	1.4	0.6	0.0
	CEDA007	44.0	0.0	1.0	16.0	5.0	11.0	11.0	2.0	9.3	3.0	6.3	7.3	0.5	4.3	1.4	2.8	3.1	0.3	2.1	0.6	1.3	1.8	0.3
	CEDA012	41.0	0.0	1.0	12.0	3.0	11.0	13.0	3.0	7.3	2.0	6.3	6.3	1.5	3.4	0.8	3.6	2.9	0.8	1.4	0.5	1.6	1.8	0.4
	CEDA016	25.0	0.0	0.0	10.0	8.0	5.0	1.0	1.0	6.8	4.8	3.8	1.0	0.3	3.8	2.6	3.0	0.5	0.0	1.9	1.0	2.0	0.3	0.0
	TERO002	36.0	0.0	0.0	14.0	9.0	8.0	5.0	0.0	8.5	6.3	5.0	4.0	0.0	3.1	3.3	2.6	2.3	0.0	1.0	2.5	1.9	1.9	0.0
	TERO003	51.0	1.0	0.0	19.0	10.0	10.0	8.0	5.0	14.0	6.5	8.0	4.8	3.5	7.0	2.5	4.6	2.9	1.9	3.3	0.6	2.3	1.6	0.9
	TERO004	20.0	0.0	0.0	8.0	6.0	4.0	2.0	0.0	6.5	3.8	3.0	1.8	0.0	4.9	3.3	1.9	1.1	0.0	3.4	1.9	1.0	0.5	0.0
	TERO006	43.0	0.0	0.0	16.0	8.0	10.0	6.0	3.0	12.0	4.3	7.3	4.8	1.8	6.5	2.3	4.8	2.9	0.8	2.6	0.8	2.0	1.5	0.3
	TERO007	33.0	1.0	0.0	11.0	5.0	8.0	10.0	0.0	7.5	3.5	5.3	5.0	0.0	4.1	1.5	3.3	2.1	0.0	1.9	1.0	1.9	0.8	0.0
	TERO008	41.0	0.0	0.0	15.0	7.0	9.0	7.0	3.0	10.3	4.3	5.0	3.8	1.3	6.1	2.4	2.8	2.3	0.5	3.5	1.0	1.3	1.6	0.3
	average	36.2	0.2	0.2	13.4	6.5	8.1	6.7	1.9	8.9	4.2	5.4	4.1	0.9	4.6	2.2	3.1	2.1	0.4	2.2	1.1	1.7	1.2	0.2
	standard deviation	9.6	0.4	0.4	3.3	2.3	2.6	3.9	1.7	2.5	1.4	1.6	1.9	1.1	1.5	0.8	1.0	0.9	0.6	0.9	0.6	0.4	0.6	0.3

^a Total species richness at the full plot (400 square meters [4,305.6 ft²]) depth

^b Mean species richness at the modular (100 square meters [1,076.3 ft²]) depth

^c Mean species richness at the nested 10 square meters (107.6 ft²) depth

^d Mean species richness at the nested 1 square meter (10.8 ft²) depth

Shrubs

- Saw palmetto (83%)
- Black highbush blueberry (*Vaccinium fuscatum*; 83%)
- Shining fetterbush (*Lyonia lucida*; 67%)
- Little gallberry (*Ilex glabra*; 67%)
- Wax myrtle (*Morella cerifera*; 67%)

Vines

- Muscadine (*Muscadinia rotundifolia*; 100%)
- Whiteleaf greenbriar (*Smilax glauca*; 100%)

Herbs/Forbs/Graminoids

- Cinnamon fern (83%)
- Spanish moss (*Tillandsia usneoides*; 83%)

All vascular plant species observed in these plots are common throughout Florida. It should be noted that both saw palmetto and cinnamon fern are listed as commercially exploited within the state by the Florida Department of Agriculture and Consumer Services (FDACS 2020). Although these species are common, they currently face the threat of removal in significant numbers from their native habitat in order to be sold on the commercial market.

Woody Stem Metrics

Total basal area (BA) of live woody stems ≥ 10 cm DBH (trees) ranged from 15 to 39 m²/ha (161.5 to 419.8 ft²/ha) in Coastal Plain Nonalluvial Wetland plots, and the overall average was higher in this type compared to the other two broadly defined habitats (28 m²/ha [301.4 ft²/ha; Table 4). Stem density within the tree stratum was also highest in this habitat type, and ranged from seven to 71 stems per plot, with an average of 31.2 (Table 4). Dominant species within the tree strata included loblolly bay (mean BA = 8.21 m²/ha [88.4 ft²/ha], mean density = 363/ha) and slash pine (mean BA = 6.63 m²/ha [71.4 ft²/ha],

mean density = 71/ha; Appendix B, Table B-2). Canopy cover within these sites ranged from 77 to 87%, and canopy height ranged from 19 to 26 meters (62.3 to 85.3 ft; Table 4). Sapling density ranged from 52 to 173 stems/80 m², with an average of 99.3; this was the highest value among broadly defined habitat types (Table 4). Seedling density ranged from 35 to 87 stems/8 m², with an average of 50.8 across all plots (Table 4). Dominant sapling and seedling species included saw palmetto, loblolly bay, water oak, shining fetterbush, swamp bay, and little gallberry (Appendix B, Table B-2).

Table 4. Woody stem abundance and canopy metrics on Southeast Coast Network vegetation plots located on Timucuan Ecological and Historic Preserve [m—meters; ha—hectares].

Broadly Defined Habitat	Plot	Tree Basal Area (m ² /ha)	Tree Density (400 m ²)	Sapling Basal Area (m ² /ha)	Sapling Density (80 m ²)	Seedling Density (8 m ²)	Mean Canopy Cover (%)	Mean Height (m)
Coastal Plain Nonalluvial Wetlands	CEDA002	37.0	71.0	3.0	94.0	35.0	85.0	21.0
	CEDA014	39.0	36.0	5.0	109.0	43.0	79.0	22.0
	TERO005	26.0	7.0	3.0	173.0	87.0	87.0	21.0
	THCR007	33.0	23.0	3.0	52.0	52.0	78.0	26.0
	THCR008	15.0	23.0	3.0	95.0	39.0	77.0	19.0
	THCR009	19.0	27.0	3.0	73.0	49.0	81.0	21.0
	average	28.0	31.2	3.2	99.3	50.8	81.1	21.7
	standard deviation	9.8	21.7	0.8	41.2	18.8	3.9	2.6
Coastal Plain Open Uplands	CEDA011	28.0	36.0	2.0	28.0	60.0	83.0	21.0
	CEDA017	21.0	36.0	4.0	75.0	42.0	80.0	21.0
	THCR001	21.0	11.0	0.0	0.0	6.0	44.0	27.0
	THCR002	19.0	18.0	0.0	0.0	0.0	53.0	18.0
	THCR003	13.0	33.0	4.0	440.0	59.0	53.0	16.0
	THCR004	19.0	24.0	3.0	128.0	64.0	81.0	17.0
	THCR005	13.0	19.0	0.0	2.0	28.0	38.0	19.0
	average	19.1	25.3	1.9	96.1	37.0	61.8	19.7
	standard deviation	5.2	9.9	1.7	159.0	26.4	19.0	3.6
Maritime Upland Forests and Shrublands	CEDA004	24.0	18.0	2.0	49.0	55.0	81.0	18.0
	CEDA007	28.0	16.0	1.0	41.0	69.0	89.0	27.0
	CEDA012	53.0	20.0	2.0	42.0	63.0	76.0	25.0
	CEDA016	7.0	15.0	8.0	121.0	70.0	91.0	16.0
	TERO002	22.0	17.0	1.0	78.0	80.0	89.0	25.0
	TERO003	17.0	16.0	5.0	93.0	130.0	88.0	24.0
	TERO004	3.0	8.0	10.0	131.0	227.0	67.0	9.0
	TERO006	13.0	12.0	4.0	105.0	111.0	87.0	19.0
	TERO007	10.0	4.0	6.0	108.0	149.0	91.0	28.0
	TERO008	50.0	23.0	4.0	73.0	94.0	82.0	19.0
	average	22.6	14.9	4.3	84.1	104.8	84.1	20.9
	standard deviation	17.3	5.6	3.0	32.8	52.7	7.9	5.8

Based on stem count alone, loblolly bay comprised 47% of the tree strata, while oaks (e.g., water, live, laurel (*Quercus laurifolia*), and Darlington (*Quercus hemisphaerica*), swamp tupelo, and pines (e.g., slash and pond [*Pinus serotina*]), comprised 20%, 15%, and 11%, respectively (Figure 8). Woody shrubs dominated the sapling and seedling strata (31% and

52%, respectively; Figure 8). It should be noted that swamp and red bay were not found in the canopy of any TIMU Coastal Plain Nonalluvial Wetland plots. However, these species did make up 6% of the sapling and 17% of the seedling count (Figure 8).

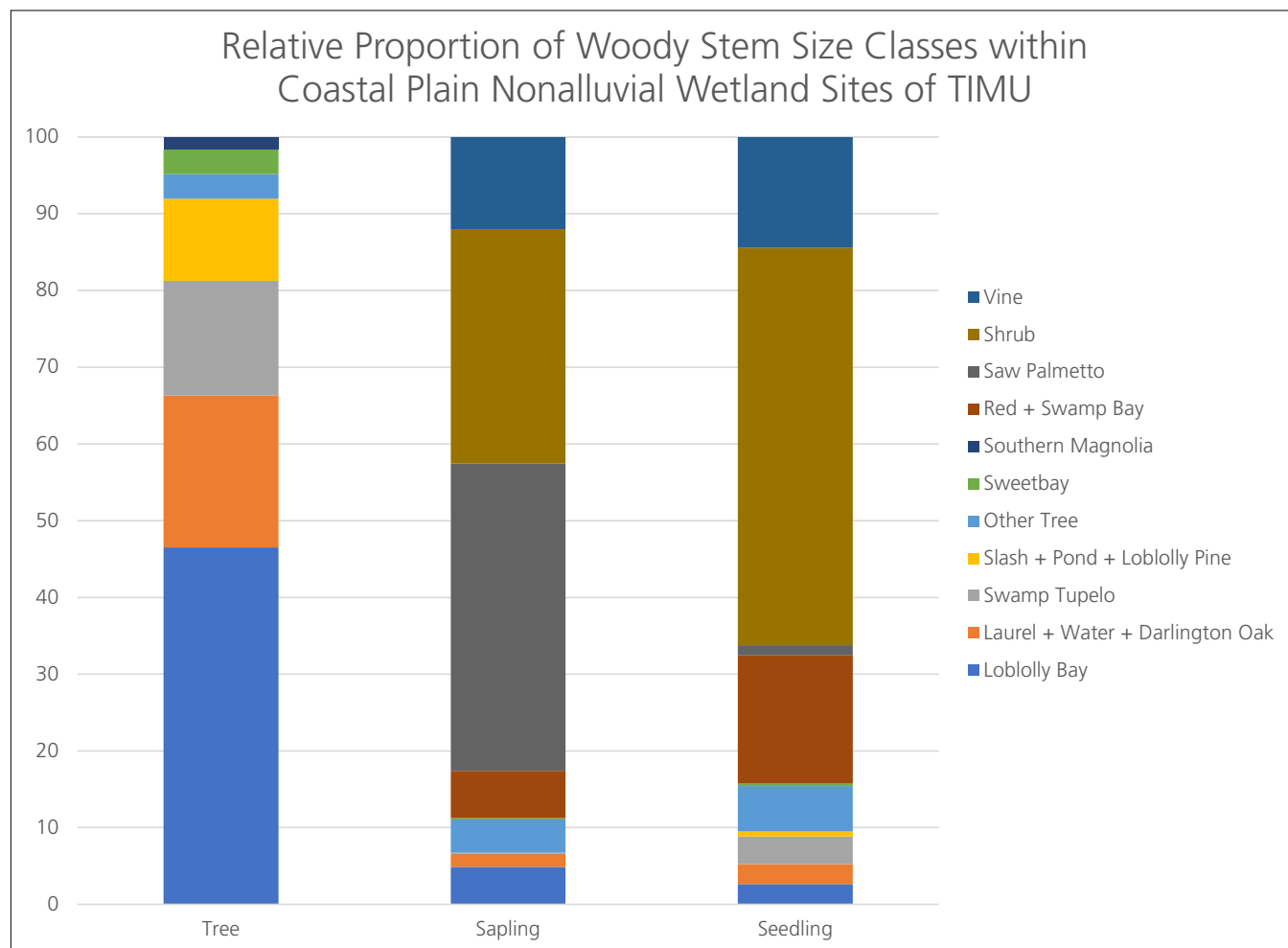


Figure 8. Relative proportion of species groups across three woody stem strata—trees, saplings, and seedlings—within Coastal Plain Nonalluvial Wetland vegetation monitoring plots of Timucuan Ecological and Historic Preserve.

Of the 198 woody stems larger than 10 centimeters (3.9 in) DBH that were measured in these six plots, 11 were found to be dead (6%; Figure 9), most of which were loblolly bay. Most

trees were either co-dominant or occupied intermediate space within the canopy crown (Figure 9). Overall tree vigor and crown dieback are also illustrated in Figure 9.

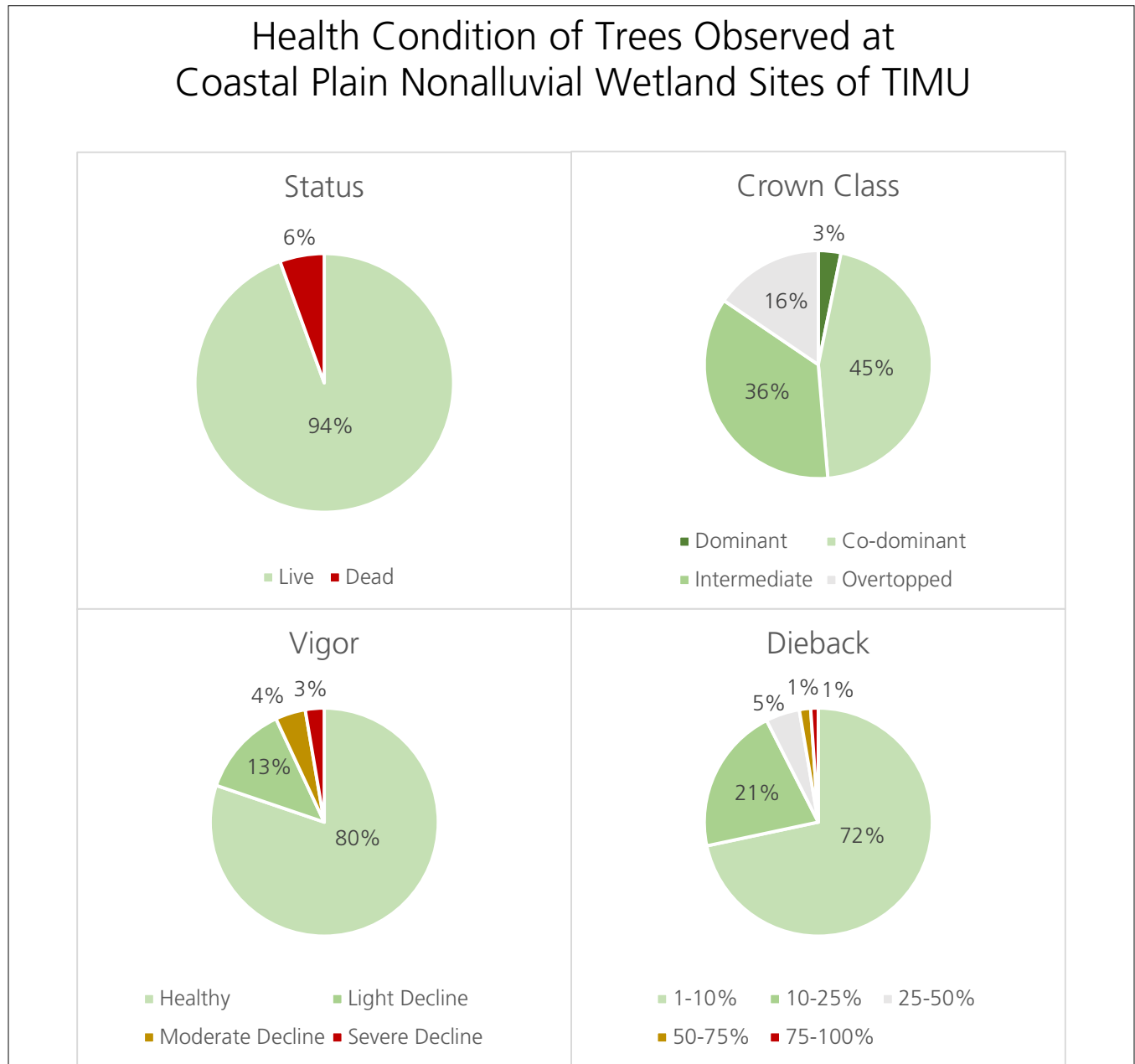


Figure 9. Health status of woody stems greater than or equal to 10 centimeters (3.9 in) DBH (trees) measured on Coastal Plain Nonalluvial Wetland vegetation monitoring plots of Timucuan Ecological and Historic Preserve.

Disturbance and Threats

There were relatively few observed current or historical disturbances on these plots. By far the most common disturbance was windthrow, which was observed on three of the six plots (Table 5). Prevalence of red and swamp bay stems

that either were succumbing (stem status = live) or had recently succumbed (stem status = dead) to laurel wilt disease were low to nonexistent because these trees had probably fallen over within the past 15 years since the redbay ambrosia beetle was observed on the park (see Study Area).

Table 5. Disturbance observations and abundance (% cover) measured on vegetation monitoring plots of Timucuan Ecological and Historic Preserve.

Broadly Defined Habitat	Plot	Feral Hog Damage	Historic Fire (> 1 year)	Logging	Plowing	Recent Fire (< 1 year)	Windthrow
Coastal Plain Nonalluvial Wetlands	CEDA002	10	–	100	–	–	–
	CEDA014	–	–	–	100	–	–
	TERO005	–	–	–	–	–	30
	THCR007	–	–	–	–	–	30
	THCR008	–	–	–	–	–	40
	THCR009	–	–	–	–	–	–
Coastal Plain Open Uplands	CEDA011	10	–	–	100	–	–
	CEDA017	–	–	–	100	–	–
	THCR001	–	–	–	–	100	–
	THCR002	–	–	–	100	100	–
	THCR003	–	–	–	–	–	–
	THCR004	–	–	–	–	–	–
	THCR005	–	–	–	–	100	–
Maritime Upland Forests and Shrublands	CEDA004	–	–	–	–	–	–
	CEDA007	–	–	–	–	–	–
	CEDA012	–	20	–	–	–	30
	CEDA016	–	100	–	–	–	–
	TERO002	–	–	–	–	–	10
	TERO003	–	–	–	–	–	20
	TERO004	–	–	–	–	–	–
	TERO006	–	10	–	–	–	80
	TERO007	–	–	–	–	–	20
	TERO008	–	–	–	–	–	–

Geomorphology and Soil

Plots located within Coastal Plain Nonalluvial Wetlands in Timucuan Ecological and Historic Preserve occurred on flat or very minor ($< 3.6^\circ$) sloping landforms, with straight to concave shapes (terrain shape indices ≥ 0 ; Table 6). Standing water was not observed on any of these sites, although flooding and/or inundation is probably common at other times during

the year. Soils within these sites were acidic, with pH values ranging from 3.2 to 4.3 (mean = 3.6; Table 7). Organic matter (OM) content within soil samples ranged from four to 73%, with an average value of 25%—the highest OM concentration observed of any broadly defined habitat sampled on the park (Table 7).

Table 6. Local landform and hydrologic condition from vegetation monitoring plots of Timucuan Ecological and Historic Preserve.

Broadly Defined Habitat	Plot	Slope ($^\circ$)	Aspect ($^\circ$)	TSI ^a ($^\circ$)	Landform Type	Submerged (%)
Coastal Plain Nonalluvial Wetlands	CEDA002	1.5	0	1.250	alluvial plain	0
	CEDA014	0.0	–	0.000	flat plain	0
	TERO005	3.5	304	0.250	alluvial plain	0
	THCR007	1.5	0	1.125	basin/sag pond	0
	THCR008	0.0	–	0.000	flat plain	0
	THCR009	0.0	–	0.000	flat plain	0
Coastal Plain Open Uplands	CEDA011	0.0	–	0.000	flat plain	0
	CEDA017	0.0	–	0.000	flat plain	0
	THCR001	0.0	–	0.000	flat plain	0
	THCR002	0.0	–	0.000	flat plain	0
	THCR003	0.0	–	0.000	flat plain	0
	THCR004	0.0	–	0.000	flat plain	0
	THCR005	0.0	–	0.000	flat plain	0
Maritime Upland Forests and Shrublands	CEDA004	0.0	–	0.000	flat plain	0
	CEDA007	2.0	90	-1.250	side slope	0
	CEDA012	0.0	–	0.000	levee	0
	CEDA016	0.0	–	0.000	flat plain	0
	TERO002	4.0	30	0.375	side slope	0
	TERO003	5.5	90	0.625	side slope	0
	TERO004	8.0	180	-1.500	interfluv	0
	TERO006	2.5	0	0.375	side slope	0
	TERO007	1.5	310	0.375	side slope	0
	TERO008	2.5	180	1.250	side slope	0

^a Terrain Shape Index: the larger the value, the higher degree of microsite concavity; the lower the value, the higher degree of microsite convexity; "0" values indicate a completely flat shape.

Table 7. Soil nutrient status from vegetation monitoring plots of Timucuan Ecological and Historic Preserve. The Mehlich III method was used to obtain volume of exchangeable cations and extractable minor elements within soil samples. Methods to obtain other soil chemistry metrics (e.g., total exchange capacity [TEC], pH, and organic matter content [OM]) can be found on the [Brookside Laboratories, Inc website](#) (BL 2021).

Broadly Defined Habitat	Plot	TEC (ME/100g)	pH H ₂ O 1:1	OM (%)	P ^a	Ca ^a	Mg ^a	K ^a	Na ^a	B ^a	Fe ^a	Mn ^a	Cu ^a	Zn ^a	Al ^a
Coastal Plain Nonalluvial Wetlands	CEDA002	20.94	3.20	73.26	21.00	231.00	210.00	45.00	76.00	< 0.20	28.00	< 1	0.90	1.16	592.00
	CEDA014	10.34	3.30	15.71	8.00	72.00	94.00	41.00	122.00	0.34	37.00	< 1	0.61	0.81	230.00
	TERO005	10.55	3.70	38.21	12.00	207.00	85.00	34.00	113.00	< 0.20	36.00	< 1	0.61	0.67	76.00
	THCR007	5.71	4.30	4.00	20.00	103.00	67.00	21.00	164.00	0.29	63.00	< 1	0.76	< 0.40	543.00
	THCR008	22.31	3.30	11.34	38.00	165.00	103.00	40.00	472.00	0.36	140.00	< 1	0.55	0.70	661.00
	THCR009	3.63	3.90	5.29	10.00	85.00	34.00	22.00	28.00	< 0.20	69.00	< 1	0.54	0.62	311.00
	average	12.25	3.62	24.64	18.17	143.83	98.83	33.83	162.50	–	62.17	–	0.66	0.79	402.17
	standard deviation	7.75	0.43	26.85	11.07	66.82	59.68	10.19	158.40	–	41.45	–	0.14	0.22	231.17
Coastal Plain Open Uplands	CEDA011	2.66	4.40	3.21	4.00	106.00	31.00	16.00	20.00	0.23	13.00	< 1	0.66	0.59	48.00
	CEDA017	8.95	3.70	9.03	10.00	250.00	58.00	36.00	33.00	< 0.20	49.00	1	0.67	0.65	172.00
	THCR001	11.32	4.00	10.92	26.00	308.00	119.00	56.00	51.00	0.33	52.00	1	0.47	0.82	174.00
	THCR002	5.81	4.20	3.94	14.00	111.00	74.00	31.00	113.00	0.28	96.00	< 1	0.39	< 0.40	197.00
	THCR003	6.12	3.80	10.09	4.00	168.00	49.00	19.00	28.00	< 0.20	20.00	< 1	0.49	0.50	97.00
	THCR004	4.57	3.70	4.24	10.00	116.00	36.00	15.00	20.00	< 0.20	62.00	< 1	0.63	0.62	217.00
	THCR005	4.83	4.00	3.91	14.00	73.00	42.00	1.003	112.00	0.29	92.00	< 1	0.65	< 0.40	284.00
	average	6.32	3.97	6.48	11.71	161.71	58.43	26.57	53.86	–	54.86	–	0.57	0.64	169.86
	standard deviation	2.91	0.26	3.37	7.52	86.48	30.35	15.61	41.40	–	31.97	–	0.11	0.12	77.64
Maritime Upland Forests and Shrublands	CEDA004	6.05	3.90	6.64	8.00	167.00	55.00	26.00	27.00	< 0.20	27.00	1	0.68	0.77	73.00
	CEDA007	23.56	7.10	8.29	40.00	4087.00	212.00	39.00	57.00	1.59	38.00	26	0.90	5.15	134.00
	CEDA012	11.00	7.10	6.64	26.00	1853.00	123.00	37.00	33.00	0.64	50.00	26	0.73	2.12	214.00
	CEDA016	6.86	3.80	10.59	6.00	184.00	52.00	35.00	34.00	< 0.20	14.00	1	0.61	1.30	52.00
	TERO002	2.78	4.30	5.47	18.00	93.00	31.00	31.00	21.00	< 0.20	28.00	< 1	0.40	0.58	175.00
	TERO003	2.75	5.10	5.35	38.00	197.00	32.00	22.00	21.00	0.27	93.00	5	0.71	0.77	547.00
	TERO004	3.06	4.00	2.31	6.00	89.00	26.00	14.00	20.00	0.30	15.00	< 1	0.46	0.69	35.00
	TERO006	2.63	4.20	2.02	21.00	91.00	26.00	13.00	19.00	< 0.20	45.00	< 1	0.74	0.46	119.00
	TERO007	7.67	6.20	3.54	47.00	1053.00	111.00	25.00	22.00	0.56	41.00	74	1.04	1.67	386.00
	TERO008	3.37	4.10	2.95	7.00	95.00	34.00	19.00	30	< 0.20	12.00	1	0.65	1.44	23.00
	average	6.97	4.98	5.38	21.70	790.90	70.20	26.10	28.40	–	36.30	–	0.69	1.50	175.80
	standard deviation	6.46	1.33	2.76	15.53	1296.37	60.86	9.28	11.47	–	24.04	–	0.19	1.39	169.14

^a Anions (P: Phosphorous); Exchangeable Cations (Ca: Calcium, Mg: Magnesium, K: Potassium, Na: Sodium); Extractable Minors (B: Boron, Fe: Iron, Mn: Manganese, Cu: Copper, Zn: Zinc, Al: Aluminum). Data reported in parts per million (ppm).

Coastal Plain Open Uplands and Woodlands

This broad category includes open-spaced forests and savannas occurring on low, flat topography (hence the common local name ‘flatwoods’) and on dry (xeric) to mesic, and occasionally wet (hydric) soils (Figure 10). They are typically maintained by a combination of frequent fire and water availability—which can vary widely among sites depending on soil texture, microtopography, and seasonal precipitation. Soils are typically imperfectly to poorly drained and are usually acidic. Vegetation associations sampled in Timucuan Ecological and Historic Preserve that belong to this broadly defined habitat type include (descriptions from NatureServe 2020):

- Slash Pine Flatwoods (CEGL3643) (2 plots): Flatwoods occurring on poorly to very poorly drained sandy or silty loams, dominated by slash pine in an open canopy, with a dense shrub stratum of gallberry and saw palmetto. (Global Status: G4—Apparently Secure; State (FL) Status: No Status Rank)

- Maritime Slash Pine – Longleaf Pine Upland Flatwoods (CEGL4658) (1 plot): Maritime-influenced upland woodlands on stabilized dunes of barrier islands and near-coastal mainland areas. (Global Status: G2—Imperiled; State (FL) Status: No Status Rank)
- Successional Slash Pine Managed Forest (CEGL7171) (3 plots): Current or former managed slash pine plantations, occurring on former longleaf pine sites. (Global Status: No Status Rank; State (FL) Status: No Status Rank)
- Longleaf / Slash Pine Scrubby Flatwoods (CEGL7714) (1 plot): Open canopy woodlands dominated by either longleaf or slash pine, occurring over a typically shrub-dominated understory of sand live oak or myrtle oak (*Quercus myrtifolia*). (Global Status: G3—Vulnerable; State (FL) Status: No Status Rank)

This broadly defined habitat was a dominant or co-dominant component of the Cedar Point and Thomas Creek land parcels in Timucuan Ecological and Historic Preserve.



Figure 10. A total of seven open uplands and woodlands were sampled during this monitoring effort. These pine-dominated woodlands occurred on flat topography (~ flatwoods) across a broad soil moisture gradient (xeric to hydric). Fire is a primary driver within these habitats, and species diversity is reduced by longer return intervals between burn events. The image on the left has not been burned in over 10 years, while the image on the right was burned during the 2019 vegetation monitoring season, as part of the Yellow Bluff Wildfire.

Species Diversity and Abundance

Native species richness ranged from seven to 30 (mean = 18.4) within vegetation plots of this broadly defined habitat type (Table 3). Species richness was lowest in plots located within the footprint of the Yellow Bluff Fire—a wildfire event which was mostly confined to the east side of I-95 on the Thomas Creek land parcel in Timucuan Ecological and Historic Preserve and burned from May 22–June 3, 2020. These vegetation plots were sampled within three weeks of the fire being officially declared 100% contained. There were no non-native species observed in any of the seven Coastal Plain Open Upland and Woodland modules in Timucuan Ecological and Historic Preserve. For all plots within this broadly defined habitat type, species with high constancy are listed below by growth form (Appendix B, Table B-1):

Trees

- Slash pine (100%)
- Water oak (71%)

Shrubs

- Saw palmetto (100%)
- Little gallberry (100%)

Vines

- Elliott’s milkpea (*Galactia elliotii*; 86%)
- Whiteleaf greenbriar (71%)
- Dune greenbriar (*Smilax auriculata*; 71%)

Herbs/Forbs/Graminoids

- Bracken (*Pteridium latiusculum*; 71%)

All vascular plant species observed in these plots are common throughout Florida. It should be noted that both saw palmetto and cinnamon fern are listed as commercially exploited within the state by the Florida Department of Agriculture and Consumer Services (FDACS 2020). Although these species

are common, they currently face the threat of removal in significant numbers from their native habitat in order to be sold on the commercial market.

Woody Stem Metrics

Total BA of canopy stems ranged from 13 to 28 m²/ha (140 to 301.4 ft²/ha) in Coastal Plain Open Upland and Woodland plots, and the overall average was lowest in this type compared to the other two broadly defined habitats (19.1 m²/ha [205.6 ft²/ha]; Table 4). Density of canopy stems ranged from 11 to 36 per plot, with an average of 25.3 (Table 4). Dominant canopy species included slash pine (mean BA = 13.8 m²/ha [148.5 ft²/ha], mean density = 336/ha), longleaf pine (mean BA = 1.53 m²/ha [16.5 ft²/ha], mean density = 104/ha), and water oak (mean BA = 1.28 m²/ha [13.8 ft²/ha], mean density = 89/ha; Appendix B, Table B-2). Canopy cover within these sites ranged from 38 to 83%, and canopy height ranged from 16 to 27 meters (52.5 to 88.6 ft; Table 4). Sapling density at the 80 m² (861.1 ft²) scale ranged from 0 to 440 stems, with an average of 96.1, while seedling density at the 8 m² (86.1 ft²) scale ranged from 0 to 64 stems, with an average of 37.0 across all plots (Table 4). Dominant sapling species included little gallberry, rusty fetterbush, and slash and longleaf pine; dominant seedlings included little gallberry, whiteleaf greenbriar, live oak, swamp bay, and saw palmetto (Appendix B, Table B-2). Low sapling and seedling counts were encountered in plots located within the footprint of the Yellow Bluff Fire.

Based on stem count, slash and pond pine comprised 54% of the tree strata, while oaks (live, water, and Darlington) comprised 22%; woody shrubs dominated the sapling and seedling strata (62% and 57%, respectively; Figure 11). It should be noted that living swamp and red bay were found in low abundance within the canopy of TIMU Coastal Plain Open Upland and Woodland plots. However, these species did make up 1% of the sapling and 7% of the seedling count (Figure 11). Although longleaf pine was observed in the tree and sapling strata of these sites, there were no longleaf pine (or any pine species) encountered in the seedling strata (Figure 11).

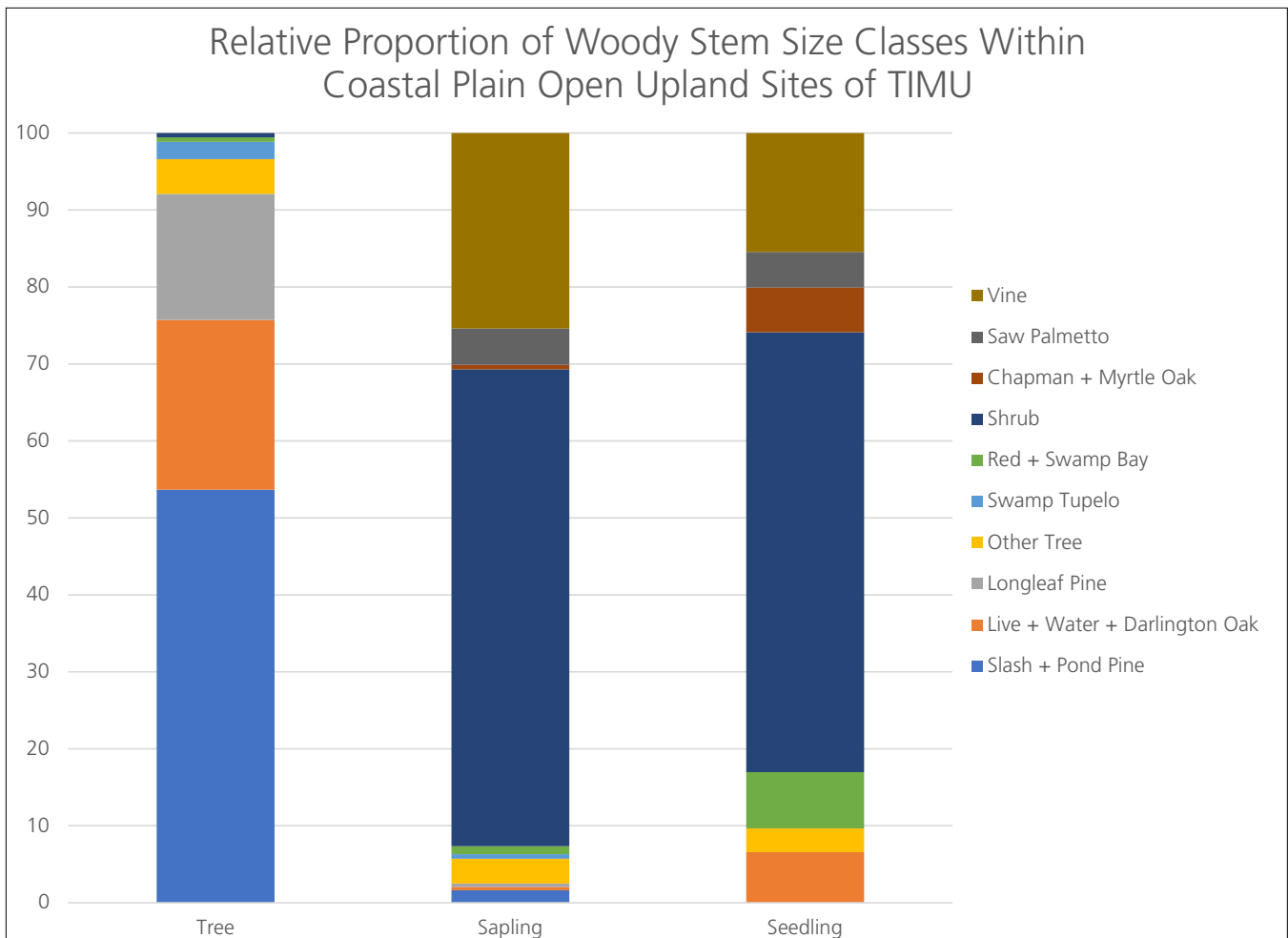


Figure 11. Relative proportion of species groups across three woody stem strata—trees, saplings, and seedlings--within Coastal Plain Open Upland and Woodland vegetation monitoring plots of Timucuan Ecological and Historic Preserve.

Of the 180 tree stems that were measured in these seven plots, only three were found to be dead (2%; Figure 12). However, a high proportion of slash pines observed in plots within the Yellow Bluff Fire footprint experienced severe decline and

vigor due to the influence of the 2019 burn disturbance (Figure 12). Future monitoring will determine the proportion of individuals that will survive.

Health Condition of Trees Observed at Coastal Plain Open Upland Sites of TIMU

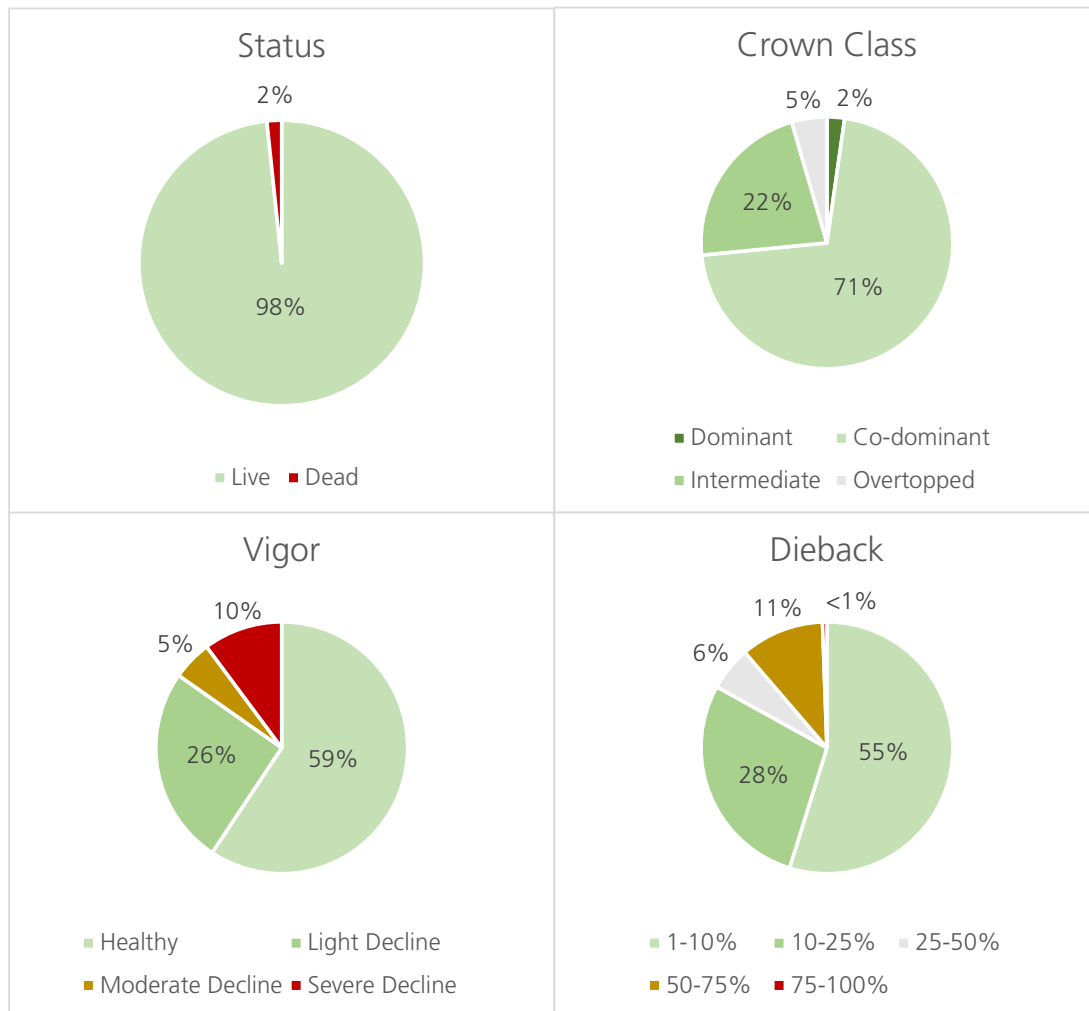


Figure 12. Health status of woody stems greater than or equal to 10 centimeters (3.9 in) DBH (trees) measured on Coastal Plain Open Upland and Woodland vegetation monitoring plots of Timucuan Ecological and Historic Preserve.

Disturbance and Threats

Three of the seven plots located within this habitat type had noticeable historical plow lines—a remnant from previous ownerships' efforts to manage these lands for pine production (Table 5). As noted previously, the three plots located east of I-95 on the Thomas Creek land parcel had burned within weeks of being monitored (Table 5). Perhaps the most noticeable threat to this habitat is the lack of observed historical fire within these sites. High density of woody shrubs (e.g., little gallberry and saw palmetto) and low diversity of forbs and graminoids in flatwoods are a result of reduced high frequency fires (Edmisten 1963). Fire is also necessary for longleaf pine regeneration, by removal of duff and organics and exposing the necessary mineral surface of the soil for

seed germination (Heyward 1939). Increasing prescribed fire frequency is one tool that can be used by park staff to promote longleaf pine regeneration and increase plant diversity in this habitat type.

Geomorphology and Soil

Plots located within this broadly defined habitat in Timucuan Ecological and Historic Preserve occurred on flat (0 degree) landforms, with straight shapes (terrain shape indices = 0) (Table 6). Soils within these sites were acidic, with pH values ranging from 3.7 to 4.4 (Table 7). Organic matter (OM) content within soil samples ranged from 3.2 to 10.9%, with an average value of 6.48% (Table 7). Other soil nutrient reported values are also located in Table 7.

Maritime Upland Forests and Shrublands

Maritime forests and shrublands of the outer Coastal Plain are located on stabilized dunes of barrier islands and ridges and bluffs of mainland settings adjacent to the coast (Figure 13). These upland communities are typically protected from tidal inundation, but occasionally can flood during strong storm surge. More persistent natural disturbances include aerosol salt spray, strong winds, and sandy, low productive soils. These conditions are more pronounced on the forest edges of Maritime Upland Forests and Shrublands, where they border ocean and dune habitat or salt marsh habitat. Across their range, these vegetation communities have been severely impacted by human growth along barrier islands and the adjacent inland maritime strand. Coastal development has fragmented these habitats, leading to increased prevalence of invasive plant species and the reduction of salt-protected zones within the typical maritime forest interior. Vegetation associations sampled in Timucuan Ecological and Historic Preserve that belong to this broadly defined habitat type include (descriptions from NatureServe 2020):

- South Atlantic Coastal Shell Midden Woodland (CEGL3525) (1 plot): Forests that occur on calcareous sands, shell hashes, Native American shell middens, and natural shell deposits, typically occurring between marsh and other matrix maritime forests. (Global Status: G2—Imperiled; State (FL) Status: No Status Rank)
- Northeast Florida Coastal Scrub (CEGL3821) (1 plot): Forests that occur in narrow strip along the coastal strand on over acidic, well-drained, infertile sands; influenced by salt spray from prevailing easterly winds. (Global Status: G2—Imperiled; State (FL) Status: No Status Rank)
- Maritime Live Oak Hammock (CEGL7032) (8 plots): Forests located on linear strands behind frontal dunes, on xeric to mesic sites; nutrient input is typically from salt spray and precipitation. (Global Status: G2—Imperiled; State (FL) Status: No Status Rank)

This broadly defined habitat was located on Cedar Point and Theodore Roosevelt land parcels in Timucuan Ecological and Historic Preserve.



Figure 13. A total of 10 maritime upland forest and shrubland sites were sampled during this monitoring effort.

Species Diversity and Abundance

Native species richness ranged from 20 to 51 (mean = 36.2) within vegetation plots of this broadly defined habitat type, and were the highest among all other habitat types across most growth forms and spatial scales—only graminoid richness at the smaller scales (< 10 square meters [107.6 ft²]) was equal or higher in Coastal Plain Open Uplands and Woodlands (Table 3). Plots located in Maritime Upland Forests and Shrublands also contained the only exotic plant species recorded during this monitoring effort. As noted previously, the two exotic species observed--citrus and Oriental false hawksbeard—are not listed in the Florida Exotic Pest Plant Council list of invasive plants (FLEPPC 2020). Each exotic plant was located on a plot within the Theodore Roosevelt land parcel of the park and were found in low abundance. Species with high constancy are listed below, by growth form (Appendix B, Table B-1):

Trees

- Darlington oak (100%)
- Red bay (100%)
- Live oak (90%)
- Cabbage palmetto (80%)
- Pignut hickory (*Carya glabra*; 80%)
- Carolina laurelcherry (*Prunus caroliniana*; 80%)
- Devilwood (*Cartrema americanum*; 80%)

Shrubs

- Yaupon (80%)
- Saw palmetto (70%)
- American beautyberry (*Callicarpa americana*; 70%)

Vines

- Muscadine (90%)
- Dune greenbriar (80%)
- Virginia creeper (*Parthenocissus quinquefolia*; 70%)
- Saw greenbriar (*Smilax bona-nox*; 70%)

Herbs/Forbs/Graminoids

- Spanish moss (100%)
- Small ballmoss (*Tillandsia recurvata*; 80%)

Most vascular plant species observed in these plots are common throughout Florida. It should be noted that the Florida Endangered (Conservation Status S2 (Imperiled) buckthorn bully (*Sideroxylon lycioides*) was observed in high abundance on three of the 10 Maritime Upland Forest and Shrubland plots within the Theodore Roosevelt land parcel. As discussed earlier, saw palmetto is listed as commercially exploited within the state by the Florida Department of Agriculture and Consumer Services (FDACS 2020).

Woody Stem Metrics

Total BA and density of tree stems exhibited high variation, ranging from 3 to 53 m²/ha (32.3 to 570.5 ft²/ha) and 4 to 24 per plot, respectively, in Maritime Upland Forests and Shrubland plots (Table 4). Dominant canopy species included live oak (mean BA = 10.78 m²/ha [116.0 ft²/ha], mean density = 78/ha), cabbage palmetto (mean BA = 2.72 m²/ha [29.3 ft²/ha], mean density = 35/ha), Darlington oak (mean BA = 2.63 m²/ha [28.3 ft²/ha], mean density = 83/ha), and pignut hickory (mean BA = 2.16 m²/ha, mean density = 30/ha; Appendix B, Table B-2). Canopy cover within these sites ranged from 67 to 91%, and canopy height ranged from 9 to 28 meters (29.5 to 91.9 ft; Table 4). Sapling density ranged from 41 to 131 stems/80 m² (861.1 ft²), with an average of 84.1, and seedling density ranged from 55 to 227 stems/8 m² (86.1 ft²), with an average of 104.8 across all plots (Table 4). Dominant sapling species included rusty fetterbush, devilwood, water oak, live oak, and Darlington oak; dominant seedlings included Darlington oak, yaupon, Carolina laurel cherry, sand live oak, and live oak (Appendix B, Table B-2).

Based on stem count alone, water and Darlington oaks comprised 31% of the relative abundance among species within the tree stratum, and live oak comprised 21%. A variety of tree species dominated the sapling and seedling strata, including American holly (*Ilex opaca*), white ash (*Fraxinus americana*), and American hornbeam (*Carpinus caroliniana*). A single live canopy-sized red bay stem was found in TIMU Maritime Upland Forest and Shrubland sites (Plot TERO008). This species made up 3% of the relative abundance in the sapling stratum and 1% in the seedling stratum (Figure 14).

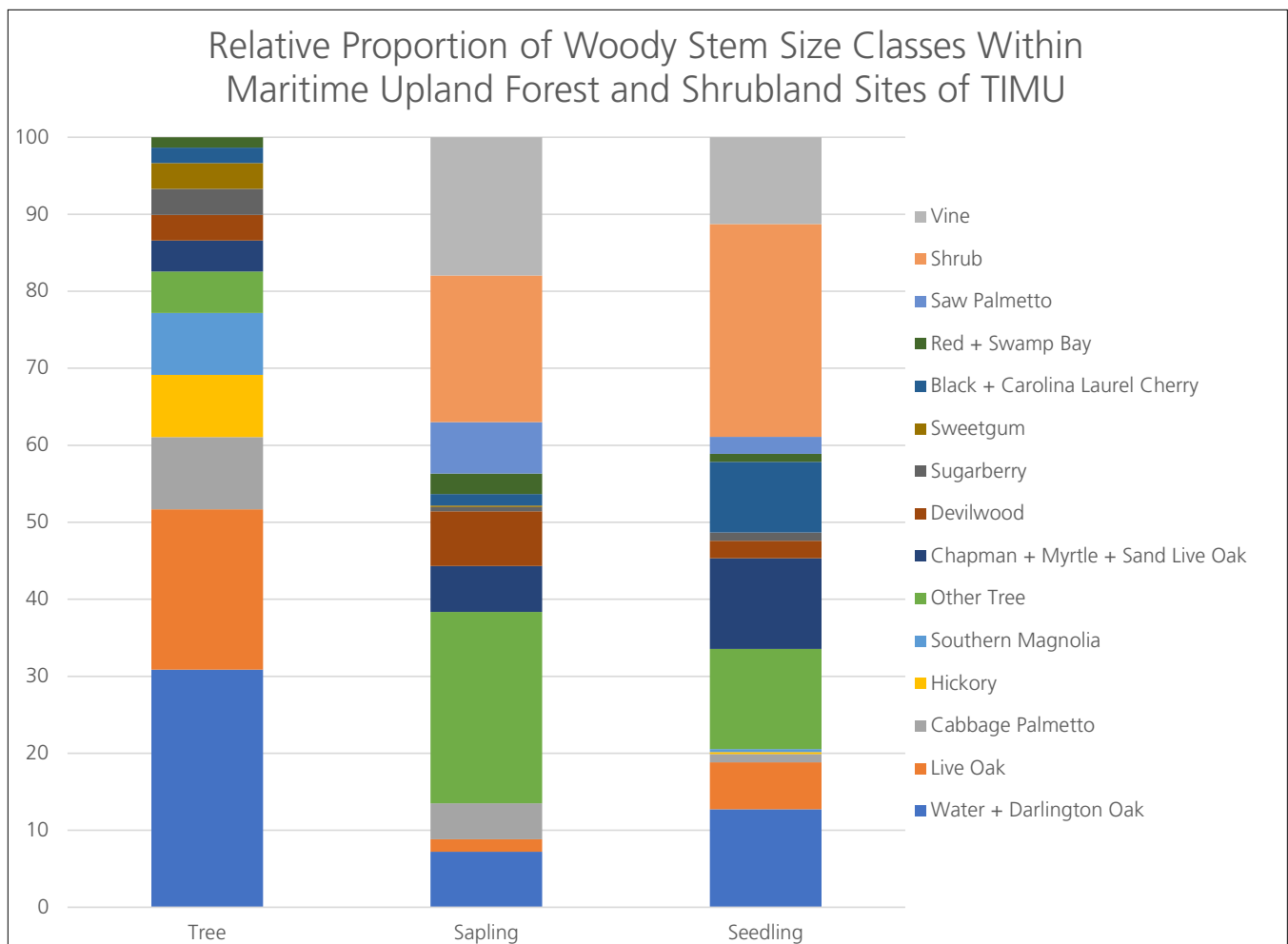


Figure 14. Relative proportion of species groups across three woody stem strata—trees, saplings, and seedlings—within Maritime Upland Forest and Shrubland vegetation monitoring plots of Timucuan Ecological and Historic Preserve.

Tree stems in Maritime Upland Forests and Shrublands had the highest rate of mortality (29%) than in any other broadly defined habitat sampled (Figure 15). Species included red

cedar, live oak, Darlington oak, and red bay. Except for the diseased red bay (see previous discussion), cause of mortality to other species could not be determined.

Health Condition of Trees Observed at Maritime Upland Forest and Shrubland Sites of TIMU

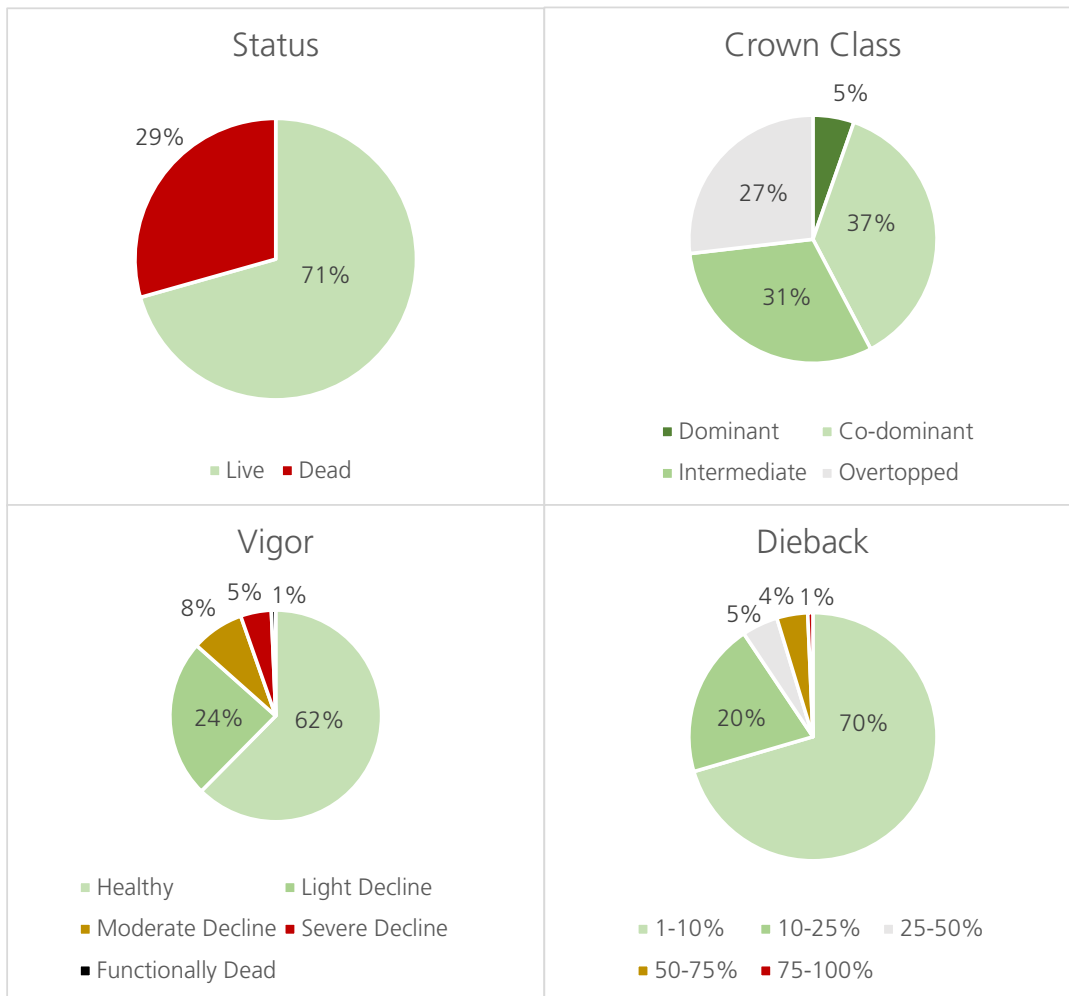


Figure 15. Health status of woody stems greater than or equal to 10 centimeters (3.9 in) DBH ('trees') measured on Maritime Upland Forest and Shrubland vegetation monitoring plots of Timucuan Ecological and Historic Preserve.

Disturbance and Threats

There were relatively few observed current or historical disturbances on these plots. By far the most common disturbance was windthrow, which was observed on five of the 10 plots (Table 5). Prevalence of red bay stems that either were succumbing (stem status = live) or had recently succumbed (stem status = dead) to laurel wilt disease were low to nonexistent because these trees had probably fallen over within the past fifteen years since the redbay ambrosia beetle was observed on the park (see Study Area).

Geomorphology and Soil

Plots located within Maritime Upland Forests and Shrublands in Timucuan Ecological and Historic Preserve occurred on the

steepest slopes within the park, ranging from 0 to 5.5°, and exhibited concave, flat, and convex terrain shapes (Table 6). Standing water was not observed on any of these sites. Like most soils measured in the park, soils within Maritime Upland Forests and Shrublands were fairly acidic; however, a few plots sampled in this habitat type exhibited rather high pH values—including two plots with alkaline (pH > 7) soils (Table 7). These two plots were located on the Cedar Point land parcel and included the single plot classified as the South Atlantic Coastal Shell Midden Woodland. Throughout their range, these vegetation communities have elevated calcium in the soil, owing to their occurrence on calcareous coastal sands, natural shell deposits, or Native American shell middens. Other soil nutrient reported values are also located in Table 7.

Fuel Load Estimates

Cedar Point

Fuel load estimates across the eight plots sampled on the Cedar Point land parcel of Timucuan Ecological and Historic Preserve ranged from 12.3 to 75.3 tons (11.2 to 68.3 tonnes)/acre (average = 32.4; Figure 16). Most of the fuel load volume on these sites is comprised of duff and litter and standing live vegetation (not measured). All fuel variables, including fine

woody debris (FWD; e.g., 1-, 10-, 100-hour diameter classes, coarse woody debris [CWD] 1,000-hour diameter class), duff, and litter were highly variable between plots. High variability in fuel loads is related to different vegetation structure and disturbance history between sites. Higher fuel loads were found on plots toward the northern end of the Cedar Point land parcel (Figure 16).

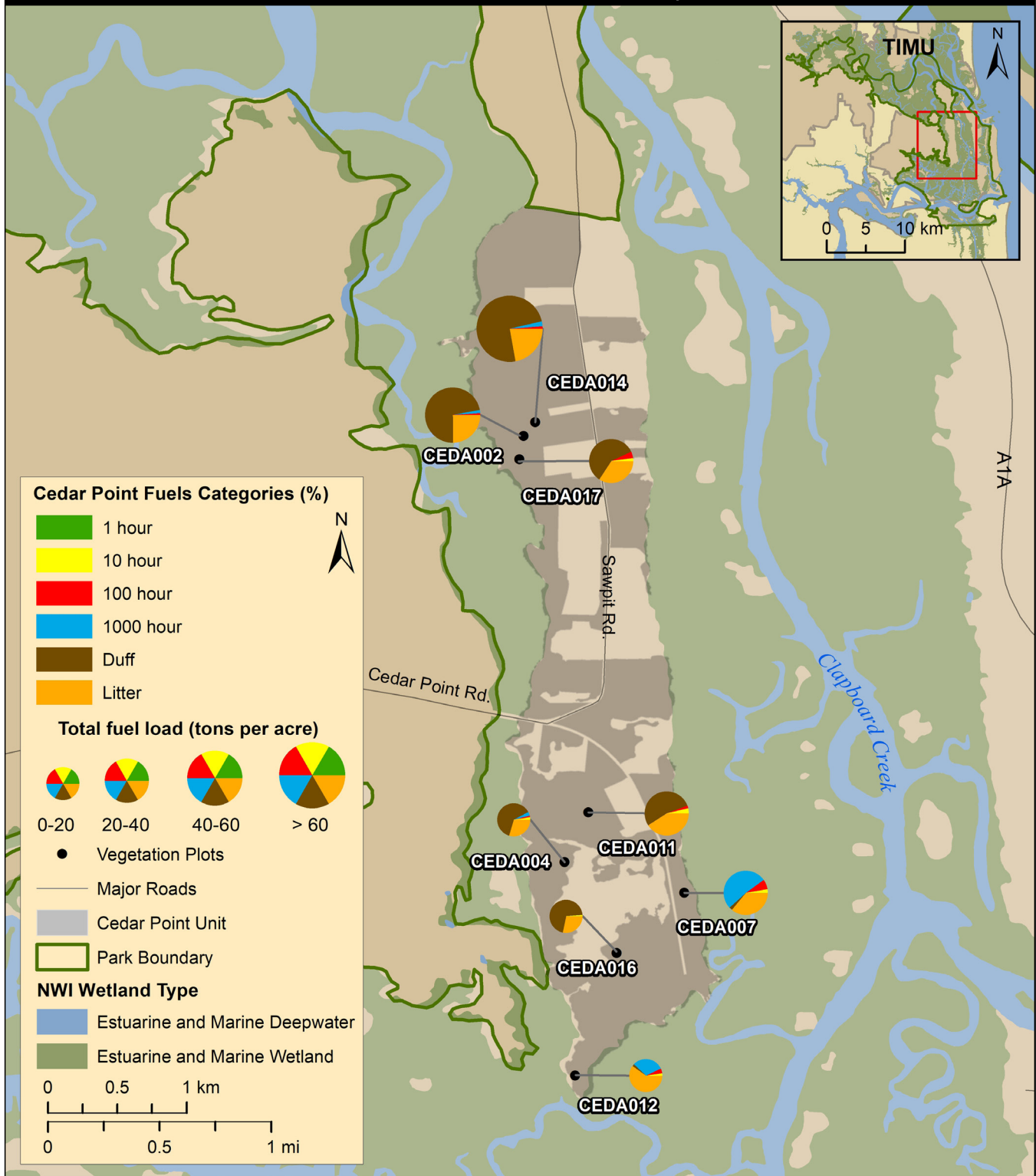


Figure 16. Fuel load estimates from vegetation monitoring plots located on the Cedar Point land parcel of Timucuan Ecological and Historic Preserve.

Theodore Roosevelt

Fuel load estimates were lowest in the Theodore Roosevelt land parcel, ranging from 11.2 to 31.3 tons (10.2 to 28.4

tonnes/acre (average = 19.7; Figure 17). Fine woody debris (FWD) comprised a higher proportion of total fuel load in this land parcel than any other.

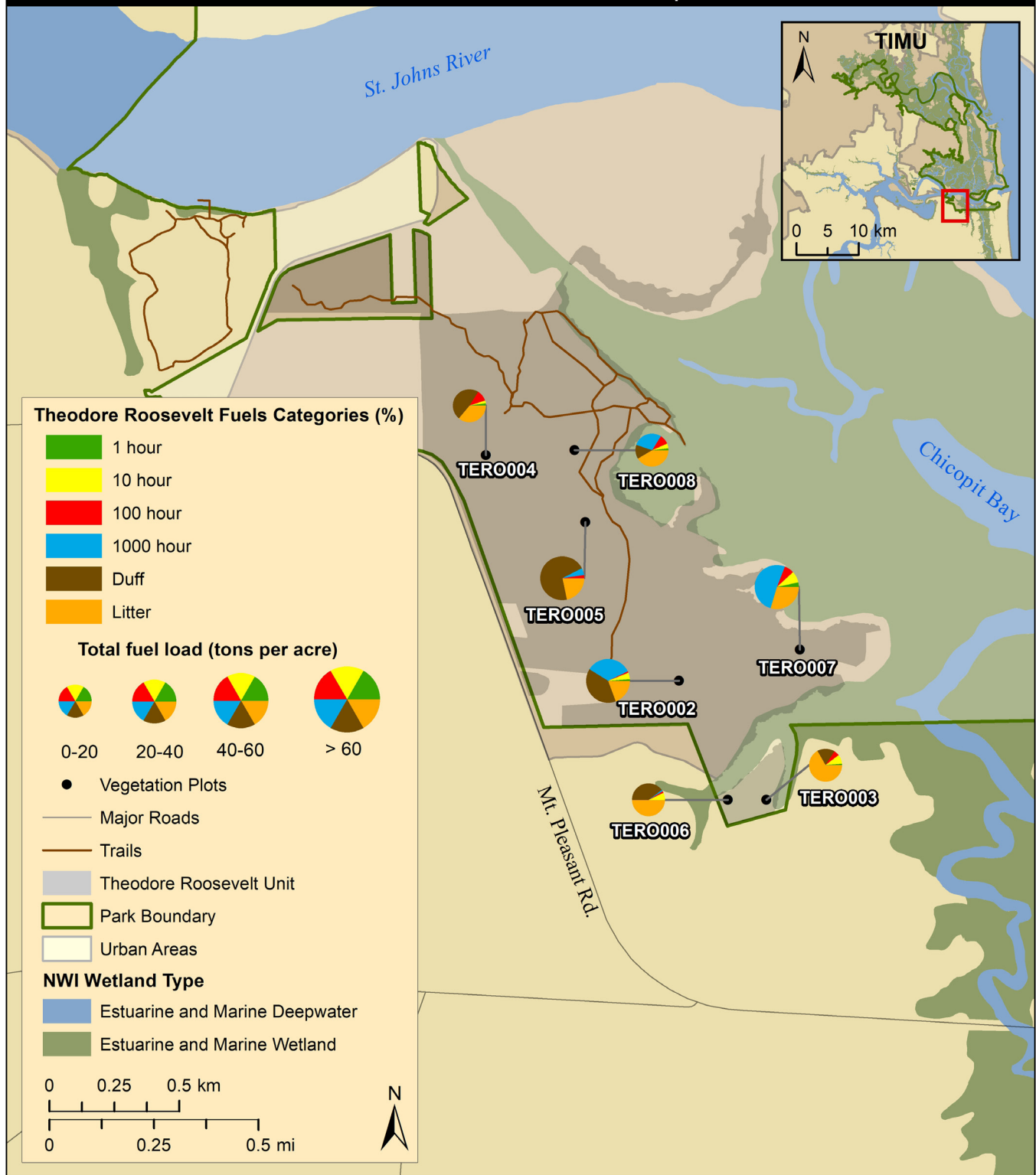


Figure 17. Fuel load estimates from vegetation monitoring plots located on the Theodore Roosevelt land parcel of Timucuan Ecological and Historic Preserve.

Thomas Creek

Fuel load estimates were highest in the Thomas Creek land parcel, ranging from 18.3 to 59.3 tons (16.6 to 53.8 tonnes)/acre (average=37.7; Figure 18). Most of the fuel load volume on these sites is comprised of duff and litter and standing live vegetation (not measured). All fuel variables, including fine woody debris (e.g., 1-, 10-, 100-hour diameter classes, coarse

woody debris [CWD] (1,000-hour diameter class), duff, and litter were highly variable between plots. Higher fuel loads were found on plots towards the northwestern end of the land parcel (Figure 18).

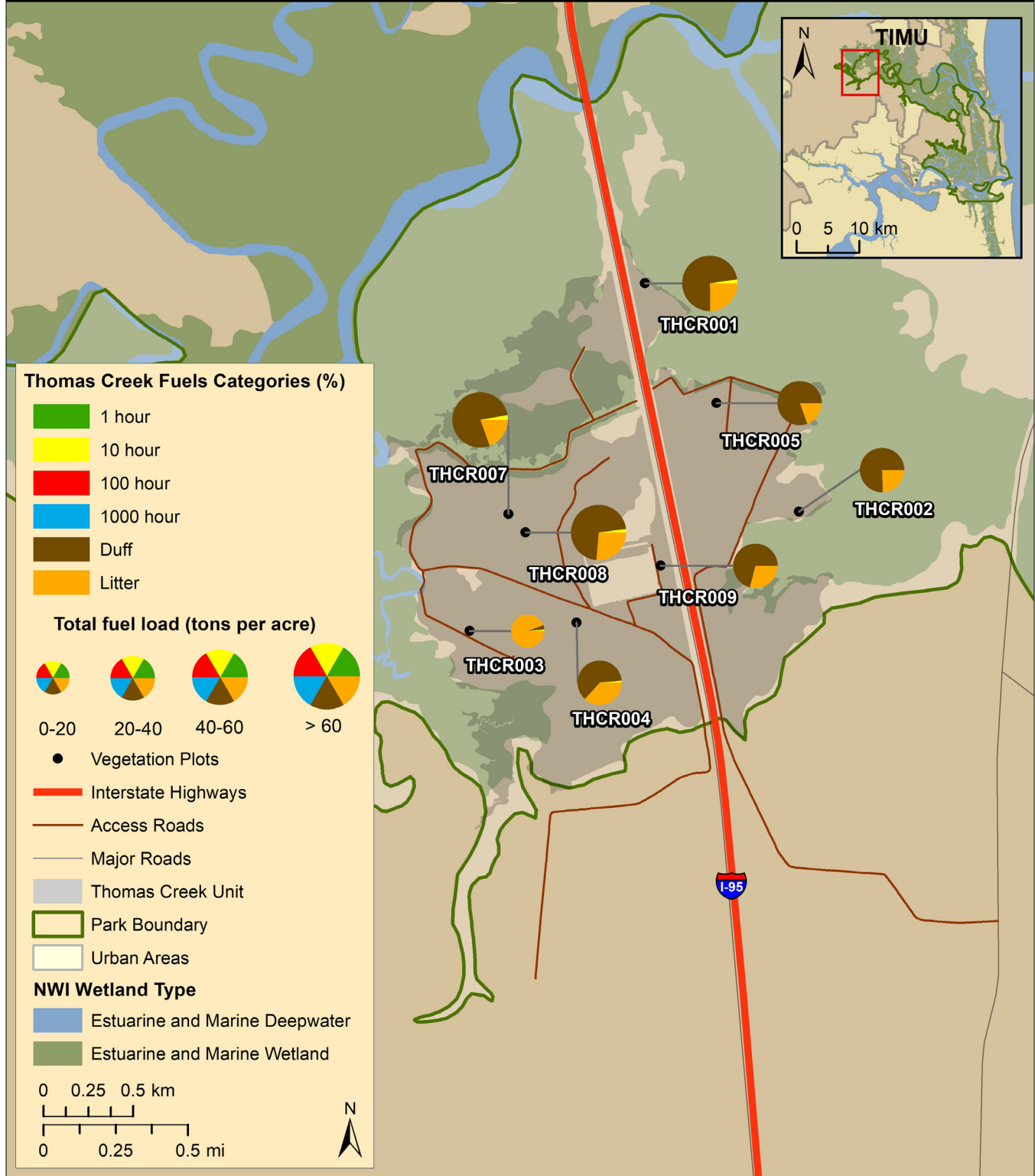


Figure 18. Fuel load estimates from vegetation monitoring plots located on the Theodore Roosevelt land parcel of Timucuan Ecological and Historic Preserve.

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Appendix A. Vascular Plants Observed During the 2019 Southeast Coast Network Terrestrial Vegetation Monitoring Effort on Timucuan Ecological and Historical Preserve

Table A-1. Vascular plant species present in 23 vegetation monitoring plots at Timucuan Ecological and Historic Preserve, May–June 2019.

Order	Family	Scientific Name	Common Name ^a	Federal Noxious Status ^a	State Noxious Status ^a	Native Status ^a	Federal T/E Status ^b	Florida T/E Status ^b	Growth Form ^a
Apiales	Araliaceae	<i>Aralia spinosa</i>	Devil's walkingstick	–	–	Native	–	–	Tree, Shrub
Arales	Araceae	<i>Arisaema dracontium</i>	Green dragon	–	–	Native	–	–	Forb/herb
Arecales	Arecaceae	<i>Sabal palmetto</i>	Cabbage palmetto	–	–	Native	–	–	Tree
Arecales	Arecaceae	<i>Serenoa repens</i>	Saw palmetto	–	–	Native	–	Commercially Exploited	Tree, Shrub
Aristolochiales	Aristolochiaceae	<i>Endodeca serpentaria</i>	Virginia snakeroot	–	–	Native	–	–	Forb/herb
Asterales	Asteraceae	<i>Bidens bipinnata</i>	Spanish needles	–	–	Native	–	–	Forb/herb
Asterales	Asteraceae	<i>Erechtites hieraciifolius</i>	American burnweed	–	–	Native	–	–	Forb/herb
Asterales	Asteraceae	<i>Mikania scandens</i>	Climbing hempvine	–	–	Native	–	–	Vine, Forb/herb
Asterales	Asteraceae	<i>Pluchea foetida</i> var. <i>foetida</i>	Stinking camphorweed	–	–	Native	–	–	Forb/herb
Asterales	Asteraceae	<i>Smallanthus uvedalia</i>	Hairy leafcup	–	–	Native	–	–	Forb/herb
Asterales	Asteraceae	<i>Solidago fistulosa</i>	Pine barren goldenrod	–	–	Native	–	–	Forb/herb
Asterales	Asteraceae	<i>Verbesina virginica</i> var. <i>virginica</i>	White crownbeard	–	–	Native	–	–	Forb/herb
Asterales	Asteraceae	<i>Vernonia gigantea</i>	Giant ironweed	–	–	Native	–	–	Forb/herb
Asterales	Asteraceae	<i>Youngia japonica</i>	Oriental false hawksbeard	–	–	Non-native	–	–	Forb/herb
Asterales	Asteraceae	<i>Elephantopus nudatus</i>	Smooth elephantsfoot	–	–	Native	–	–	Forb/herb
Bromeliales	Bromeliaceae	<i>Tillandsia bartramii</i>	Bartram's airplant	–	–	Native	–	–	Forb/herb
Bromeliales	Bromeliaceae	<i>Tillandsia recurvata</i>	Small ballmoss	–	–	Native	–	–	Forb/herb
Bromeliales	Bromeliaceae	<i>Tillandsia usneoides</i>	Spanish moss	–	–	Native	–	–	Vine, Forb/herb
Caryophyllales	Phytolaccaceae	<i>Phytolacca americana</i>	American pokeweed	–	–	Native	–	–	Forb/herb
Celastrales	Aquifoliaceae	<i>Ilex ambigua</i>	Carolina holly	–	–	Native	–	–	Tree, Shrub
Celastrales	Aquifoliaceae	<i>Ilex cassine</i>	Dahoon	–	–	Native	–	–	Tree, Shrub
Celastrales	Aquifoliaceae	<i>Ilex coriacea</i>	Large gallberry	–	–	Native	–	–	Tree, Shrub
Celastrales	Aquifoliaceae	<i>Ilex glabra</i>	Inkberry	–	–	Native	–	–	Shrub
Celastrales	Aquifoliaceae	<i>Ilex myrtifolia</i>	Myrtle dahoon	–	–	Native	–	–	Shrub, Tree
Celastrales	Aquifoliaceae	<i>Ilex opaca</i>	American holly	–	–	Native	–	–	Tree, Shrub
Celastrales	Aquifoliaceae	<i>Ilex vomitoria</i>	Yaupon	–	–	Native	–	–	Tree, Shrub
Celastrales	Celastraceae	<i>Euonymus americanus</i>	Bursting-heart	–	–	Native	–	–	Forb/herb, Subshrub

^a Information obtained from the PLANTS database (USDA 2020)^b Information obtained from the Florida Regulated Plant Index (FDACS 2020)

Table A-1 (continued). Vascular plant species present in 23 vegetation monitoring plots at Timucuan Ecological and Historic Preserve, May–June 2019.

Order	Family	Scientific Name	Common Name ^a	Federal Noxious Status ^a	State Noxious Status ^a	Native Status ^a	Federal T/E Status ^b	Florida T/E Status ^b	Growth Form ^a
Commelinales	Commelinaceae	<i>Commelina</i>	Dayflower	–	–	Unknown	–	–	Forb/herb
Commelinales	Commelinaceae	<i>Tradescantia ohiensis</i>	Bluejacket	–	–	Native	–	–	Forb/herb
Cornales	Cornaceae	<i>Nyssa biflora</i>	Swamp tupelo	–	–	Native	–	–	Tree
Cornales	Cornaceae	<i>Swida asperifolia</i>	Toughleaf dogwood	–	–	Native	–	–	Shrub
Cyperales	Cyperaceae	<i>Carex</i>	Sedge	–	–	Native	–	–	Graminoid
Cyperales	Cyperaceae	<i>Carex glaucescens</i>	Southern waxy sedge	–	–	Native	–	–	Graminoid
Cyperales	Cyperaceae	<i>Cyperus croceus</i>	Baldwin's flatsedge	–	–	Native	–	–	Graminoid
Cyperales	Cyperaceae	<i>Eleocharis</i>	Spikerush	–	–	Native	–	–	Graminoid
Cyperales	Cyperaceae	<i>Eleocharis vivipara</i>	Viviparous spikerush	–	–	Native	–	–	Graminoid
Cyperales	Cyperaceae	<i>Scleria</i>	Nutrush	–	–	Native	–	–	Graminoid
Cyperales	Cyperaceae	<i>Scleria oligantha</i>	Littlehead nutrush	–	–	Native	–	–	Graminoid
Cyperales	Poaceae	<i>Andropogon gyrans</i>	Elliott's bluestem	–	–	Native	–	–	Graminoid
Cyperales	Poaceae	<i>Chasmanthium laxum</i>	Slender woodoats	–	–	Native	–	–	Graminoid
Cyperales	Poaceae	<i>Chasmanthium sessiliflorum</i>	Longleaf woodoats	–	–	Native	–	–	Graminoid
Cyperales	Poaceae	<i>Dichanthelium</i>	Rosette grass	–	–	Native	–	–	Graminoid
Cyperales	Poaceae	<i>Dichanthelium commutatum</i>	Variable panicgrass	–	–	Native	–	–	Graminoid
Cyperales	Poaceae	<i>Dichanthelium dichotomum</i>	Cypress panicgrass	–	–	Native	–	–	Graminoid
Cyperales	Poaceae	<i>Dichanthelium laxiflorum</i>	Openflower rosette grass	–	–	Native	–	–	Graminoid
Cyperales	Poaceae	<i>Kelloggloa verrucosa</i>	Warty panicgrass	–	–	Native	–	–	Graminoid
Cyperales	Poaceae	<i>Oplismenus setarius</i>	Basketgrass	–	–	Native	–	–	Graminoid
Cyperales	Poaceae	<i>Poaceae</i>	Grass Family	–	–	Native	–	–	Graminoid
Dipsacales	Caprifoliaceae	<i>Lonicera sempervirens</i>	Trumpet honeysuckle	–	–	Native	–	–	Vine
Ebenales	Ebenaceae	<i>Diospyros virginiana</i>	Common persimmon	–	–	Native	–	–	Tree
Ebenales	Sapotaceae	<i>Sideroxylon lycioides</i>	Buckthorn bully	–	–	Native	–	Endangered	Tree, Shrub
Ebenales	Sapotaceae	<i>Sideroxylon tenax</i>	Tough bully	–	–	Native	–	–	Tree, Shrub
Ebenales	Styracaceae	<i>Styrax grandifolius</i>	Bigleaf snowbell	–	–	Native	–	–	Tree, Shrub
Ebenales	Symplocaceae	<i>Symplocos tinctoria</i>	Common sweetleaf	–	–	Native	–	–	Tree, Shrub
Ericales	Ericaceae	<i>Agarista populifolia</i>	Florida hobblebush	–	–	Native	–	–	Shrub
Ericales	Ericaceae	<i>Bejaria racemosa</i>	Flyweed	–	–	Native	–	–	Shrub

^a Information obtained from the PLANTS database (USDA 2020)^b Information obtained from the Florida Regulated Plant Index (FDACS 2018)

Table A-1 (continued). Vascular plant species present in 23 vegetation monitoring plots at Timucuan Ecological and Historic Preserve, May–June 2019.

Order	Family	Scientific Name	Common Name ^a	Federal Noxious Status ^a	State Noxious Status ^a	Native Status ^a	Federal T/E Status ^b	Florida T/E Status ^b	Growth Form ^a
Ericales	Ericaceae	<i>Ceratiola ericoides</i>	Sand heath	–	–	Native	–	–	Subshrub, Shrub, Forb/ herb
Ericales	Ericaceae	<i>Gaylussacia dumosa</i>	Dwarf huckleberry	–	–	Native	–	–	Subshrub, Shrub
Ericales	Ericaceae	<i>Gaylussacia nana</i>	Confederate huckleberry	–	–	Native	–	–	Shrub
Ericales	Ericaceae	<i>Lyonia ferruginea</i>	Rusty staggerbush	–	–	Native	–	–	Tree, Shrub
Ericales	Ericaceae	<i>Lyonia lucida</i>	Fetterbush lyonia	–	–	Native	–	–	Shrub
Ericales	Ericaceae	<i>Monotropa uniflora</i>	Indianpipe	–	–	Native	–	–	Forb/herb
Ericales	Ericaceae	<i>Vaccinium arboreum</i>	Farkleberry	–	–	Native	–	–	Tree, Shrub
Ericales	Ericaceae	<i>Vaccinium caesariense</i>	New Jersey blueberry	–	–	Native	–	–	Shrub
Ericales	Ericaceae	<i>Vaccinium fuscatum</i>	Black highbush blueberry	–	–	Native	–	–	Shrub
Ericales	Ericaceae	<i>Vaccinium myrsinites</i>	Shiny blueberry	–	–	Native	–	–	Shrub
Ericales	Ericaceae	<i>Vaccinium stamineum</i>	Deerberry	–	–	Native	–	–	Shrub
Euphorbiales	Euphorbiaceae	<i>Cnidoscolus stimulosus</i>	Finger rot	–	–	Native	–	–	Forb/herb
Fabales	Fabaceae	<i>Erythrina herbacea</i>	Redcardinal	–	–	Native	–	–	Tree, Subshrub, Shrub
Fabales	Fabaceae	<i>Galactia elliotii</i>	Elliott's milkpea	–	–	Native	–	–	Forb/herb, Vine
Fabales	Fabaceae	<i>Strophostyles helvola</i>	Amberique-bean	–	–	Native	–	–	Vine, Forb/herb
Fagales	Fagaceae	<i>Castanea pumila</i>	Chinquapin	–	–	Native	–	–	Tree, Shrub
Fagales	Fagaceae	<i>Quercus chapmanii</i>	Chapman oak	–	–	Native	–	–	Tree, Shrub
Fagales	Fagaceae	<i>Quercus geminata</i>	Sand live oak	–	–	Native	–	–	Tree, Shrub
Fagales	Fagaceae	<i>Quercus hemisphaerica</i>	Darlington oak	–	–	Native	–	–	Tree
Fagales	Fagaceae	<i>Quercus laurifolia</i>	Laurel oak	–	–	Native	–	–	Tree
Fagales	Fagaceae	<i>Quercus myrtifolia</i>	Myrtle oak	–	–	Native	–	–	Tree, Shrub
Fagales	Fagaceae	<i>Quercus nigra</i>	Water oak	–	–	Native	–	–	Tree
Fagales	Fagaceae	<i>Quercus virginiana</i>	Live oak	–	–	Native	–	–	Tree
Fagales	Betulaceae	<i>Carpinus caroliniana</i> var. <i>caroliniana</i>	American hornbeam	–	–	Native	–	–	Tree, Shrub
Gentianales	Apocynacea	<i>Orthosia scoparia</i>	Leafless swallow-wort	–	–	Native	–	–	Vine, Forb/herb

^a Information obtained from the PLANTS database (USDA 2020)^b Information obtained from the Florida Regulated Plant Index (FDACS 2018)

Table A-1 (continued). Vascular plant species present in 23 vegetation monitoring plots at Timucuan Ecological and Historic Preserve, May–June 2019.

Order	Family	Scientific Name	Common Name ^a	Federal Noxious Status ^a	State Noxious Status ^a	Native Status ^a	Federal T/E Status ^b	Florida T/E Status ^b	Growth Form ^a
Gentianales	Asclepiadaceae	<i>Matelea</i>	Milkvine	–	–	Native	–	–	Vine, Forb/herb
Gentianales	Gelsemiaceae	<i>Gelsemium sempervirens</i>	Evening trumpetflower	–	–	Native	–	–	Vine, Shrub
Gentianales	Gentianaceae	<i>Sabatia brevifolia</i>	Shortleaf rose gentian	–	–	Native	–	–	Forb/herb
Hamamelidales	Altingiaceae	<i>Liquidambar styraciflua</i>	Sweetgum	–	–	Native	–	–	Tree
Hamamelidales	Hamamelidaceae	<i>Hamamelis virginiana</i>	American witchhazel	–	–	Native	–	–	Tree, Shrub
Juglandales	Juglandaceae	<i>Carya glabra</i>	Pignut hickory	–	–	Native	–	–	Tree
Juglandales	Juglandaceae	<i>Carya cordiformis</i>	Bitternut hickory	–	–	Native	–	–	Tree
Juncales	Juncaceae	<i>Juncus acuminatus</i>	Tapertip rush	–	–	Native	–	–	Graminoid
Juncales	Juncaceae	<i>Juncus polycephalos</i>	Manyhead rush	–	–	Native	–	–	Graminoid
Lamiales	Lamiaceae	<i>Callicarpa americana</i>	American beautyberry	–	–	Native	–	–	Shrub
Lamiales	Lamiaceae	<i>Scutellaria integrifolia</i>	Helmet flower	–	–	Native	–	–	Forb/herb
Laurales	Lauraceae	<i>Persea borbonia</i>	Redbay	–	–	Native	–	–	Tree, Shrub
Laurales	Lauraceae	<i>Persea palustris</i>	Swamp bay	–	–	Native	–	–	Shrub, Tree
Liliales	Haemodoraceae	<i>Lachnanthes caroliniana</i>	Carolina redroot	–	–	Native	–	–	Forb/herb
Liliales	Smilacaceae	<i>Smilax auriculata</i>	Earleaf greenbrier	–	–	Native	–	–	Shrub, Vine
Liliales	Smilacaceae	<i>Smilax bona-nox</i>	Saw greenbrier	–	–	Native	–	–	Shrub, Vine
Liliales	Smilacaceae	<i>Smilax glauca</i>	Cat greenbrier	–	–	Native	–	–	Shrub, Vine
Liliales	Smilacaceae	<i>Smilax laurifolia</i>	Laurel greenbrier	–	–	Native	–	–	Shrub, Vine
Liliales	Smilacaceae	<i>Smilax pumila</i>	Sarsparilla vine	–	–	Native	–	–	Subshrub, Vine, Shrub
Liliales	Smilacaceae	<i>Smilax rotundifolia</i>	Roundleaf greenbrier	–	–	Native	–	–	Vine, Shrub
Liliales	Smilacaceae	<i>Smilax walteri</i>	Coral greenbrier	–	–	Native	–	–	Shrub, Vine
Magnoliales	Annonaceae	<i>Asimina incana</i>	Woolly pawpaw	–	–	Native	–	–	Shrub
Magnoliales	Annonaceae	<i>Asimina parviflora</i>	Smallflower pawpaw	–	–	Native	–	–	Tree, Shrub
Magnoliales	Magnoliaceae	<i>Magnolia grandiflora</i>	Southern magnolia	–	–	Native	–	–	Tree
Magnoliales	Magnoliaceae	<i>Magnolia virginiana</i> var. <i>australis</i>	Sweetbay	–	–	Native	–	–	Tree, Shrub
Malvales	Malvaceae	<i>Tilia americana</i> var. <i>caroliniana</i>	American basswood	–	–	Native	–	–	Tree
Myricales	Myricaceae	<i>Morella cerifera</i>	Wax myrtle	–	–	Native	–	–	Tree, Subshrub, Shrub

^a Information obtained from the PLANTS database (USDA 2020)^b Information obtained from the Florida Regulated Plant Index (FDACS 2018)

Table A-1 (continued). Vascular plant species present in 23 vegetation monitoring plots at Timucuan Ecological and Historic Preserve, May–June 2019.

Order	Family	Scientific Name	Common Name ^a	Federal Noxious Status ^a	State Noxious Status ^a	Native Status ^a	Federal T/E Status ^b	Florida T/E Status ^b	Growth Form ^a
Myrtales	Melastomataceae	<i>Rhexia nashii</i>	Maid Marian	–	–	Native	–	–	Forb/herb
Pinales	Cupressaceae	<i>Juniperus [silicicola + virginiana]</i>	Southern redcedar + eastern redcedar	–	–	Native	–	–	Tree
Pinales	Pinaceae	<i>Pinus elliotii</i>	Slash pine	–	–	Native	–	–	Tree
Pinales	Pinaceae	<i>Pinus palustris</i>	Longleaf pine	–	–	Native	–	–	Tree
Pinales	Pinaceae	<i>Pinus serotina</i>	Pond pine	–	–	Native	–	–	Tree
Pinales	Pinaceae	<i>Pinus taeda</i>	Loblolly pine	–	–	Native	–	–	Tree
Polypodiales	Aspleniaceae	<i>Asplenium platyneuron</i>	Ebony spleenwort	–	–	Native	–	–	Forb/herb
Polypodiales	Blechnaceae	<i>Anchistea virginica</i>	Virginia chainfern	–	–	Native	–	–	Forb/herb
Polypodiales	Blechnaceae	<i>Lorinseria areolata</i>	Netted chainfern	–	–	Native	–	–	Forb/herb
Polypodiales	Osmundaceae	<i>Osmundastrum cinnamomeum</i>	Cinnamon fern	–	–	Native	–	Commercially Exploited	Forb/herb
Polypodiales	Polypodiaceae	<i>Pleopeltis michauxiana</i>	Resurrection fern	–	–	Native	–	–	Forb/herb, Vine
Polypodiales	Dennstaedtiaceae	<i>Pteridium pseudocaudatum</i>	Brackenfern	–	–	Native	–	–	Forb/herb
Ranunculales	Ranunculaceae	<i>Clematis catesbyana</i>	Satincurls	–	–	Native	–	–	Vine
Rhamnales	Vitaceae	<i>Muscadinia rotundifolia</i> var. <i>rotundifolia</i>	Muscadine	–	–	Native	–	–	Vine
Rhamnales	Vitaceae	<i>Parthenocissus quinquefolia</i>	Virginia creeper	–	–	Native	–	–	Vine
Rhamnales	Vitaceae	<i>Vitis aestivalis</i> var. <i>aestivalis</i>	Summer grape	–	–	Native	–	–	Vine
Rhamnales	Vitaceae	<i>Vitis vulpina</i>	Frost grape	–	–	Native	–	–	Vine
Rosales	Chrysobalanaceae	<i>Geobalanus oblongifolius</i>	Gopher apple	–	–	Native	–	–	Subshrub, Shrub
Rosales	Iteaceae	<i>Itea virginica</i>	Virginia sweetspire	–	–	Native	–	–	Shrub
Rosales	Rosaceae	<i>Aronia arbutifolia</i>	Red chokeberry	–	–	Native	–	–	Shrub
Rosales	Rosaceae	<i>Prunus caroliniana</i>	Carolina laurelcherry	–	–	Native	–	–	Tree, Shrub
Rosales	Rosaceae	<i>Prunus serotina</i> var. <i>serotina</i>	Black cherry	–	–	Native	–	–	Tree, Shrub
Rosales	Rosaceae	<i>Prunus umbellata</i>	Hog plum	–	–	Native	–	–	Tree, Shrub
Rosales	Rosaceae	<i>Rubus pensilvanicus</i>	Pennsylvania blackberry	–	–	Native	–	–	Subshrub
Rosales	Rosaceae	<i>Rubus trivialis</i>	Southern dewberry	–	–	Native	–	–	Subshrub, Vine
Rubiales	Rubiaceae	<i>Cephalanthus occidentalis</i>	Common buttonbush	–	–	Native	–	–	Shrub, Tree

^a Information obtained from the PLANTS database (USDA 2020)^b Information obtained from the Florida Regulated Plant Index (FDACS 2018)

Table A-1 (continued). Vascular plant species present in 23 vegetation monitoring plots at Timucuan Ecological and Historic Preserve, May–June 2019.

Order	Family	Scientific Name	Common Name ^a	Federal Noxious Status ^a	State Noxious Status ^a	Native Status ^a	Federal T/E Status ^b	Florida T/E Status ^b	Growth Form ^a
Rubiales	Rubiaceae	<i>Mitchella repens</i>	partridgeberry	–	–	Native	–	–	Subshrub, Forb/ herb
Rubiales	Rubiaceae	<i>Psychotria nervosa</i>	Seminole balsamo	–	–	Native	–	–	Tree, Shrub
Rubiales	Rubiaceae	<i>Galium circaeazans</i>	Licorice bedstraw	–	–	Native	–	–	Subshrub, Forb/ herb
Sapindales	Anacardiaceae	<i>Rhus copallinum</i> var. <i>copallinum</i>	Winged sumac	–	–	Native	–	–	Tree, Shrub
Sapindales	Anacardiaceae	<i>Toxicodendron radicans</i> var. <i>radicans</i>	Eastern poison ivy	–	–	Native	–	–	Shrub, Subshrub, Vine
Sapindales	Rutaceae	<i>Ptelea trifoliata</i>	Common hoptree	–	–	Native	–	–	Tree, Shrub
Sapindales	Sapindaceae	<i>Acer rubrum</i>	Red maple	–	–	Native	–	–	Tree
Sapindales	Sapindaceae	<i>Sapindus marginatus</i>	Wingleaf soapberry	–	–	Native	–	–	Tree, Shrub
Sapindales	Rutaceae	<i>Citrus</i>	Citrus	–	–	Non-native	–	–	Tree, Shrub
Scrophulariales	Acanthaceae	<i>Ruellia caroliniensis</i>	Carolina wild petunia	–	–	Native	–	–	Forb/herb
Scrophulariales	Bignoniaceae	<i>Bignonia capreolata</i>	Crossvine	–	–	Native	–	–	Vine
Scrophulariales	Oleaceae	<i>Cartrema americanum</i>	Devilwood	–	–	Native	–	–	Tree, Shrub
Scrophulariales	Oleaceae	<i>Fraxinus americana</i>	White ash	–	–	Native	–	–	Tree
Solanales	Convolvulaceae	<i>Ipomoea</i>	Morning-glory	–	–	Native	–	–	Vine, Forb/herb
Solanales	Solanaceae	<i>Solanum americanum</i>	American black nightshade	–	–	Native	–	–	Subshrub, Forb/ herb
Theales	Hypericaceae	<i>Hypericum cistifolium</i>	Roundpod St. Johnswort	–	–	Native	–	–	Shrub, Forb/ herb, Subshrub
Theales	Hypericaceae	<i>Hypericum virgatum</i>	Virginia marsh St. Johnswort	–	–	Native	–	–	Forb/herb
Theales	Theaceae	<i>Gordonia lasianthus</i>	Loblolly bay	–	–	Native	–	–	Tree, Shrub
Urticales	Cannabaceae	<i>Celtis laevigata</i>	Sugarberry	–	–	Native	–	–	Tree, Shrub
Urticales	Moraceae	<i>Morus rubra</i>	Red mulberry	–	–	Native	–	–	Tree
Urticales	Urticaceae	<i>Boehmeria cylindrica</i>	Smallspike false nettle	–	–	Native	–	–	Forb/herb
Violales	Cucurbitaceae	<i>Melothria pendula</i>	Guadeloupe cucumber	–	–	Native	–	–	Vine, Forb/herb
Violales	Passifloraceae	<i>Passiflora lutea</i>	Yellow passionflower	–	–	Native	–	–	Vine, Forb/herb

^a Information obtained from the PLANTS database (USDA 2020)^b Information obtained from the Florida Regulated Plant Index (FDACS 2018)

Appendix B. Species Diversity, Abundance, and Woody Stem Metrics Summarized by Broadly Defined Habitats of Timucuan Ecological and Historical Preserve

Table B-1. Constancy and average cover class for all vascular plant species observed in 23 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPNW = Coastal Plain Nonalluvial Wetlands (six plots); CPOU = Coastal Plain Open Uplands (seven plots); and MUFS = Maritime Upland Forests and Shrublands (Ten plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	CPNW Constancy	CPNW Cover	CPOU Constancy	CPOU Cover	MUFS Constancy	MUFS Cover
<i>Acer rubrum</i>	33	2	43	2	10	1
<i>Agarista populifolia</i>	17	5	–	–	20	4
<i>Anchistea virginica</i>	50	2	–	–	–	–
<i>Andropogon gyrans</i>	33	2	14	1	–	–
<i>Aralia spinosa</i>	17	3	–	–	–	–
<i>Arisaema dracontium</i>	–	–	–	–	20	3
<i>Aronia arbutifolia</i>	17	1	14	1	–	–
<i>Asimina incana</i>	17	2	29	2	–	–
<i>Asimina parviflora</i>	17	2	–	–	40	2
<i>Asplenium platyneuron</i>	–	–	–	–	10	1
<i>Bejaria racemosa</i>	–	–	14	2	–	–
<i>Bidens bipinnata</i>	–	–	–	–	10	1
<i>Bignonia capreolata</i>	17	2	–	–	50	2
<i>Boehmeria cylindrica</i>	17	1	–	–	–	–
<i>Callicarpa americana</i>	–	–	–	–	70	2
<i>Carex</i>	17	1	–	–	10	2
<i>Carex glaucescens</i>	17	2	–	–	–	–
<i>Carpinus caroliniana</i> var. <i>caroliniana</i>	–	–	–	–	10	3
<i>Cartrema americanum</i>	17	5	29	2	80	5
<i>Carya cordiformis</i>	–	–	–	–	20	1
<i>Carya glabra</i>	–	–	–	–	80	6
<i>Castanea pumila</i>	–	–	–	–	10	2
<i>Celtis laevigata</i>	–	–	–	–	30	5
<i>Cephalanthus occidentalis</i>	–	–	14	2	–	–
<i>Ceratiola ericoides</i>	–	–	–	–	10	2
<i>Chasmanthium laxum</i>	50	2	–	–	10	2
<i>Chasmanthium sessiliflorum</i>	–	–	–	–	20	3
<i>Citrus</i>	–	–	–	–	10	2
<i>Clematis catesbyana</i>	–	–	–	–	10	2
<i>Cnidioscolus stimulosus</i>	–	–	–	–	30	2
<i>Commelina</i>	–	–	–	–	20	2
<i>Cyperus croceus</i>	17	1	–	–	–	–
<i>Dichanthelium</i>	–	–	–	–	10	1
<i>Dichanthelium commutatum</i>	33	1	14	2	40	2
<i>Dichanthelium dichotomum</i>	33	2	43	2	20	1

Table B-1 (continued). Constancy and average cover class for all vascular plant species observed in 23 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPNW = Coastal Plain Nonalluvial Wetlands (six plots); CPOU = Coastal Plain Open Uplands (seven plots); and MUFS = Maritime Upland Forests and Shrublands (Ten plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	CPNW Constancy	CPNW Cover	CPOU Constancy	CPOU Cover	MUFS Constancy	MUFS Cover
<i>Dichanthelium laxiflorum</i>	17	2	–	–	–	–
<i>Diospyros virginiana</i>	17	2	–	–	–	–
<i>Eleocharis</i>	–	–	14	2	–	–
<i>Eleocharis vivipara</i>	17	2	–	–	–	–
<i>Elephantopus nudatus</i>	–	–	–	–	20	2
<i>Endodeca serpentaria</i>	–	–	–	–	30	1
<i>Erechtites hieraciifolius</i>	–	–	–	–	20	1
<i>Erythrina herbacea</i>	–	–	–	–	30	2
<i>Euonymus americanus</i>	17	2	–	–	10	2
<i>Fraxinus americana</i>	–	–	–	–	10	5
<i>Galactia elliottii</i>	–	–	86	2	40	2
<i>Galium circaeans</i>	–	–	–	–	30	1
<i>Gaylussacia dumosa</i>	50	2	29	2	–	–
<i>Gaylussacia nana</i>	–	–	14	1	20	5
<i>Gelsemium sempervirens</i>	33	2	43	3	50	4
<i>Geobalanus oblongifolius</i>	–	–	–	–	10	2
<i>Gordonia lasianthus</i>	67	7	29	4	–	–
<i>Hamamelis virginiana</i>	–	–	–	–	20	4
<i>Hypericum cistifolium</i>	17	1	–	–	–	–
<i>Hypericum virgatum</i>	–	–	14	1	–	–
<i>Ilex ambigua</i>	17	2	14	1	30	4
<i>Ilex cassine</i>	67	3	29	2	–	–
<i>Ilex coriacea</i>	33	2	–	–	–	–
<i>Ilex glabra</i>	67	4	100	6	–	–
<i>Ilex myrtifolia</i>	33	2	14	2	–	–
<i>Ilex opaca</i>	50	3	29	4	50	4
<i>Ilex vomitoria</i>	17	2	29	3	80	5
<i>Ipomoea</i>	–	–	–	–	10	1
<i>Itea virginica</i>	33	4	14	1	–	–
<i>Juncus acuminatus</i>	33	2	–	–	–	–
<i>Juncus polycephalus</i>	17	2	–	–	–	–
<i>Juniperus [silicicola + virginiana]</i>	–	–	–	–	50	3
<i>Kelloggloa verrucosa</i>	17	1	–	–	–	–
<i>Lachnanthes caroliniana</i>	–	–	14	2	–	–
<i>Liquidambar styraciflua</i>	33	4	14	6	30	5
<i>Lonicera sempervirens</i>	–	–	–	–	10	1
<i>Lorinseria areolata</i>	33	2	–	–	–	–
<i>Lyonia ferruginea</i>	50	3	43	5	70	6
<i>Lyonia lucida</i>	67	6	–	–	10	3

Table B-1 (continued). Constancy and average cover class for all vascular plant species observed in 23 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPNW = Coastal Plain Nonalluvial Wetlands (six plots); CPOU = Coastal Plain Open Uplands (seven plots); and MUFS = Maritime Upland Forests and Shrublands (Ten plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	CPNW Constancy	CPNW Cover	CPOU Constancy	CPOU Cover	MUFS Constancy	MUFS Cover
<i>Magnolia grandiflora</i>	33	6	14	1	40	6
<i>Magnolia virginiana</i> var. <i>australis</i>	83	4	14	5	10	3
<i>Matelea</i>	–	–	–	–	20	1
<i>Melothria pendula</i>	–	–	–	–	10	1
<i>Mikania scandens</i>	–	–	–	–	10	1
<i>Mitchella repens</i>	17	1	–	–	40	2
<i>Monotropa uniflora</i>	–	–	–	–	10	1
<i>Morella cerifera</i>	67	3	29	3	30	4
<i>Morus rubra</i>	–	–	–	–	10	3
<i>Muscadinia rotundifolia</i> var. <i>rotundifolia</i>	100	5	57	4	90	4
<i>Nyssa biflora</i>	100	5	29	6	–	–
<i>Oplismenus setarius</i>	–	–	–	–	40	1
<i>Orthosia scoparia</i>	–	–	–	–	10	2
<i>Osmundastrum cinnamomeum</i>	83	3	43	2	–	–
<i>Parthenocissus quinquefolia</i>	33	2	–	–	70	3
<i>Passiflora lutea</i>	–	–	–	–	20	1
<i>Persea borbonia</i>	50	3	43	3	100	4
<i>Persea palustris</i>	83	4	57	4	–	–
<i>Phytolacca americana</i>	–	–	–	–	10	1
<i>Pinus elliotii</i>	67	5	100	6	10	4
<i>Pinus palustris</i>	–	–	14	7	–	–
<i>Pinus serotina</i>	17	3	14	5	–	–
<i>Pinus taeda</i>	17	4	–	–	10	2
<i>Pleopeltis michauxiana</i>	33	2	–	–	60	2
<i>Pluchea foetida</i> var. <i>foetida</i>	17	1	–	–	–	–
<i>Poaceae</i>	17	1	–	–	–	–
<i>Prunus caroliniana</i>	50	1	14	2	80	5
<i>Prunus serotina</i> var. <i>serotina</i>	–	–	–	–	40	3
<i>Prunus umbellata</i>	–	–	–	–	10	3
<i>Psychotria nervosa</i>	–	–	–	–	10	1
<i>Ptelea trifoliata</i>	–	–	–	–	10	2
<i>Pteridium pseudocaudatum</i>	50	2	71	3	30	3
<i>Quercus chapmanii</i>	–	–	14	2	20	4
<i>Quercus geminata</i>	–	–	–	–	10	6
<i>Quercus hemisphaerica</i>	33	3	29	4	100	6
<i>Quercus laurifolia</i>	33	6	–	–	–	–
<i>Quercus myrtifolia</i>	–	–	14	2	30	6
<i>Quercus nigra</i>	100	5	71	5	40	6

Table B-1 (continued). Constancy and average cover class for all vascular plant species observed in 23 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPNW = Coastal Plain Nonalluvial Wetlands (six plots); CPOU = Coastal Plain Open Uplands (seven plots); and MUFS = Maritime Upland Forests and Shrublands (Ten plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	CPNW Constancy	CPNW Cover	CPOU Constancy	CPOU Cover	MUFS Constancy	MUFS Cover
<i>Quercus virginiana</i>	17	4	29	6	90	6
<i>Rhexia nashii</i>	17	2	–	–	–	–
<i>Rhus copallinum</i> var. <i>copallinum</i>	17	2	–	–	20	2
<i>Rubus pensilvanicus</i>	–	–	–	–	10	1
<i>Rubus trivialis</i>	–	–	–	–	20	2
<i>Ruellia caroliniensis</i>	–	–	14	1	30	2
<i>Sabal palmetto</i>	50	3	–	–	80	6
<i>Sabatia brevifolia</i>	–	–	–	–	10	1
<i>Sapindus marginatus</i>	–	–	–	–	20	4
<i>Scleria</i>	33	2	–	–	30	2
<i>Scleria oligantha</i>	–	–	–	–	10	1
<i>Scutellaria integrifolia</i>	–	–	14	1	–	–
<i>Serenoa repens</i>	83	6	100	6	70	6
<i>Sideroxylon lycioides</i>	–	–	–	–	30	6
<i>Sideroxylon tenax</i>	–	–	–	–	50	2
<i>Smallanthus uvedalia</i>	–	–	–	–	20	2
<i>Smilax auriculata</i>	33	2	71	2	80	3
<i>Smilax bona-nox</i>	33	1	14	1	70	3
<i>Smilax glauca</i>	100	2	71	3	60	2
<i>Smilax laurifolia</i>	33	2	–	–	–	–
<i>Smilax pumila</i>	17	2	–	–	60	3
<i>Smilax rotundifolia</i>	33	2	14	2	30	3
<i>Smilax walteri</i>	17	1	–	–	–	–
<i>Solanum americanum</i>	–	–	–	–	10	1
<i>Solidago fistulosa</i>	–	–	14	2	–	–
<i>Strophostyles helvola</i>	–	–	–	–	20	1
<i>Styrax grandifolius</i>	–	–	–	–	10	1
<i>Swida asperifolia</i>	–	–	–	–	30	2
<i>Symplocos tinctoria</i>	–	–	–	–	40	3
<i>Tilia americana</i> var. <i>caroliniana</i>	–	–	–	–	10	4
<i>Tillandsia bartramii</i>	17	1	–	–	–	–
<i>Tillandsia recurvata</i>	17	1	14	1	80	2
<i>Tillandsia usneoides</i>	83	2	29	2	100	5
<i>Toxicodendron radicans</i> var. <i>radicans</i>	33	2	–	–	60	2
<i>Tradescantia ohiensis</i>	–	–	–	–	10	1
<i>Vaccinium arboreum</i>	17	1	–	–	60	4
<i>Vaccinium caesariense</i>	–	–	14	4	–	–
<i>Vaccinium fuscum</i>	83	3	29	2	60	5
<i>Vaccinium myrsinites</i>	–	–	14	3	20	5

Table B-1 (continued). Constancy and average cover class for all vascular plant species observed in 23 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPNW = Coastal Plain Nonalluvial Wetlands (six plots); CPOU = Coastal Plain Open Uplands (seven plots); and MUFS = Maritime Upland Forests and Shrublands (Ten plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	CPNW Constancy	CPNW Cover	CPOU Constancy	CPOU Cover	MUFS Constancy	MUFS Cover
<i>Vaccinium stamineum</i>	33	2	43	3	50	3
<i>Verbesina virginica</i> var. <i>virginica</i>	–	–	–	–	20	3
<i>Vernonia gigantea</i>	–	–	–	–	10	2
<i>Vitis aestivalis</i> var. <i>aestivalis</i>	–	–	–	–	20	2
<i>Vitis vulpina</i>	–	–	–	–	10	3
<i>Youngia japonica</i>	–	–	–	–	10	1

Table B-2. Basal area (BA, m²/ha) and density (Den, count/ha) of woody vascular plant species observed in 23 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPNW = Coastal Plain Nonalluvial Wetlands (six plots); CPOU = Coastal Plain Open Uplands (seven plots); and MUFS = Maritime Upland Forests and Shrublands (ten plots).

Species	CPNW Tree BA	CPNW Tree DEN	CPNW Sapling BA	CPNW Sapling Den	CPNW Seedling Den	CPOU Tree BA	CPOU Tree DEN	CPOU Sapling BA	CPOU Sapling Den	CPOU Seedling Den	MUFS Tree BA	MUFS Tree DEN	MUFS Sapling BA	MUFS Sapling Den	MUFS Seedling Den
<i>Acer rubrum</i>	–	–	0.00	21	2708	0.05	4	0.00	18	179	–	–	–	–	–
<i>Agarista populifolia</i>	–	–	0.00	63	208	–	–	–	–	–	–	–	0.00	225	750
<i>Aralia spinosa</i>	–	–	0.00	21	–	–	–	–	–	–	–	–	–	–	–
<i>Asimina incana</i>	–	–	–	–	–	–	–	–	–	536	–	–	–	–	–
<i>Asimina parviflora</i>	–	–	–	–	625	–	–	–	–	–	–	–	0.00	50	250
<i>Bignonia capreolata</i>	–	–	0.00	21	833	–	–	–	–	–	–	–	–	–	2250
<i>Carpinus caroliniana</i> var. <i>caroliniana</i>	–	–	–	–	–	–	–	–	–	–	–	–	0.00	100	125
<i>Cartrema americanum</i>	–	–	0.00	104	–	–	–	–	–	–	0.15	13	0.02	838	3000
<i>Carya cordiformis</i>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	250
<i>Carya glabra</i>	–	–	–	–	–	–	–	–	–	–	2.16	30	–	–	125
<i>Celtis laevigata</i>	–	–	–	–	–	–	–	–	–	–	0.27	13	0.00	63	1375
<i>Citrus</i>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	125
<i>Euonymus americanus</i>	–	–	–	–	208	–	–	–	–	–	–	–	0.00	13	–
<i>Fraxinus americana</i>	–	–	–	–	–	–	–	–	–	–	0.22	3	–	–	500
<i>Gaylussacia dumosa</i>	–	–	–	–	417	–	–	–	–	–	–	–	–	–	–
<i>Gaylussacia nana</i>	–	–	–	–	–	–	–	–	–	536	–	–	0.00	38	6250
<i>Gelsemium sempervirens</i>	–	–	0.01	333	–	–	–	0.04	1964	1429	–	–	0.01	500	1375
<i>Geobalanus oblongifolius</i>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1000
<i>Gordonia lasianthus</i>	8.21	363	0.01	646	1667	0.10	4	–	–	–	–	–	–	–	–
<i>Hamamelis virginiana</i>	–	–	–	–	–	–	–	–	–	–	–	–	0.00	150	1750
<i>Ilex ambigua</i>	–	–	0.00	42	–	–	–	–	–	–	–	–	0.01	413	125
<i>Ilex cassine</i>	0.07	4	0.00	188	833	–	–	0.00	54	714	–	–	–	–	–
<i>Ilex coriacea</i>	–	–	0.00	146	833	–	–	–	–	–	–	–	–	–	–
<i>Ilex glabra</i>	–	–	0.01	604	4792	–	–	0.15	7446	22321	–	–	–	–	–
<i>Ilex myrtifolia</i>	–	–	0.00	63	–	–	–	–	–	–	–	–	–	–	–
<i>Ilex opaca</i>	0.08	8	0.00	83	208	0.06	4	–	–	536	0.03	3	0.00	38	125
<i>Ilex vomitoria</i>	–	–	0.00	42	1667	0.04	4	–	–	179	–	–	0.01	638	13500
<i>Itea virginica</i>	–	–	0.02	1146	2708	–	–	–	–	179	–	–	–	–	–
<i>Juniperus [silicicola + virginiana]</i>	–	–	–	–	–	–	–	–	–	–	0.16	10	–	–	–

Table B-2 (continued). Basal area (BA, m²/ha) and density (Den, count/ha) of woody vascular plant species observed in 23 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPNW = Coastal Plain Nonalluvial Wetlands (six plots); CPOU = Coastal Plain Open Uplands (seven plots); and MUFS = Maritime Upland Forests and Shrublands (ten plots).

Species	CPNW Tree BA	CPNW Tree DEN	CPNW Sapling BA	CPNW Sapling Den	CPNW Seedling Den	CPOU Tree BA	CPOU Tree DEN	CPOU Sapling BA	CPOU Sapling Den	CPOU Seedling Den	MUFS Tree BA	MUFS Tree DEN	MUFS Sapling BA	MUFS Sapling Den	MUFS Seedling Den
<i>Liquidambar styraciflua</i>	0.24	8	–	–	–	0.16	11	0.00	71	–	1.18	13	0.00	25	–
<i>Lyonia ferruginea</i>	–	–	–	–	–	–	–	0.00	232	–	0.04	3	0.02	1163	3750
<i>Lyonia lucida</i>	–	–	0.03	1333	20208	–	–	–	–	–	–	–	–	–	625
<i>Magnolia grandiflora</i>	3.53	13	–	–	–	–	–	–	–	–	1.51	30	–	–	500
<i>Magnolia virginiana</i> var. <i>australis</i>	0.70	25	0.00	21	208	0.15	7	0.00	18	–	–	–	–	–	–
<i>Morella cerifera</i>	–	–	0.00	63	208	–	–	–	–	1071	–	–	0.00	238	1375
<i>Morus rubra</i>	–	–	–	–	–	–	–	–	–	–	0.04	3	–	–	–
<i>Muscadinia rotundifolia</i> var. <i>rotundifolia</i>	–	–	0.02	979	2708	–	–	0.01	357	536	–	–	0.01	738	1375
<i>Nyssa biflora</i>	3.99	117	0.00	21	2292	0.18	14	0.00	71	–	–	–	–	–	–
<i>Parthenocissus quinquefolia</i>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	750
<i>Persea borbonia</i>	–	–	0.00	125	1458	0.03	4	–	–	1250	0.03	3	0.01	313	1375
<i>Persea palustris</i>	–	–	0.01	667	9167	–	–	0.00	125	2143	0.11	3	–	–	–
<i>Pinus elliotii</i>	6.63	71	–	–	417	13.82	336	0.00	196	–	–	–	–	–	–
<i>Pinus palustris</i>	–	–	–	–	–	1.53	104	0.00	54	–	–	–	–	–	–
<i>Pinus serotina</i>	0.48	8	–	–	–	0.29	4	–	–	–	–	–	–	–	–
<i>Pinus taeda</i>	0.34	4	–	–	–	–	–	–	–	–	–	–	–	–	–
<i>Prunus caroliniana</i>	–	–	–	–	–	–	–	–	–	–	0.07	3	0.00	175	11875
<i>Prunus serotina</i> var. <i>serotina</i>	–	–	–	–	–	–	–	–	–	–	0.16	5	–	–	125
<i>Ptelea trifoliata</i>	–	–	–	–	–	–	–	–	–	–	–	–	0.00	13	–
<i>Quercus chapmanii</i>	–	–	–	–	–	–	–	0.00	71	1250	–	–	0.00	75	375
<i>Quercus geminata</i>	–	–	–	–	–	–	–	–	–	–	0.22	15	0.00	250	8750
<i>Quercus hemisphaerica</i>	0.07	4	0.00	63	833	0.47	11	–	–	–	2.63	83	0.01	513	16375
<i>Quercus laurifolia</i>	0.34	33	–	–	208	–	–	–	–	–	–	–	–	–	–
<i>Quercus myrtifolia</i>	–	–	–	–	–	–	–	–	–	1429	–	–	0.01	375	6250
<i>Quercus nigra</i>	3.00	113	0.00	104	625	1.28	89	0.00	54	357	0.61	33	0.01	338	250
<i>Quercus virginiana</i>	0.14	4	0.00	21	–	0.90	39	–	–	2679	10.78	78	0.00	188	8000
<i>Sabal palmetto</i>	0.22	4	–	–	–	–	–	–	–	–	2.72	35	0.01	550	1375
<i>Sapindus marginatus</i>	–	–	–	–	–	–	–	–	–	–	–	–	0.00	188	1750

Table B-2 (continued). Basal area (BA, m²/ha) and density (Den, count/ha) of woody vascular plant species observed in 23 Southeast Coast Network vegetation monitoring plots. Broad Habitat Type Codes are as follows: CPNW = Coastal Plain Nonalluvial Wetlands (six plots); CPOU = Coastal Plain Open Uplands (seven plots); and MUFS = Maritime Upland Forests and Shrublands (ten plots).

Species	CPNW Tree BA	CPNW Tree DEN	CPNW Sapling BA	CPNW Sapling Den	CPNW Seedling Den	CPOU Tree BA	CPOU Tree DEN	CPOU Sapling BA	CPOU Sapling Den	CPOU Seedling Den	MUFS Tree BA	MUFS Tree DEN	MUFS Sapling BA	MUFS Sapling Den	MUFS Seedling Den
<i>Serenoa repens</i>	–	–	0.10	5313	833	–	–	0.01	571	2143	–	–	0.02	788	2875
<i>Sideroxylon lycioides</i>	–	–	–	–	–	–	–	–	–	–	–	–	0.02	850	4750
<i>Sideroxylon tenax</i>	–	–	–	–	–	–	–	–	–	–	–	–	0.00	75	1500
<i>Smilax auriculata</i>	–	–	–	–	833	–	–	0.00	250	1071	–	–	0.01	313	625
<i>Smilax bona-nox</i>	–	–	–	–	–	–	–	–	–	179	–	–	0.01	350	1250
<i>Smilax glauca</i>	–	–	0.00	146	2083	–	–	0.01	518	3750	–	–	0.00	25	1000
<i>Smilax laurifolia</i>	–	–	0.00	42	–	–	–	–	–	–	–	–	–	–	–
<i>Smilax pumila</i>	–	–	–	–	417	–	–	–	–	–	–	–	0.00	25	4375
<i>Smilax rotundifolia</i>	–	–	–	–	2292	–	–	–	–	179	–	–	0.00	88	250
<i>Swida asperifolia</i>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	125
<i>Symplocos tinctoria</i>	–	–	–	–	–	–	–	–	–	–	–	–	0.00	75	750
<i>Toxicodendron radicans</i> var. <i>radicans</i>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1500
<i>Vaccinium arboreum</i>	–	–	–	–	–	–	–	–	–	–	–	–	0.01	350	2500
<i>Vaccinium caesariense</i>	–	–	–	–	–	–	–	–	–	536	–	–	–	–	–
<i>Vaccinium fuscatum</i>	–	–	0.00	146	1042	–	–	0.00	71	–	–	–	0.01	350	6125
<i>Vaccinium myrsinites</i>	–	–	–	–	–	–	–	–	–	536	–	–	0.00	100	4250
<i>Vaccinium stamineum</i>	–	–	0.00	42	–	–	–	0.00	18	536	–	–	0.00	100	1125
<i>Vitis aestivalis</i> var. <i>aestivalis</i>	–	–	–	–	–	–	–	–	–	–	–	–	0.00	13	–
<i>Vitis vulpina</i>	–	–	–	–	–	–	–	–	–	–	–	–	0.00	63	–

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