



# Vegetation Community Monitoring at Fort Sumter National Monument, 2012

Natural Resource Data Series NPS/SECN/NRDS—2014/711



**ON THE COVER**

Trailing wild bean (*Strophostyles helvola*) in the dunes at Fort Sumter National Monument.  
Photograph by: Sarah C. Heath, SECN Botanist.

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## Executive Summary

In 2009, the National Park Service Southeast Coast Network (SECN) Inventory and Monitoring Network began collecting vegetation community data as part of the NPS Vital Signs monitoring program. Information collected under this Vital Sign will be used to help managers make better-informed decisions by understanding trends and variability related to plant species, frequency of occurrence, percent cover, diversity, and distribution in the groundcover, shrub, and canopy strata.

Within each stratum, vegetation communities were sampled using hybrid methods following the North Carolina Vegetation Survey nested-subplot design (Peet et al. 1998) within a circular plot similar to the Forest Inventory and Analysis protocol (Bechtold and Patterson 2005). This report summarizes vegetation community data collected at Fort Sumter National Monument in 2012.

- Data were collected at four sampling locations at FOSU from 7/2/2012 through 7/3/2012.
- Monitoring efforts resulted in the addition of five species, subspecies, or varieties to the park's species list.
- Absolute canopy cover across the park was approximately 42.98%.
- Hackberry (*Celtis laevigata*) frequently occurring species in the shrub stratum.
- Hercules club (*Zanthoxylum clava-herculis*) had the highest relative cover in the shrub stratum, red mulberry (*Morus rubra*) had the second-highest relative cover in the shrub stratum.
- Wax myrtle (*Morella cerifera*) had the highest absolute cover, while Carolina laurel cherry (*Prunus caroliniana*) had the second-highest cover in the groundcover stratum.
- Earleaf greenbriar and southern dewberry (*Rubus trivialis*) were the most frequently occurring species in the shrub stratum.
- Leaf litter and bare ground were the most frequently occurring ground condition at the park, and also had the highest relative and absolute cover of any ground condition.
- Pecan (*Carya illinoensis*) had the largest average diameter at breast height (DBH) of any canopy species at the park where more than two individuals were measured.
- Carolina laurel cherry (*Prunus caroliniana*) had the highest estimated seedling density at the park.

The full dataset, and associated metadata, can be acquired from the data store at <http://irma.nps.gov>



## List of Terms

**Absolute cover:** The total amount of ground surface that is covered by each species or group. This metric describes the amount of cover that each species or group represents in a stratum and is expressed as a percentage that can exceed 100% due to overlap. This metric is calculated as the total cover of each species or group divided by the total possible cover for a plot.

**Canopy species:** Woody species known to occur in the midstory or overstory of the canopy, or shrub species that grow greater than or equal to four centimeters DBH and are measureable at breast height (1.4 m).

**Canopy stratum:** The structural zone above 1.1 meters (i.e., elbow height of a typical observer per densiometer instructions), which consists of all live and dead plant material that affects the amount of light penetrating to the ground. This includes individual elements whose cover is also potentially measured and accounted for in the shrub- or groundcover-stratum measurements but exceeds 1.1 meters in height, is detected by the densiometer, and contributes to canopy cover. This stratum can also be referred to as the midstory, overstory, or sub-canopy.

**Cover:** The vertical projection of the outermost extent of a species, or the extent of the shadow cast by the species if the sun were directly overhead. Cover is also known as foliar cover.

**DBH:** Diameter at breast height, or 1.4 meters above the ground surface.

**Frequency:** The number of times a species or group is detected in a plot, expressed as a percentage. This provides information on the regularity with which a species or group is encountered.

**Groundcover stratum:** The structural zone that consists of all non-woody species (i.e., forbs and graminoids) and all woody species (i.e., shrubs and trees) with a DBH of less than four centimeters and seedlings 30 centimeters or less in height.

**Relative cover:** The cover of each species or group as a function of all other plant species that occurred in a plot. This metric describes the percentage of cover that each species represents out of the total vegetative cover in a stratum, is expressed as a percentage, and always sums to 100%. Relative cover is calculated as the total cover of each species or group divided by the sum of the cover of all other species that occur in a plot.

**Seedlings:** Woody dicotyledonous plants less than 30 centimeters in height.

**Shrub stratum:** All woody species greater than 30 centimeters in height with a DBH of less than four centimeters.

**Stratum:** A structural size category of vegetation at a site. These are the canopy, shrub, and groundcover layers.



# 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 and wildlife habitat for many species, and function as a carbon sink, produce oxygen, cycle nutrients and energy through an ecosystem. Additionally, plants influence the local climate, improve water quality, and moderate flooding and erosion. Determining trends in vegetation communities is vital to understanding the ecological processes occurring at a site and identifying stressors and their impacts.

Vegetation communities are dynamic with constant changes in composition, cover, distribution, and structure in response to natural or anthropogenic stressors. Disturbance is the primary stressor and regulating mechanism of Southeast Coast Network (SECN) vegetation communities. The timing, type, and extent of a disturbance generally evoke a distinguishable response in the species composition, diversity, and structure of the landscape (Foster et al. 1998; Turner et al. 1990). The primary natural disturbance processes in SECN parks are fire and weather (e.g., hurricanes and drought). Anthropogenic influences include fire suppression, landscape fragmentation, altered hydrology, and non-native species introduction.

The SECN parks host a diverse assemblage of vegetation communities. Approximately 180 vegetation associations (i.e., fine-resolution floristic description), as defined by the National Vegetation and Classification System (FGDC 2008), occur in the SECN. These include sparsely vegetated primary dune communities, late successional old-growth bottomland hardwood forest communities, and highly diverse herbaceous-dominated mesic pine savannah communities.

Given the widespread anthropogenic influences in SECN parks and the importance of vegetation communities, quantifying trends in vegetation cover, frequency, diversity, and distribution is a high priority (DeVivo et al. 2008). An evaluation of trends in these metrics provides a measure for assessing the ecological integrity and sustainability in southeastern systems and identifying the need for specific management activities on our park lands. The National Park Service Omnibus Management Act of 1998, and other reinforcing policies and regulations, require park managers “to establish baseline information and to provide information on the long-term trends in the condition of National Park System resources” (Title II, Sec. 204). The vegetation community monitoring data summarized herein is a tool to assist park managers in fulfilling this mandate.

This report summarizes vegetation community Vital Signs monitoring data collected at Fort Sumter National Monument (FOSU) in August, 2012.

## Monitoring Objectives

To characterize the effects of landscape and local ecosystem drivers on vegetation communities, the SECN monitors several components of community structure, function, and composition. Each component illustrates community change dynamics, and data from the following five monitoring objectives are presented:

1. Determine trends in plant species richness and diversity in the groundcover, shrub, and canopy strata.
2. Determine trends in the percent cover of vegetation in the groundcover, shrub, and canopy strata.
3. Determine trends in the frequency of species in the groundcover stratum.
4. Determine trends in the diameter at breast height (DBH) of canopy species.
5. Determine trends in woody species seedling counts in the groundcover stratum.

## Methods

### Study Area

FOSU is located at the mouth of the Charleston Harbor and on the southern tip of Sullivan's Island in Charleston, South Carolina (Figure 1). The Monument is co-administered with Charles Pinckney National Historic Site (CHPI), although CHPI was not included as part of this monitoring effort. The Monument is 81 ha (200 ac), of which approximately 50 ha (122 ac) is submerged in the harbor. Although the Monument is primarily managed as an important cultural site (i.e., it was the site of the first engagement of the Civil War), it also contains natural resources that provide important stopover sites for migratory birds. Additionally, an accreted area adjacent to the Fort and the beachfront areas on Sullivan's Island provide foraging habitat for shorebirds year-round.

Vegetation is sparse around the fort itself, and consists primarily of early-successional tidal forbs (e.g., *Batis maritima*). The vegetation communities in the Fort Moultrie unit on Sullivan's Island are somewhat more complex, although impacted from a long history of anthropogenic influences, and consist of primarily dune, beach, and maritime hammock communities, and manicured lawn. The primary dune is characterized by sea oats (*Uniola paniculata*), while the maritime hammock is dominated by Virginia live oak (*Quercus virginiana*).

FOSU has 276 known vascular plant species, subspecies, and varieties (Appendix A).

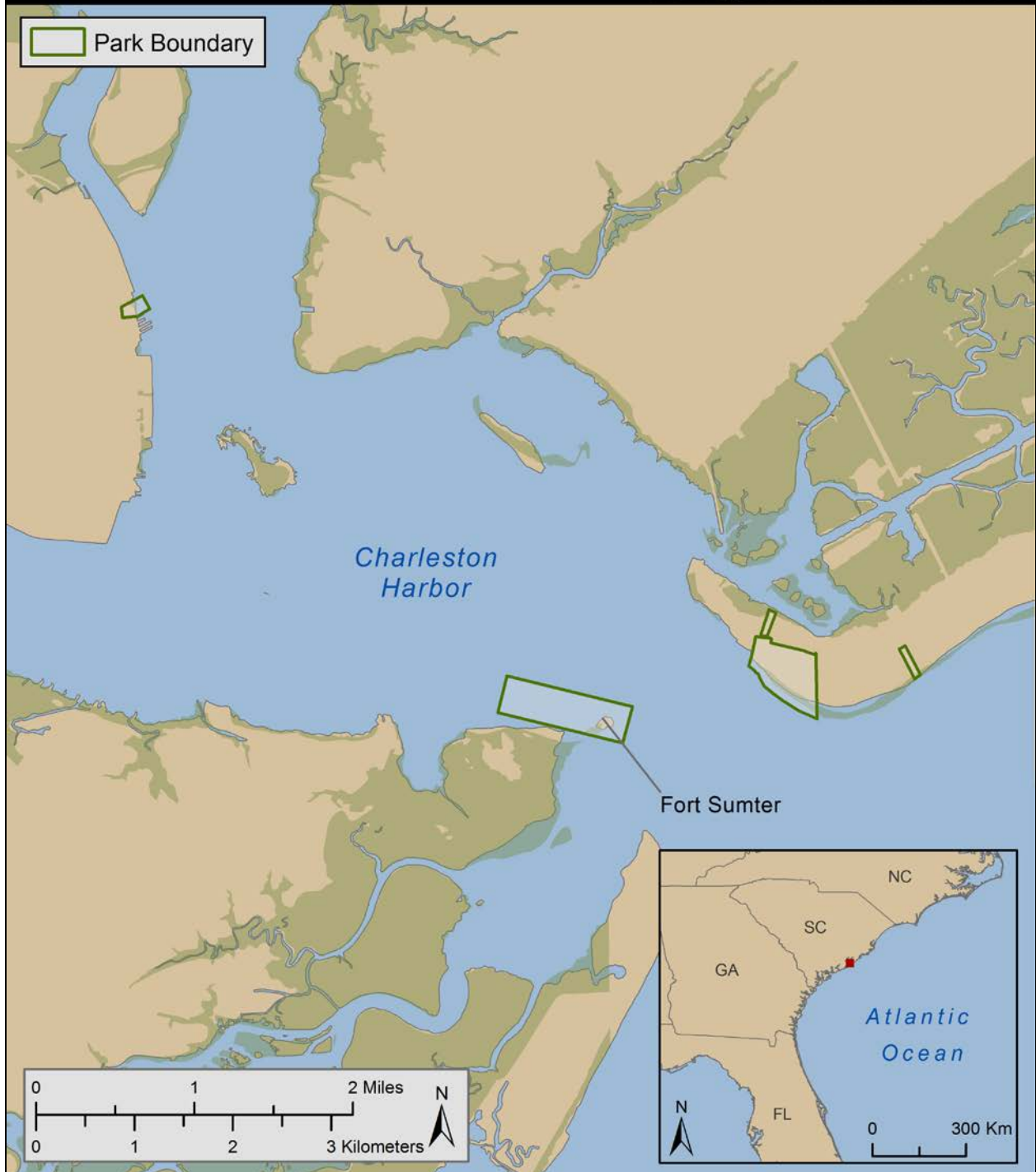
### Sampling Design

To allow for park-wide inference, FOSU's administrative boundary was used as the sampling frame, in which 30 permanent spatially-balanced random sampling locations were selected for monitoring vegetation, landbird, and vocal anuran communities. Sampling locations were selected using the Reversed Randomized Quadrant-Recursive Raster (RRQRR) algorithm (Figure 2; Theobald et al. 2007 as presented in Byrne et al. 2013). All sampling locations occur within naturally-vegetated areas suitable for co-located Vital Signs monitoring efforts (Byrne et al. 2013).

Vegetation communities were monitored at FOSU from 7/2/2012 through 7/3/2012.

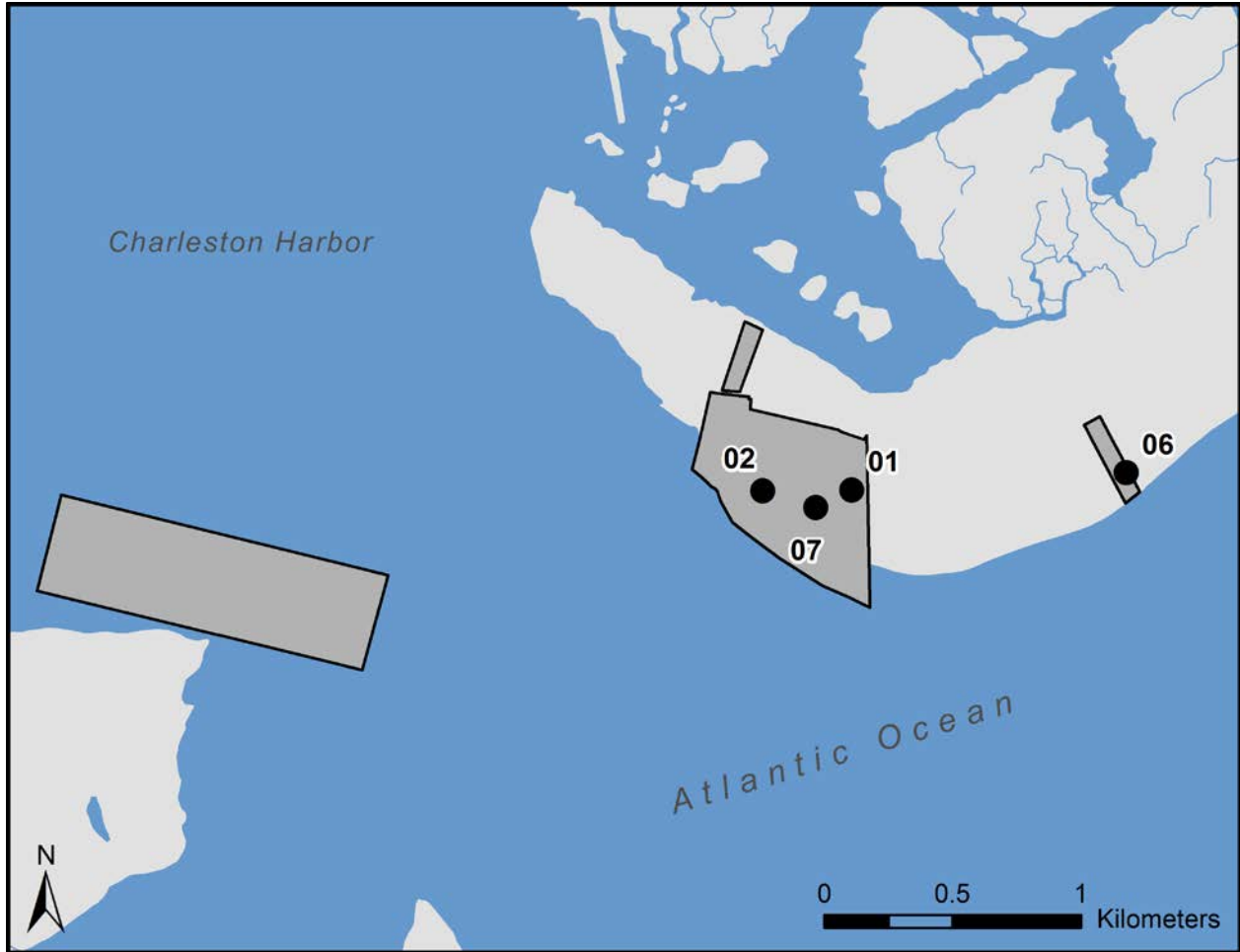
# Fort Sumter National Monument

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



**Figure 1.** Location of Fort Sumter National Monument, SC.



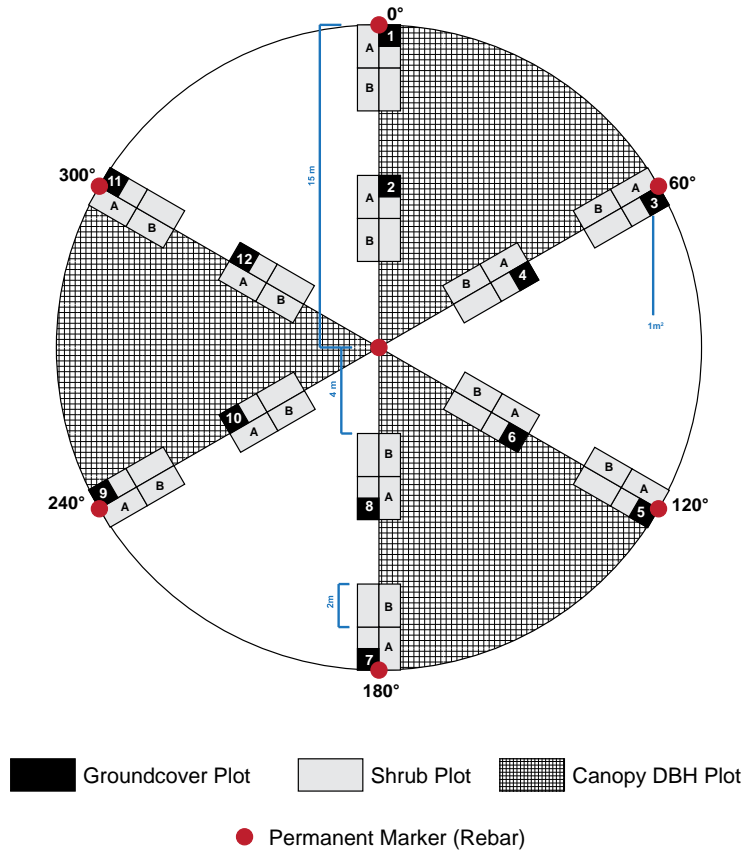


**Figure 2.** Spatially-balanced random sampling locations at Fort Sumter National Monument, 2012.

## Sampling Methodology

Vegetation community measures were divided into three strata based on height, canopy, shrub, and groundcover. Within each stratum, vegetation communities were sampled using hybrid methods following the North Carolina Vegetation Survey nested-subplot design (Peet et al. 1998) within a circular plot similar to the Forest Inventory and Analysis protocol (Bechtold and Patterson 2005).

The plot layout consisted of a circular plot with a radius of 15 meter within each 0.5-hectare sampling location. Subplots were systematically placed along six transects that radiated out from the center point at azimuths of 0°/360°, 60°, 120°, 180°, 240°, and 300° (Figure 3). To avoid overlap, subplots originated four meters from the plot array (i.e., 0.5-ha grid) center point and extended away from the center point. Canopy cover, shrub cover, DBH, canopy species seedling frequency, and herbaceous cover data were collected in the nested subplots within each plot. Canopy cover was measured from the center point of the 0.5-hectare sampling location. Shrub coverage was measured in two 2- by 4-meter shrub plots along each transect. Shrub plots were further subdivided into 2- by 2-meter subplots to improve cover estimation accuracy and precision (solid gray shading; Figure 3). Shrub and herbaceous cover is estimated in one of eight coverage classes (Table 1). Groundcover coverage, groundcover nested frequency, and seedling frequency were measured in two 1- by 1-meter groundcover plots (solid black shading; Figure 3) along each transect. Canopy species DBH was measured in three sections, each representing 1/3 of the total circular plot (hashed gray shading; Figure 3). A comprehensive species list was also compiled for all species occurring in the 0.5-hectare sampling location. See Byrne and Corbett 2012; Byrne, Corbett, and Smrekar 2013; Corbett and Byrne 2012a; Corbett and Byrne 2012b; and Corbett 2013 for detailed field methods.



**Figure 3.** Southeast Coast Network vegetation community monitoring plot and subplot layout identifying the juxtaposition of canopy cover, canopy diameter, shrub, and groundcover plots within a circular array. Although not depicted, the above array is positioned at the center point of each 0.5-hectare sampling location.

**Table 1.** Cover estimation coverage class, percent cover range, and value used for analyses.

Coverage Class	Percent Cover Range	Value Used for Analyses
0	0%	0.0
1	Trace (<1%)	0.5
2	1-5%	2.5
3	5-25%	15.0
4	25-50%	37.5
5	50-75%	62.5
6	75-95%	85.0
7	95-100%	97.5



## Findings

We detected 62 taxa during this monitoring effort (Appendix A), including five species, subspecies, and varieties not previously known to occur at FOSU (Table 2). We detected four occurrences with uncertain taxonomic affinity (Appendix A) that were identified only to genus, family, or a higher taxonomic level.

Highlights by monitoring objective include:

### **Plant Species Richness And Diversity In The Groundcover, Shrub, And Canopy Strata.**

- Five species new to the Monument species list were detected (Table 2).

### **Percent Cover Of Vegetation In The Groundcover, Shrub, And Canopy Strata.**

- Absolute canopy cover was showed great variability across all sampling locations ( $\bar{x}$  = 42.98%, SD = 43.32; Table 3).
- Hackberry (*Celtis laevigata*) was the most frequently occurring shrub species ( $f$  = 75.00).
- Hercules club (*Zanthoxylum clava-herculis*) also had the highest relative cover in the shrub stratum ( $\bar{x}$  = 25.00%, SD = 50.00; Table 5). Red mulberry (*Morus rubra*) had the second-highest relative cover ( $\bar{x}$  = 21.05%, SD = 42.11) in the shrub stratum (Table 5).
- Wax myrtle (*Morella cerifera*) had the highest absolute cover in the shrub stratum ( $\bar{x}$  = 11.07%, SD = 16.33; Table 5). Carolina laurel cherry (*Prunus caroliniana*) had the second-highest absolute cover ( $\bar{x}$  = 8.72%, SD = 10.08) in the shrub stratum (Table 5).
- Earleaf greenbriar (*Smilax auriculata*) had the highest relative cover in the groundcover stratum ( $\bar{x}$  = 21.77%, SD = 11.80), followed by poison ivy (*Toxicodendron radicans*;  $\bar{x}$  = 12.81%, SD = 16.08; Table 6).
- Earleaf greenbriar also had the highest absolute cover in the groundcover stratum ( $\bar{x}$  = 25.83%, SD = 11.95), while poison ivy had the second-highest absolute cover ( $\bar{x}$  = 17.36%, SD = 20.89; Table 7).
- Leaf litter was the most common ground condition, with a relative cover of 73.75% (SD 21.57; Table 6) and an absolute cover of 71.41% (SD 25.26; Table 7).

### **Frequency Of Species In The Groundcover Stratum.**

- Earleaf greenbriar ( $f$  =100) and southern dewberry (*Rubus trivialis*;  $f$  =100) were the most frequently occurring species in the groundcover stratum, respectively (Table 6).
- Leaf litter and bare ground were the most frequently occurring ground conditions at the park ( $f$  = 100; Table 6).

### DBH Of Canopy Species.

- The largest tree detected on average where more than one individual was measured was pecan (*Carya illinoensis*;  $\bar{x}$  = 21.05 cm, SD = 6.32; Table 8).

### Woody Species Seedling Counts In The Groundcover Stratum.

- Carolina laurel cherry (*Prunus caroliniana*) had the highest estimated seedling density at the park (4.29/m<sup>2</sup>, SD=1.24; Table 9).

**Table 2.** New vascular plant species, subspecies, or varieties found at Fort Sumter National Monument, 2012.

Order	Family	Species	Nativity
Fagales	Juglandaceae	<i>Carya alba</i>	Native
Magnoliales	Magnoliaceae	<i>Magnolia grandiflora</i>	Native
Psilotales	Psilotaceae	<i>Psilotum nudum</i>	Native
Malpighiales	Euphorbiaceae	<i>Sapium sebiferum</i>	Non-Native
Poales	Poaceae	<i>Schizachyrium littorale</i>	Native

**Table 3.** Average canopy cover for vegetation monitoring macroplots at Fort Sumter National Monument, 2012. Average canopy cover is based on data pooled across observers at each sampling location.

<b>Sampling Location</b>	<b>Average</b>	<b>Standard Deviation</b>
FOSU001	86.17	2.36
FOSU002	0.00	0.00
FOSU006	0.00	0.00
FOSU007	85.75	2.29
<b>Park Average</b>	<b>42.98</b>	<b>43.32</b>

**Table 4.** Percentage of vegetation cover (relative cover) and frequency (Freq) of occurrence of shrub species in vegetation monitoring sampling locations at Fort Sumter National Monument, 2012. Relative cover is averaged across shrub plots at each sampling location, and park-wide calculations are averaged (Avg) across all sampling locations with standard deviation (SD).

<b>Species</b>	<b>Frequency</b>	<b>Average Cover</b>	<b>Standard Deviation</b>	<b>FOSU001</b>	<b>FOSU002</b>	<b>FOSU006</b>	<b>FOSU007</b>
<i>Baccharis halimifolia</i>	25	0.90	1.80				3.61
<i>Celtis laevigata</i>	75	5.00	7.35	3.53		15.79	0.70
<i>Ilex vomitoria</i>	50	8.52	14.80	30.59			3.49
<i>Juniperus virginiana</i> var. <i>silicicola</i>	50	3.51	4.78	3.92			10.13
<i>Ligustrum sinense</i>	50	2.92	3.86	3.53			8.15
<i>Morella cerifera</i>	50	14.22	18.42	18.24			38.65
<i>Morus rubra</i>	25	21.05	42.11			84.21	
<i>Pinus taeda</i>	25	0.05	0.10	0.20			
<i>Prunus angustifolia</i>	25	3.29	6.58				13.15
<i>Prunus caroliniana</i>	50	13.16	16.29	33.53			19.09
<i>Quercus nigra</i>	25	0.29	0.59	1.18			
<i>Quercus virginiana</i>	50	1.74	2.04	3.92			3.03
<i>Sapium sebiferum</i>	25	0.34	0.69	1.37			
<i>Zanthoxylum clava-herculis</i>	25	25.00	50.00		100.00		



**Table 5.** Percentage of area covered (absolute cover) and frequency of occurrence of shrub species sampled in vegetation monitoring sampling locations at Fort Sumter National Monument, 2012. Absolute cover is averaged across shrub plots at each sampling location, and park-wide calculations are averaged across all sampling locations. [Freq – Frequency; Avg – Average; SD – Standard Deviation].

<b>Species</b>	<b>Frequency</b>	<b>Average</b>	<b>Standard Deviation</b>	<b>FOSU001</b>	<b>FOSU002</b>	<b>FOSU006</b>	<b>FOSU007</b>
<i>Baccharis halimifolia</i>	25	0.81	1.61				3.23
<i>Celtis laevigata</i>	75	0.94	0.81	1.88		1.25	0.63
<i>Ilex vomitoria</i>	50	4.84	7.75	16.25			3.13
<i>Juniperus virginiana</i> var. <i>silicicola</i>	50	2.79	4.30	2.08			9.06
<i>Ligustrum sinense</i>	50	2.29	3.45	1.88			7.29
<i>Morella cerifera</i>	50	11.07	16.33	9.69			34.58
<i>Morus rubra</i>	25	1.67	3.33			6.67	
<i>Pinus taeda</i>	25	0.03	0.05	0.10			
<i>Prunus angustifolia</i>	25	2.94	5.89				11.77
<i>Prunus caroliniana</i>	50	8.72	10.08	17.81			17.08
<i>Quercus nigra</i>	25	0.16	0.31	0.63			
<i>Quercus virginiana</i>	50	1.20	1.41	2.08			2.71
<i>Sapium sebiferum</i>	25	0.18	0.36	0.73			
<i>Zanthoxylum clava-herculis</i>	25	0.16	0.31		0.63		

**Table 6.** Percentage of vegetation cover (relative cover) and frequency of occurrence of groundcover species in vegetation monitoring sampling locations at Fort Sumter National Monument, 2012. Relative cover is averaged across groundcover plots at each sampling location, and park-wide calculations are averaged across all sampling locations. [Freq – Frequency; Avg – Average; SD – Standard Deviation].

Species	Average	Standard Deviation	Frequency	FOSU001	FOSU002	FOSU006	FOSU007
<i>Ampelopsis arborea</i>	1.56	1.88	50.00	3.75		2.50	
<i>Berchemia scandens</i>	0.31	0.63	25.00				1.25
<i>Campsis radicans</i>	0.68	0.79	50.00	1.25			1.46
<i>Celtis laevigata</i>	1.42	1.98	50.00	4.21			1.46
<i>Cenchrus</i> sp.	1.61	3.23	25.00		6.46		
<i>Cladium mariscus</i> ssp. <i>jamaicense</i>	0.31	0.63	25.00	1.25			
<i>Conyza canadensis</i>	0.68	1.35	25.00		2.71		
<i>Croton punctatus</i>	0.31	0.63	25.00		1.25		
Cyperaceae	0.05	0.10	25.00		0.21		
<i>Galium</i> sp.	0.43	0.72	50.00	1.50	0.21		
<i>Heterotheca subaxillaris</i>	2.55	4.19	50.00		8.75	1.46	
<i>Hydrocotyle bonariensis</i>	0.73	1.32	50.00		0.21	2.71	
<i>Ilex vomitoria</i>	0.94	1.20	50.00	2.50			1.25
<i>Ipomoea imperati</i>	0.31	0.63	25.00		1.25		
<i>Juniperus virginiana</i> var. <i>silicicola</i>	0.10	0.21	25.00	0.42			
<i>Ligustrum sinense</i>	0.31	0.63	25.00	1.25			
<i>Morella cerifera</i>	0.31	0.63	25.00				1.25
<i>Oenothera drummondii</i>	4.17	4.96	75.00		10.21	6.25	0.21
<i>Opuntia</i> sp.	0.73	0.73	75.00		1.25	0.21	1.46
<i>Panicum amarum</i>	1.30	1.87	50.00		3.96	1.25	
<i>Parthenocissus quinquefolia</i>	3.49	4.14	50.00	8.13			5.83
<i>Physalis walteri</i>	0.31	0.63	25.00	1.25			
<i>Pinus taeda</i>	0.06	0.13	25.00	0.25			
<i>Prunus caroliniana</i>	3.59	4.34	50.00	5.63			8.75
<i>Quercus virginiana</i>	0.31	0.63	25.00	1.25			
<i>Rubus trivialis</i>	2.30	1.18	100.00	1.46	1.25	2.71	3.79

**Table 6.** (Continued.)

<b>Species</b>	<b>Average</b>	<b>Standard Deviation</b>	<b>Frequency</b>	<b>FOSU001</b>	<b>FOSU002</b>	<b>FOSU006</b>	<b>FOSU007</b>
<i>Smilax auriculata</i>	21.77	11.80	100.00	6.88	29.58	32.71	17.92
<i>Smilax bona-nox</i>	1.30	2.60	25.00	5.21			
<i>Spartina patens</i>	3.59	4.92	50.00		3.96	10.42	
<i>Strophostyles helvola</i>	4.64	6.30	50.00		13.33	5.21	
<i>Toxicodendron radicans</i>	12.81	16.08	50.00	33.33			17.92
<i>Tradescantia ohiensis</i>	0.68	1.22	50.00			0.21	2.50
<i>Uniola paniculata</i>	8.23	11.99	50.00		7.50	25.42	
<i>Vitis rotundifolia</i>	0.01	0.02	25.00	0.04			
<i>Yucca filamentosa</i>	0.68	1.22	50.00		2.50	0.21	
<b>Ground Condition</b>							
<i>Bare Ground</i>	30.00	29.79	100.00	0.21	63.54	46.04	10.21
<i>Exposed Humus</i>	1.09	2.19	25.00				4.38
<i>Leaf Litter/Duff</i>	73.75	21.57	100.00	97.50	50.21	61.88	85.42
<i>Tree Base</i>	0.31	0.63	25.00				1.25

**Table 7.** Percentage of area covered (absolute cover) and frequency of occurrence by groundcover species sampled in vegetation monitoring at sampling locations at Fort Sumter National Monument, 2012. Absolute cover is averaged across groundcover plots at each sampling location, and park-wide calculations are averaged across all sampling locations. [Freq – Frequency; Avg – Average; SD – Standard Deviation].

<b>Species</b>	<b>Average</b>	<b>Standard Deviation</b>	<b>Frequency</b>	<b>FOSU001</b>	<b>FOSU002</b>	<b>FOSU006</b>	<b>FOSU007</b>
<i>Ampelopsis arborea</i>	1.86	2.30	50	4.71		2.74	
<i>Berchemia scandens</i>	0.48	0.96	25				1.92
<i>Campsis radicans</i>	0.95	1.13	50	1.57			2.24
<i>Celtis laevigata</i>	1.88	2.51	50	5.29			2.24
<i>Cenchrus</i> sp.	1.71	3.41	25		6.83		
<i>Cladium mariscus</i> ssp. <i>jamaicense</i>	0.39	0.79	25	1.57			
<i>Conyza canadensis</i>	0.72	1.43	25		2.86		
<i>Croton punctatus</i>	0.33	0.66	25		1.32		
<i>Cyperaceae</i>	0.06	0.11	25		0.22		
<i>Galium</i> sp.	0.53	0.91	50	1.89	0.22		
<i>Heterotheca subaxillaris</i>	2.71	4.42	50		9.25	1.60	
<i>Hydrocotyle bonariensis</i>	0.80	1.45	50		0.22	2.97	
<i>Ilex vomitoria</i>	1.27	1.54	50	3.14			1.92
<i>Ipomoea imperati</i>	0.33	0.66	25		1.32		
<i>Juniperus virginiana</i> var. <i>silicicola</i>	0.13	0.26	25	0.52			
<i>Ligustrum sinense</i>	0.39	0.79	25	1.57			
<i>Morella cerifera</i>	0.48	0.96	25				1.92
<i>Oenothera drummondii</i>	4.49	5.25	75		10.79	6.85	0.32
<i>Opuntia</i> sp.	0.95	1.04	75		1.32	0.23	2.24
<i>Panicum amarum</i>	1.39	1.97	50		4.19	1.37	
<i>Parthenocissus quinquefolia</i>	4.80	5.56	50	10.21			8.97
<i>Physalis walteri</i>	0.39	0.79	25	1.57			
<i>Pinus taeda</i>	0.08	0.16	25	0.31			
<i>Prunus caroliniana</i>	5.13	6.47	50	7.07			13.45
<i>Quercus virginiana</i>	0.39	0.79	25	1.57			
<i>Rubus trivialis</i>	2.99	2.02	100	1.83	1.32	2.97	5.83

Table 7. (Continued.)

<b>Species</b>	<b>Average</b>	<b>Standard Deviation</b>	<b>Frequency</b>	<b>FOSU001</b>	<b>FOSU002</b>	<b>FOSU006</b>	<b>FOSU007</b>
<i>Smilax auriculata</i>	25.83	11.95	100	8.64	31.28	35.84	27.55
<i>Smilax bona-nox</i>	1.64	3.27	25	6.55			
<i>Spartina patens</i>	3.90	5.38	50		4.19	11.42	
<i>Strophostyles helvola</i>	4.95	6.66	50		14.10	5.71	
<i>Toxicodendron radicans</i>	17.36	20.89	50	41.91			27.55
<i>Tradescantia ohiensis</i>	1.02	1.89	50			0.23	3.84
<i>Uniola paniculata</i>	8.95	13.15	50		7.93	27.85	
<i>Vitis rotundifolia</i>	0.01	0.03	25	0.05			
<i>Yucca filamentosa</i>	0.72	1.29	50		2.64	0.23	
<b>Ground Condition</b>							
<i>Bare Ground</i>	27.21	26.34	100	0.21	55.86	42.66	10.08
<i>Exposed Humus</i>	1.08	2.16	25				4.32
<i>Leaf Litter/Duff</i>	71.41	25.26	100	99.79	44.14	57.34	84.36
<i>Tree Base</i>	0.31	0.62	25				1.23

**Table 8.** Average canopy species size, measured as diameter (cm) at breast height (DBH) for species sampled in vegetation monitoring macroplots at Fort Sumter National Monument, 2012. Numbers in parentheses indicate the number of individual trees measured within each plot. DBH measurements are averaged across DBH plots at each sampling location, and park-wide calculations are averaged across all sampling locations. [Avg – Average; SD – Standard Deviation].

<b>Species</b>	<b>Average</b>	<b>Standard Deviation</b>	<b>FOSU001</b>	<b>FOSU002</b>	<b>FOSU006</b>	<b>FOSU007</b>
<i>Baccharis halimifolia</i>	4.00					4.00 (1)
<i>Carya illinoensis</i>	21.05	6.32	15.80 (5)			26.30 (1)
<i>Celtis laevigata</i>	14.70	8.72	12.10 (12)			17.30 (5)
<i>Ilex vomitoria</i>	6.12	3.02	6.12 (10)			
<i>Juniperus virginiana</i> var. <i>silicicola</i>	7.22	1.44				7.22 (5)
<i>Ligustrum sinense</i>	4.30					4.30 (1)
<i>Magnolia grandiflora</i>	20.30		20.30 (1)			
<i>Morella cerifera</i>	6.64	2.99	5.90 (6)			7.38 (19)
<i>Morus rubra</i>	14.17	5.44	14.17 (3)			
<i>Prunus caroliniana</i>	6.62	2.37	8.63 (6)			4.60 (3)
<i>Quercus laurifolia</i>	6.75	1.73				6.75 (6)
<i>Quercus virginiana</i>	18.36	10.37	18.36 (8)			
<i>Magnolia grandiflora</i> (dead)	6.20		6.20 (1)			
<i>Morella cerifera</i> (dead)	5.52	1.46	5.93 (3)			5.10 (1)
<i>Morus rubra</i> (dead)	4.10		4.10 (1)			

**Table 9.** Seedling frequency for canopy and shrub species in vegetation monitoring macroplots at Fort Sumter National Monument, 2012. Seedling frequency is averaged across groundcover plots at each sampling location, and park-wide calculations are averaged across all sampling locations. [SD – Standard Deviation].

<b>Species</b>	<b>Total Seedlings</b>	<b>Seedlings/m<sup>2</sup></b>	<b>Standard Deviation</b>	<b>FOSU001</b>	<b>FOSU002</b>	<b>FOSU006</b>	<b>FOSU007</b>
<i>Celtis laevigata</i>	21	0.88	1.00	1.58			0.17
<i>Ilex vomitoria</i>	32	1.33	0.12	1.25			1.42
<i>Juniperus virginiana</i> var. <i>silicicola</i>	3	0.25		0.25			
<i>Ligustrum sinense</i>	5	0.42		0.42			
<i>Morella cerifera</i>	4	0.33					0.33
<i>Pinus taeda</i>	4	0.33		0.33			
<i>Prunus caroliniana</i>	103	4.29	1.24	3.42			5.17
<i>Quercus virginiana</i>	2	0.17		0.17			





## Literature Cited

- Bechtold, W. A. and P. L. Patterson, editors. 2005. The enhanced forest inventory and analysis program — national sampling design and estimation procedures. General Technical Report SRS-80. USDA Forest Service, Southern Research Station, Asheville, NC. 85 pp.
- Byrne, M. W. 2009. Sampling-point generation for SECN monitoring protocols: Generating a spatially-balanced random sample with the RRQRR tool in ArcGIS 9.1. Draft Standard Operating Procedure Version 1.0, last updated March 2009.
- Byrne, M. W., and S. L. Corbett. 2012. Vegetation monitoring methodology. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-1.4.10.
- Byrne, M. W., S. L. Corbett, and B. D. Smrekar. 2013. Installation and relocation of permanent terrestrial monitoring sampling locations. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-1.4.19. National Park Service, Athens, Georgia.
- Corbett, S. L., and M. W. Byrne. 2012a. Botanical identification training and pre-requisites for seasonal field staff. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-1.4.07 National Park Service, Athens, Georgia.
- Corbett, S. L., and M. W. Byrne. 2012b. Constructing a standard 1-m<sup>2</sup> sampling frame for vegetation monitoring. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-1.4.8. National Park Service, Athens, Georgia.
- Corbett, S. L. 2013. Handling, collection, and temporary archiving of botanical specimens expected to be used for consumptive analysis. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-1.4.14. National Park Service, Athens, Georgia.
- DeVivo, J. C., C. J. Wright, M. W. Byrne, E. DiDonato, and T. Curtis. 2008. Vital signs monitoring in the Southeast Coast Inventory & Monitoring Network. Natural Resource Report NPS/SECN/NRR—2008/061. National Park Service, Fort Collins, Colorado.
- Federal Geographic Data Committee (FGDC). 2008. National vegetation classification standard, version 2. FGDC-STD-005-2008. Available online:  
<http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/index.html>
- Foster, D. R., G. Motzkin, and B. Slater. 1998. Land-use history as long-term broad-scale disturbance: regional forest dynamics in central New England. *Ecosystems* 1:96-119.
- NPSpecies - The National Park Service Biodiversity Database. Secure online version.  
<https://irma.nps.gov/NPSpecies/>.
- Peet R. K., T. R. Wentworth, and P. S White. 1998. A flexible, multipurpose method for recording vegetation composition and structure. *Castanea* 63:262-274.

- Theobald, D. M., D. L. Stevens, D. White, N. S. Urquhart, A. R. Olsen, and J. B. Norman. 2007. Using GIS to generate spatially balanced random survey designs for natural resource applications. *Environmental Management* 40:134-146.
- Turner, II, B. L., W. C. Clark, R. W. Kates, J. F. Richards, J. T. Mathews, and W. B. Meyer, editors. 1990. *The earth as transformed by human action: Global and regional changes in the biosphere over the past 300 years*. Cambridge University Press, Cambridge, UK.

## Appendix A. Plant Species Known to Occur at FOSU.

**Table A-1.** Vascular plant species known to occur at Fort Sumter National Monument (NPSpecies 2012) and species detected during 2012 monitoring efforts.

Order	Family	Scientific Name	NPSpecies	This Study
Apiales	Apiaceae	<i>Centella erecta</i>	X	
Apiales	Apiaceae	<i>Chaerophyllum tainturieri</i>	X	
Apiales	Apiaceae	<i>Daucus carota</i>	X	
Apiales	Apiaceae	<i>Ptilimnium capillaceum</i>	X	
Apiales	Apiaceae	<i>Sanicula canadensis</i>	X	
Apiales	Araliaceae	<i>Hydrocotyle bonariensis</i>	X	X
Apiales	Araliaceae	<i>Hydrocotyle umbellata</i>	X	
Apiales	Araliaceae	<i>Hydrocotyle verticillata</i>	X	
Apiales	Pittosporaceae	<i>Pittosporum tobira</i>	X	
Aquifoliales	Aquifoliaceae	<i>Ilex vomitoria</i>	X	X
Arecales	Arecaceae	<i>Sabal palmetto</i>	X	X
Asparagales	Amaryllidaceae	<i>Allium vineale</i>	X	
Asparagales	Amaryllidaceae	<i>Nothoscordum bivalve</i>	X	
Asparagales	Amaryllidaceae	<i>Zephyranthes atamasca</i>	X	
Asparagales	Asparagaceae	<i>Asparagus officinalis</i>	X	
Asparagales	Asparagaceae	<i>Yucca aloifolia</i>	X	X
Asparagales	Asparagaceae	<i>Yucca filamentosa</i>	X	X
Asterales	Asteraceae	<i>Achillea millefolium</i>	X	
Asterales	Asteraceae	<i>Ambrosia artemisiifolia</i>	X	X
Asterales	Asteraceae	<i>Artemisia vulgaris</i>	X	
Asterales	Asteraceae	<i>Aster dumosus</i>	X	
Asterales	Asteraceae	<i>Baccharis halimifolia</i>	X	X
Asterales	Asteraceae	<i>Bidens bipinnata</i>	X	
Asterales	Asteraceae	<i>Borrchia frutescens</i>	X	
Asterales	Asteraceae	<i>Carphephorus odoratissimus</i>	X	
Asterales	Asteraceae	<i>Cirsium nuttallii</i>	X	
Asterales	Asteraceae	<i>Conoclinium coelestinum</i>	X	
Asterales	Asteraceae	<i>Conyza bonariensis</i>	X	
Asterales	Asteraceae	<i>Conyza canadensis</i>	X	X
Asterales	Asteraceae	<i>Conyza canadensis var. pusilla</i>	X	
Asterales	Asteraceae	<i>Coreopsis basalis</i>	X	
Asterales	Asteraceae	<i>Elephantopus carolinianus</i>	X	
Asterales	Asteraceae	<i>Elephantopus nudatus</i>	X	
Asterales	Asteraceae	<i>Erechtites hieraciifolia</i>	X	
Asterales	Asteraceae	<i>Erigeron philadelphicus</i>	X	
Asterales	Asteraceae	<i>Erigeron quercifolius</i>	X	
Asterales	Asteraceae	<i>Erigeron strigosus</i>	X	

**Table A-1.** (Continued.)

Order	Family	Scientific Name	NPSpecies	This Study
Asterales	Asteraceae	<i>Eupatorium capillifolium</i>	X	X
Asterales	Asteraceae	<i>Euthamia tenuifolia</i>	X	
Asterales	Asteraceae	<i>Gaillardia pulchella</i>	X	X
Asterales	Asteraceae	<i>Gamochaeta falcata</i>	X	
Asterales	Asteraceae	<i>Gamochaeta pensylvanica</i>	X	
Asterales	Asteraceae	<i>Gamochaeta purpurea</i>	X	
Asterales	Asteraceae	<i>Heterotheca subaxillaris</i>	X	X
Asterales	Asteraceae	<i>Hypochaeris brasiliensis</i>	X	
Asterales	Asteraceae	<i>Hypochaeris glabra</i>	X	
Asterales	Asteraceae	<i>Iva frutescens</i>	X	
Asterales	Asteraceae	<i>Iva imbricata</i>	X	
Asterales	Asteraceae	<i>Pluchea carolinensis</i>	X	
Asterales	Asteraceae	<i>Pseudognaphalium obtusifolium</i> ssp. <i>obtusifolium</i>	X	
Asterales	Asteraceae	<i>Pyrrhopappus carolinianus</i>	X	
Asterales	Asteraceae	<i>Senecio vulgaris</i>	X	
Asterales	Asteraceae	<i>Solidago odora</i>	X	
Asterales	Asteraceae	<i>Solidago rugosa</i>	X	
Asterales	Asteraceae	<i>Solidago sempervirens</i>	X	
Asterales	Asteraceae	<i>Solidago stricta</i>	X	
Asterales	Asteraceae	<i>Sonchus asper</i>	X	
Asterales	Asteraceae	<i>Sonchus oleraceus</i>	X	
Asterales	Asteraceae	<i>Symphotrichum dumosum</i>	X	
Asterales	Asteraceae	<i>Symphotrichum pilosum</i> var. <i>pilosum</i>	X	
Asterales	Asteraceae	<i>Symphotrichum subulatum</i>	X	
Asterales	Asteraceae	<i>Symphotrichum tenuifolium</i>	X	
Asterales	Asteraceae	<i>Taraxacum laevigatum</i>	X	
Asterales	Asteraceae	<i>Taraxacum officinale</i>	X	
Asterales	Asteraceae	<i>Youngia japonica</i>	X	
Asterales	Campanulaceae	<i>Triodanis perfoliata</i>	X	
Boraginales	Boraginaceae	<i>Buglossoides arvensis</i>	X	
Brassicales	Brassicaceae	<i>Cakile edentula</i>	X	
Brassicales	Brassicaceae	<i>Cardamine hirsuta</i>	X	
Brassicales	Brassicaceae	<i>Cardamine pensylvanica</i>	X	
Brassicales	Brassicaceae	<i>Coronopus didymus</i>	X	
Brassicales	Brassicaceae	<i>Descurainia pinnata</i>	X	
Brassicales	Brassicaceae	<i>Lepidium virginicum</i>	X	
Caryophyllales	Aizoaceae	<i>Sesuvium portulacastrum</i>	X	
Caryophyllales	Amaranthaceae	<i>Alternanthera philoxeroides</i>	X	
Caryophyllales	Amaranthaceae	<i>Atriplex cristata</i>	X	

**Table A-1.** (Continued.)

Order	Family	Scientific Name	NPSpecies	This Study
Caryophyllales	Amaranthaceae	<i>Atriplex patula</i>	X	
Caryophyllales	Amaranthaceae	<i>Atriplex prostrata</i>	X	
Caryophyllales	Amaranthaceae	<i>Chenopodium album</i>	X	
Caryophyllales	Amaranthaceae	<i>Chenopodium ambrosioides</i>	X	
Caryophyllales	Amaranthaceae	<i>Salicornia virginica</i>	X	
Caryophyllales	Amaranthaceae	<i>Salsola kali</i>	X	
Caryophyllales	Amaranthaceae	<i>Suaeda linearis</i>	X	
Caryophyllales	Cactaceae	<i>Opuntia humifusa</i>	X	
Caryophyllales	Cactaceae	<i>Opuntia pusilla</i>	X	
Caryophyllales	Cactaceae	<i>Opuntia</i> sp.	X	X
Caryophyllales	Caryophyllaceae	<i>Arenaria serpyllifolia</i>	X	
Caryophyllales	Caryophyllaceae	<i>Cerastium fontanum</i>	X	
Caryophyllales	Caryophyllaceae	<i>Polycarpon tetraphyllum</i>	X	
Caryophyllales	Caryophyllaceae	<i>Sagina decumbens</i>	X	
Caryophyllales	Caryophyllaceae	<i>Stellaria media</i>	X	
Caryophyllales	Molluginaceae	<i>Mollugo verticillata</i>	X	
Caryophyllales	Phytolaccaceae	<i>Phytolacca americana</i>	X	
Caryophyllales	Polygonaceae	<i>Polygonum persicaria</i>	X	
Caryophyllales	Polygonaceae	<i>Polygonum punctatum</i>	X	
Caryophyllales	Polygonaceae	<i>Polygonum virginianum</i>	X	
Caryophyllales	Polygonaceae	<i>Rumex conglomeratus</i>	X	
Caryophyllales	Polygonaceae	<i>Rumex crispus</i>	X	
Caryophyllales	Polygonaceae	<i>Rumex hastatulus</i>	X	
Caryophyllales	Polygonaceae	<i>Rumex verticillatus</i>	X	
Caryophyllales	Portulacaceae	<i>Portulaca oleracea</i>	X	
Caryophyllales	Portulacaceae	<i>Portulaca pilosa</i>	X	
Caryophyllales	Tamaricaceae	<i>Tamarix gallica</i>	X	
Commelinales	Commelinaceae	<i>Tradescantia ohiensis</i>	X	X
Cucurbitales	Cucurbitaceae	<i>Citrullus lanatus</i> var. <i>lanatus</i>	X	
Cucurbitales	Cucurbitaceae	<i>Melothria pendula</i>	X	
Cupressales	Cupressaceae	<i>Juniperus virginiana</i> var. <i>silicicola</i>	X	X
Dipsacales	Caprifoliaceae	<i>Lonicera japonica</i>	X	X
Ericales	Ebenaceae	<i>Diospyros virginiana</i>	X	
Ericales	Ericaceae	<i>Rhododendron</i>	X	
Ericales	Polemoniaceae	<i>Phlox drummondii</i>	X	
Ericales	Sapotaceae	<i>Sideroxylon lycioides</i>	X	
Ericales	Sapotaceae	<i>Sideroxylon tenax</i>	X	
Ericales	Theaceae	<i>Camellia japonica</i>	X	
Ericales	Theaceae	<i>Camellia sasanqua</i>	X	

**Table A-1.** (Continued.)

<b>Order</b>	<b>Family</b>	<b>Scientific Name</b>	<b>NPSpecies</b>	<b>This Study</b>
Fabales	Fabaceae	<i>Aeschynomene indica</i>	X	
Fabales	Fabaceae	<i>Centrosema virginianum</i>	X	
Fabales	Fabaceae	<i>Clitoria mariana</i>	X	
Fabales	Fabaceae	<i>Crotalaria spectabilis</i>	X	
Fabales	Fabaceae	<i>Desmodium incanum</i>	X	
Fabales	Fabaceae	<i>Galactia volubilis</i>	X	
Fabales	Fabaceae	<i>Medicago lupulina</i>	X	
Fabales	Fabaceae	<i>Medicago polymorpha</i>	X	
Fabales	Fabaceae	<i>Melilotus alba</i>	X	
Fabales	Fabaceae	<i>Melilotus officinalis</i>	X	
Fabales	Fabaceae	<i>Senna obtusifolia</i>	X	
Fabales	Fabaceae	<i>Sesbania punicea</i>	X	X
Fabales	Fabaceae	<i>Strophostyles helvula</i>	X	X
Fabales	Fabaceae	<i>Trifolium dubium</i>	X	
Fabales	Fabaceae	<i>Trifolium repens</i>	X	
Fabales	Fabaceae	<i>Vicia angustifolia</i>	X	
Fabales	Fabaceae	<i>Vicia hirsuta</i>	X	
Fabales	Fabaceae	<i>Vicia sativa</i> ssp. <i>nigra</i>	X	
Fabales	Fabaceae	<i>Wisteria sinensis</i>	X	
Fagales	Fagaceae	<i>Quercus chapmanii</i>	X	
Fagales	Fagaceae	<i>Quercus geminata</i>	X	
Fagales	Fagaceae	<i>Quercus laurifolia</i>		X
Fagales	Fagaceae	<i>Quercus nigra</i>	X	X
Fagales	Fagaceae	<i>Quercus virginiana</i>	X	X
Fagales	Juglandaceae	<i>Carya alba</i>		X
Fagales	Juglandaceae	<i>Carya illinoensis</i>	X	X
Fagales	Myricaceae	<i>Morella cerifera</i>	X	X
Gentianales	Apocynaceae	<i>Nerium oleander</i>	X	
Gentianales	Gentianaceae	<i>Sabatia stellaris</i>	X	
Gentianales	Rubiaceae	<i>Diodia teres</i>	X	
Gentianales	Rubiaceae	<i>Diodia virginiana</i>	X	
Gentianales	Rubiaceae	<i>Galium</i> sp.	X	X
Gentianales	Rubiaceae	<i>Galium tinctorium</i>	X	
Gentianales	Rubiaceae	<i>Oldenlandia corymbosa</i>	X	
Gentianales	Rubiaceae	<i>Richardia scabra</i>	X	
Geraniales	Geraniaceae	<i>Geranium carolinianum</i>	X	
Lamiales	Bignoniaceae	<i>Bignonia capreolata</i>	X	
Lamiales	Bignoniaceae	<i>Campsis radicans</i>	X	X
Lamiales	Lamiaceae	<i>Callicarpa americana</i>	X	

**Table A-1.** (Continued.)

<b>Order</b>	<b>Family</b>	<b>Scientific Name</b>	<b>NPSpecies</b>	<b>This Study</b>
Lamiales	Lamiaceae	<i>Lamium amplexicaule</i>	X	
Lamiales	Lamiaceae	<i>Mentha X gentilis</i>	X	
Lamiales	Lamiaceae	<i>Salvia lyrata</i>	X	
Lamiales	Lamiaceae	<i>Stachys floridana</i>	X	
Lamiales	Lamiaceae	<i>Stachys hyssopifolia</i>	X	
Lamiales	Lamiaceae	<i>Teucrium canadense</i>	X	X
Lamiales	Lamiaceae	<i>Vitex agnus-castus</i>	X	
Lamiales	Oleaceae	<i>Ligustrum sinense</i>	X	X
Lamiales	Plantaginaceae	<i>Nuttallanthus canadensis</i>	X	
Lamiales	Plantaginaceae	<i>Plantago aristata</i>	X	
Lamiales	Plantaginaceae	<i>Plantago lanceolata</i>	X	
Lamiales	Plantaginaceae	<i>Plantago virginica</i>	X	
Lamiales	Plantaginaceae	<i>Veronica arvensis</i>	X	
Lamiales	Plantaginaceae	<i>Veronica peregrina</i>	X	
Lamiales	Verbenaceae	<i>Lantana camara</i>	X	
Lamiales	Verbenaceae	<i>Phyla nodiflora</i>	X	
Lamiales	Verbenaceae	<i>Verbena bonariensis</i>	X	
Lamiales	Verbenaceae	<i>Verbena brasiliensis</i>	X	
Laurales	Lauraceae	<i>Persea borbonia</i>	X	
Liliales	Liliaceae	<i>Ornithogalum umbellatum</i>	X	
Liliales	Smilacaceae	<i>Smilax auriculata</i>	X	X
Liliales	Smilacaceae	<i>Smilax bona-nox</i>	X	X
Liliales	Smilacaceae	<i>Smilax laurifolia</i>	X	
Magnoliales	Magnoliaceae	<i>Magnolia grandiflora</i>		X
Malpighiales	Euphorbiaceae	<i>Acalypha gracilens</i>	X	
Malpighiales	Euphorbiaceae	<i>Chamaesyce nutans</i>	X	
Malpighiales	Euphorbiaceae	<i>Chamaesyce polygonifolia</i>	X	X
Malpighiales	Euphorbiaceae	<i>Croton glandulosus</i>	X	
Malpighiales	Euphorbiaceae	<i>Croton punctatus</i>	X	X
Malpighiales	Euphorbiaceae	<i>Croton willdenowii</i>	X	
Malpighiales	Euphorbiaceae	<i>Euphorbia heterophylla</i>	X	
Malpighiales	Euphorbiaceae	<i>Sapium sebiferum</i>		X
Malpighiales	Hypericaceae	<i>Hypericum gentianoides</i>	X	
Malpighiales	Hypericaceae	<i>Hypericum hypericoides</i>	X	X
Malpighiales	Salicaceae	<i>Populus alba</i>	X	
Malpighiales	Salicaceae	<i>Populus heterophylla</i>	X	
Malvales	Cistaceae	<i>Lechea mucronata</i>	X	
Malvales	Malvaceae	<i>Modiola caroliniana</i>	X	
Malvales	Malvaceae	<i>Sida rhombifolia</i>	X	

**Table A-1.** (Continued.)

<b>Order</b>	<b>Family</b>	<b>Scientific Name</b>	<b>NPSpecies</b>	<b>This Study</b>
Myrtales	Onagraceae	<i>Ludwigia maritima</i>	X	
Myrtales	Onagraceae	<i>Oenothera biennis</i>	X	
Myrtales	Onagraceae	<i>Oenothera drummondii</i>	X	X
Myrtales	Onagraceae	<i>Oenothera fruticosa</i>	X	
Myrtales	Onagraceae	<i>Oenothera humifusa</i>	X	
Myrtales	Onagraceae	<i>Oenothera laciniata</i>	X	
Myrtales	Onagraceae	<i>Oenothera speciosa</i>	X	
Oxalidales	Oxalidaceae	<i>Oxalis rubra</i>	X	
Oxalidales	Oxalidaceae	<i>Oxalis stricta</i>	X	
Pinales	Pinaceae	<i>Pinus taeda</i>	X	X
Poales	Bromeliaceae	<i>Tillandsia usneoides</i>	X	
Poales	Cyperaceae	<i>Cladium mariscus</i> ssp. <i>jamaicense</i>		X
Poales	Cyperaceae	<i>Cyperaceae, unknown</i>	X	X
Poales	Cyperaceae	<i>Cyperus croceus</i>	X	
Poales	Cyperaceae	<i>Cyperus echinatus</i>	X	
Poales	Cyperaceae	<i>Cyperus esculentus</i> var. <i>leptostachyus</i>	X	
Poales	Cyperaceae	<i>Cyperus polystachyos</i>	X	
Poales	Cyperaceae	<i>Cyperus pseudovegetus</i>	X	
Poales	Cyperaceae	<i>Cyperus retrorsus</i>	X	
Poales	Cyperaceae	<i>Cyperus strigosus</i>	X	
Poales	Cyperaceae	<i>Eleocharis flavescens</i>	X	
Poales	Cyperaceae	<i>Fimbristylis thermalis</i>	X	
Poales	Cyperaceae	<i>Kyllinga brevifolia</i>	X	
Poales	Cyperaceae	<i>Schoenoplectus robustus</i>	X	
Poales	Juncaceae	<i>Juncus roemerianus</i>	X	
Poales	Poaceae	<i>Andropogon glomeratus</i>	X	
Poales	Poaceae	<i>Andropogon gyrans</i> var. <i>gyrans</i>	X	
Poales	Poaceae	<i>Andropogon ternarius</i>	X	
Poales	Poaceae	<i>Andropogon virginicus</i>	X	
Poales	Poaceae	<i>Briza minor</i>	X	
Poales	Poaceae	<i>Bromus catharticus</i>	X	
Poales	Poaceae	<i>Cenchrus longispinus</i>	X	
Poales	Poaceae	<i>Cenchrus</i> sp.	X	X
Poales	Poaceae	<i>Cenchrus tribuloides</i>	X	X
Poales	Poaceae	<i>Chasmanthium laxum</i>	X	
Poales	Poaceae	<i>Cynodon dactylon</i>	X	
Poales	Poaceae	<i>Dichantherium commutatum</i>	X	
Poales	Poaceae	<i>Dichantherium scabriusculum</i>	X	
Poales	Poaceae	<i>Digitaria sanguinalis</i>	X	



**Table A-1.** (Continued.)

<b>Order</b>	<b>Family</b>	<b>Scientific Name</b>	<b>NPSpecies</b>	<b>This Study</b>
Poales	Poaceae	<i>Digitaria violascens</i>	X	
Poales	Poaceae	<i>Distichlis spicata</i>	X	
Poales	Poaceae	<i>Eleusine indica</i>	X	
Poales	Poaceae	<i>Elymus virginicus</i>	X	
Poales	Poaceae	<i>Eustachys petraea</i>	X	X
Poales	Poaceae	<i>Lolium perenne</i>	X	
Poales	Poaceae	<i>Muhlenbergia capillaris</i> var. <i>trichopodes</i>	X	
Poales	Poaceae	<i>Panicum amarum</i>	X	X
Poales	Poaceae	<i>Panicum dichotomiflorum</i>	X	
Poales	Poaceae	<i>Paspalum dilatatum</i>	X	
Poales	Poaceae	<i>Paspalum notatum</i>	X	X
Poales	Poaceae	<i>Paspalum notatum</i> var. <i>saurae</i>	X	
Poales	Poaceae	<i>Poa annua</i>	X	
Poales	Poaceae	<i>Schizachyrium littorale</i>		X
Poales	Poaceae	<i>Setaria corrugata</i>	X	
Poales	Poaceae	<i>Sorghum halepense</i>	X	
Poales	Poaceae	<i>Spartina alterniflora</i>	X	
Poales	Poaceae	<i>Spartina patens</i>	X	X
Poales	Poaceae	<i>Sphenopholis nitida</i>	X	
Poales	Poaceae	<i>Sporobolus indicus</i> var. <i>indicus</i>	X	
Poales	Poaceae	<i>Sporobolus virginicus</i>	X	
Poales	Poaceae	<i>Stenotaphrum secundatum</i>	X	
Poales	Poaceae	<i>Triplasis purpurea</i>	X	
Poales	Poaceae	<i>Uniola paniculata</i>	X	X
Poales	Poaceae	<i>Vulpia octoflora</i> var. <i>octoflora</i>	X	
Poales	Typhaceae	<i>Typha latifolia</i>	X	
Polypodiales	Polypodiaceae	<i>Pleopeltis polypodioides</i> ssp. <i>polypodioides</i>	X	
Polypodiales	Pteridaceae	<i>Pteris vittata</i>	X	
Psilotales	Psilotaceae	<i>Psilotum nudum</i>		X
Rosales	Cannabaceae	<i>Celtis laevigata</i>	X	X
Rosales	Elaeagnaceae	<i>Elaeagnus pungens</i>	X	
Rosales	Moraceae	<i>Morus rubra</i>	X	X
Rosales	Rhamnaceae	<i>Berchemia scandens</i>		X
Rosales	Rosaceae	<i>Prunus angustifolia</i>	X	X
Rosales	Rosaceae	<i>Prunus caroliniana</i>	X	X
Rosales	Rosaceae	<i>Prunus serotina</i>	X	
Rosales	Rosaceae	<i>Prunus</i> sp.	X	X
Rosales	Rosaceae	<i>Rubus argutus</i>	X	
Rosales	Rosaceae	<i>Rubus trivialis</i>	X	X

**Table A-1.** (Continued.)

<b>Order</b>	<b>Family</b>	<b>Scientific Name</b>	<b>NPSpecies</b>	<b>This Study</b>
Sapindales	Anacardiaceae	<i>Rhus copallinum</i>	X	
Sapindales	Anacardiaceae	<i>Toxicodendron radicans</i>		X
Sapindales	Meliaceae	<i>Melia azedarach</i>	X	
Sapindales	Rutaceae	<i>Zanthoxylum clava-herculis</i>	X	
Solanales	Convolvulaceae	<i>Dichondra carolinensis</i>	X	
Solanales	Convolvulaceae	<i>Ipomoea carnea</i> ssp. <i>fistulosa</i>	X	
Solanales	Convolvulaceae	<i>Ipomoea imperati</i>	X	X
Solanales	Convolvulaceae	<i>Ipomoea lacunosa</i>	X	
Solanales	Convolvulaceae	<i>Ipomoea pandurata</i>	X	
Solanales	Convolvulaceae	<i>Ipomoea sagittata</i>	X	X
Solanales	Solanaceae	<i>Physalis walteri</i>	X	X
Solanales	Solanaceae	<i>Solanum carolinense</i>	X	
Solanales	Solanaceae	<i>Solanum pseudogracile</i>	X	
Solanales	Solanaceae	<i>Solanum ptychanthum</i>	X	
Solanales	Solanaceae	<i>Solanum rostratum</i>	X	
Vitales	Vitaceae	<i>Ampelopsis arborea</i>	X	X
Vitales	Vitaceae	<i>Parthenocissus quinquefolia</i>	X	X
Vitales	Vitaceae	<i>Vitis aestivalis</i>	X	X
Vitales	Vitaceae	<i>Vitis rotundifolia</i>		X
Zingiberales	Cannaceae	<i>Canna X generalis</i>	X	

## Appendix B. Plant Species Detected in Sampling Locations.

**Table B-1.** Vascular plant species detected at each sampling location across all strata at Fort Sumter National Monument, 2012.

Scientific Name	FOSU001	FOSU002	FOSU006	FOSU007
<i>Ambrosia artemisiifolia</i>	X			
<i>Ampelopsis arborea</i>	X		X	X
<i>Baccharis halimifolia</i>				X
<i>Berchemia scandens</i>	X			X
<i>Campsis radicans</i>	X			X
<i>Carya alba</i>	X			
<i>Carya illinoensis</i>	X	X	X	X
<i>Celtis laevigata</i>	X		X	X
<i>Cenchrus sp.</i>	X	X		
<i>Cenchrus tribuloides</i>		X		
<i>Chamaesyce polygonifolia</i>	X			
<i>Cladium mariscus ssp. jamaicense</i>	X			
<i>Conyza canadensis</i>	X	X		
<i>Croton punctatus</i>		X		
Cyperaceae		X		
<i>Eupatorium capillifolium</i>	X		X	
<i>Eustachys petraea</i>	X			X
<i>Gaillardia pulchella</i>			X	
<i>Galium sp.</i>	X	X	X	
<i>Heterotheca subaxillaris</i>	X	X	X	
<i>Hydrocotyle bonariensis</i>	X	X	X	
<i>Hypericum hypericoides</i>	X			
<i>Ilex vomitoria</i>	X			X
<i>Ipomoea imperati</i>		X	X	
<i>Ipomoea sagittata</i>				X
<i>Juniperus virginiana var. silicicola</i>	X	X		X
<i>Ligustrum sinense</i>	X			X
<i>Lonicera japonica</i>	X		X	X
<i>Magnolia grandiflora</i>	X			
<i>Morella cerifera</i>	X	X	X	X
<i>Morus rubra</i>	X		X	
<i>Oenothera drummondii</i>		X	X	X
<i>Opuntia sp.</i>		X	X	X
<i>Panicum amarum</i>		X	X	
<i>Parthenocissus quinquefolia</i>	X		X	X
<i>Paspalum notatum</i>	X	X		X
<i>Physalis walteri</i>	X			

**Table B-1.** (Continued.)

Scientific Name	FOSU001	FOSU002	FOSU006	FOSU007
<i>Pinus taeda</i>	X		X	
<i>Prunus angustifolia</i>				X
<i>Prunus caroliniana</i>	X			X
<i>Prunus</i> sp.	X			
<i>Psilotum nudum</i>	X			
<i>Quercus laurifolia</i>				X
<i>Quercus nigra</i>	X			
<i>Quercus virginiana</i>	X		X	X
<i>Rubus trivialis</i>	X	X	X	X
<i>Sabal palmetto</i>	X		X	
<i>Sapium sebiferum</i>	X			X
<i>Schizachyrium littorale</i>			X	
<i>Sesbania punicea</i>				X
<i>Smilax auriculata</i>	X	X	X	X
<i>Smilax bona-nox</i>	X			
<i>Spartina patens</i>		X	X	
<i>Strophostyles helvola</i>		X	X	X
<i>Teucrium canadense</i>				X
<i>Toxicodendron radicans</i>	X		X	X
<i>Tradescantia ohiensis</i>	X	X	X	X
<i>Tradescantia</i> sp.				X
<i>Uniola paniculata</i>		X	X	X
<i>Vitis aestivalis</i>				X
<i>Vitis rotundifolia</i>	X			
<i>Yucca aloifolia</i>		X	X	
<i>Yucca filamentosa</i>		X	X	X
<i>Zanthoxylum clava-herculis</i>		X		X

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