



Vegetation Community Monitoring at Cumberland Island National Seashore, 2012

Natural Resource Data Series NPS/SECN/NRDS—2014/722



ON THE COVER

Curled developing fiddlehead of royal fern (*Osmunda regalis*) at Cumberland Island National Seashore.
Photograph by: Sarah C. Heath, SECN Botanist.

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Executive Summary

In 2009, the National Park Service (NPS) 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 Cumberland Island National Seashore in 2012.

- Data were collected at 30 sampling locations at the Park from 2/29/2012 through 3/16/2012.
- Monitoring efforts resulted in the addition of 4 species, subspecies, or varieties to the park's species list.
- Absolute canopy cover across the Park was approximately 68.05%.
- Saw palmetto (*Serenoa repens*) had the highest absolute and relative cover in the shrub stratum, while wax myrtle (*Morella cerifera*) had the second highest absolute and relative cover in the shrub stratum.
- Saw palmetto and wax myrtle were the most frequently occurring species in the shrub stratum.
- Saw palmetto had the highest relative cover, while Virginia live oak (*Quercus virginiana*) had the second highest relative cover in the groundcover stratum.
- Muscadine grape (*Vitis rotundifolia*) had the highest absolute cover, while seashore dropseed (*Sporobolus virginicus*) had the second highest absolute cover cover in the groundcover stratum.
- Virginia live oak, *Smilax* spp., saw palmetto, and redbay (*Persea borbonia*) were the most frequently occurring species in the groundcover stratum.
- Leaf litter was the most frequently occurring ground condition at the Park, and also had the highest relative and absolute cover of any ground condition.
- Eastern redcedar (*Juniperus virginiana* var. *silicicola*) had the largest average diameter at breast height (DBH) of any canopy species at the Park where more than two individuals were measured, followed by Virginia live oak.
- Live and standing dead Redbay and swamp bay of canopy size were detected.

- Virginia live oak 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 Cumberland Island National Seashore (CUIS) 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:

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

Methods

Study Area

CUIS, a 26-km (17.5-mi) long barrier island, is one of the larger and most diverse islands on the Atlantic Coast (Figure 1). Located off the southern Georgia coast adjacent to the Georgia-Florida border, it totals 14,743 ha (36,415 ac), of which 6,821 ha (16,850 ac) are estuarine. A cordgrass (*Spartina* spp.) dominated salt marsh, oyster mud flats, and tidal creeks provide habitat for a diverse assemblage of fish and wildlife. The terrestrial areas of the park consist of Virginia live oak (*Quercus virginiana*)/palmetto (*Sabal palmetto*) maritime forests, extensive dune systems, interdunal wetlands, freshwater ponds and wetlands, and mixed-pine/hardwood forests in the northern part of the park. Approximately 4,000 ha (9,886 ac) of the island's northern portion are designated a Wilderness Area. The coastal maritime hammock at CUIS is an excellent example of this community type and is host to a variety of resident and migratory fauna. Although many of the freshwater wetlands and pine communities on the island evolved with frequent fires that maintained an open and highly diverse understory community, the island has experienced substantial anthropogenically-influenced fire suppression over the last century. This has resulted in woody-encroachment and drying freshwater wetlands and a reduction in the diversity and composition of the herbaceous understory in the fire adapted uplands.

The island is known as one of the primary loggerhead sea turtle nesting sites and provides key habitat for nesting and migratory shorebirds and landbirds. The island is also host to an actively controlled feral hog (*Sus scrofa*) population and a currently uncontrolled feral horse population. Rooting by hogs, especially in wetland areas, is very destructive and seriously impedes seedling recruitment, damages groundcover, causes substantial soil disturbance, and serves as a vector for non-native plant species. Feral horses (*Equus caballus*) graze extensively in open areas, particularly influencing salt marshes (D. Hoffman, pers. comm.). Annual horse counts have shown little fluctuation in the horse population over the past decade (CUIS Annual Horse Count, unpublished data).

The island has a multi-century history of Native American habitation; shifting occupation by several colonial European nations; use of the island as a plantation in the early to mid-19th century; and a brief occupancy in the late 19th century by wealthy American families who used the island as their primary residence or as a winter retreat. The island is sparsely developed and many of the structures occur in the island's five historic districts listed on the National Register of Historic Places. Historic land uses have changed the vegetation communities of CUIS over the past 150 years. For instance, large live oaks from the island's interior maritime hammocks were harvested for the shipbuilding industry near the turn of the century, thus removing the largest and oldest trees from the island. The indigo, rice, and cotton plantations established during the 19th century influenced the vegetation composition and structure of forested areas and wetlands on the island. Further, loblolly pine (*Pinus taeda*) plantations were planted for silvicultural purposes. These stands replaced the native maritime hammock forests and some persist on the island.

CUIS has 848 known vascular plant species, subspecies, and varieties (Appendix A). Non-native species present in the park that are a management challenge include Japanese and Chinese privet

(*Ligustrum japonicum* and *L. sinense*), Chinaberry (*Melia azedarach*), bamboo (*Bambusa* spp.), tamarisk (*Tamarix gallica*), and Chinese wisteria (*Wisteria sinensis*).

Redbay (*Persea borbonia*) are a critical native element of the coastal maritime hammock community and also serve as an important habitat component for many vertebrates, invertebrates, vascular plants, and non-vascular plants. Occurrences of native redbay throughout coastal Southeastern U.S. are in rapid decline due to the introduction of a fungal pathogen, laurel wilt (*Raffaelea lauricola*), whose vector is the non-native redbay ambrosia beetle (from Asia; *Xyleborus glabratus*). Since the beetle's initial detection in 2002 (Haack 2006; Rabaglia 2003), and the subsequent lethality of laurel wilt to redbay, this pathogen has had a profound adverse effect on redbay in more than 60 counties in the Southeastern U.S. (Fraedrich et al. 2008), primarily along the Atlantic Coast (http://www.fs.fed.us/r8/foresthealth/laurelwilt/dist_map.shtml). The non-native redbay ambrosia beetle, and laurel wilt, does occur at CUIS, and has caused an estimated 90% mortality of redbay over 4 cm in diameter at the park (J. Fry, pers. comm.). Extensive multi-agency efforts are currently underway to further understand this pathogen, identify possible methods of eradication, and identify mitigation procedures to ensure the persistence of redbay and other potentially susceptible members of the Lauraceae. The breadth of the adverse ecological impacts of the loss of redbay in the coastal maritime hammock is unknown.

Sampling Design

To allow for park-wide inference, the Park'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 CUIS from 2/29/2012 through 3/16/2012.

Cumberland Island National Seashore

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



Figure 1. Location of Cumberland Island National Seashore, GA.

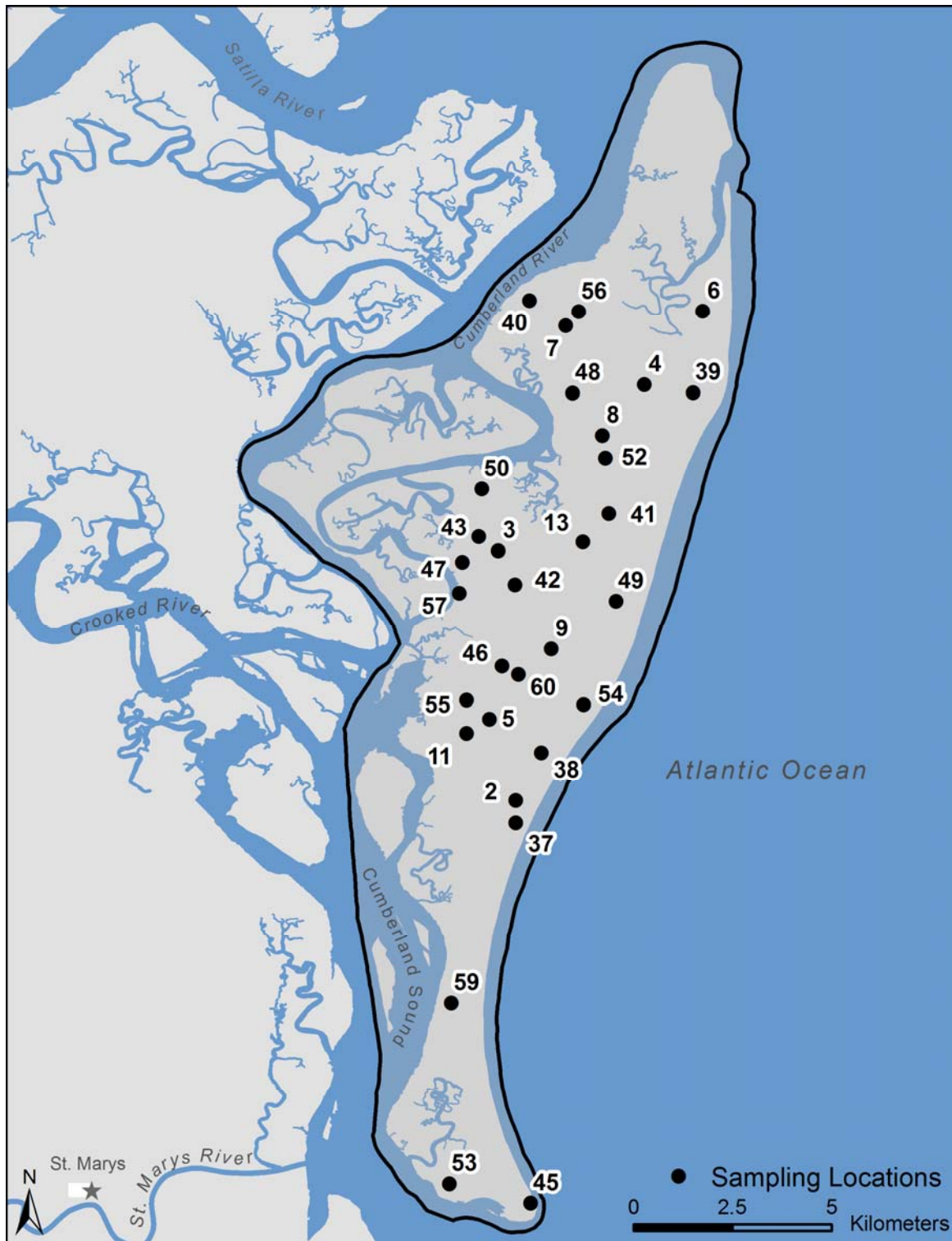


Figure 2. Spatially-balanced random sampling locations at Cumberland Island National Seashore, 2012.

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.

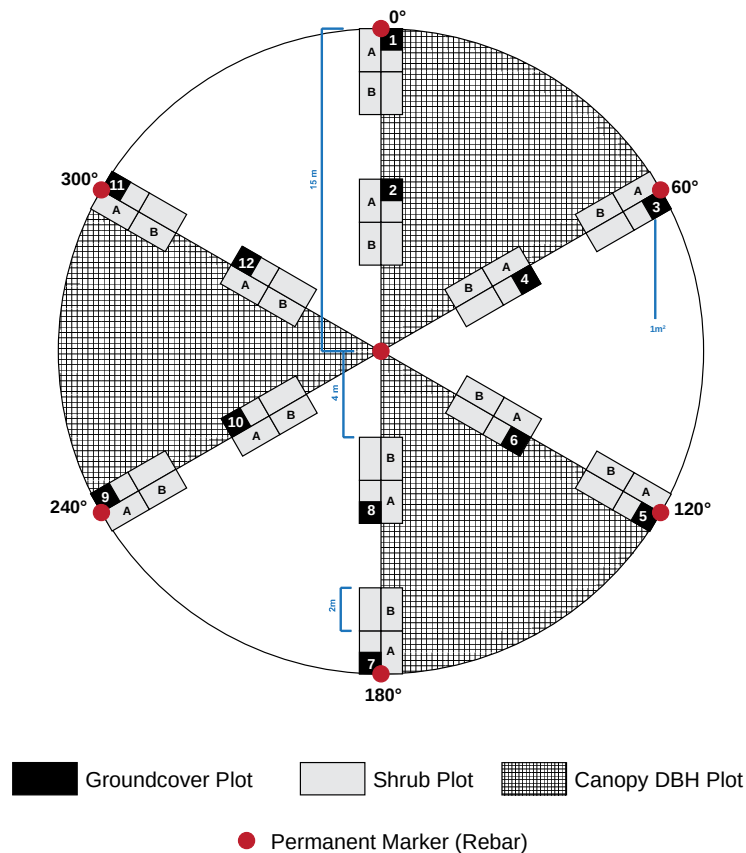


Figure 3. Southeast Coast Network vegetation community monitoring plot and subplot layout identifying the juxtaposition of canopy cover, canopy diameter, shrub, and groundcover plots within a circular array. Although not depicted, the above array is positioned at the center point of each 0.5-hectare 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 178 taxa during this monitoring effort (Appendix A), including 4 species, subspecies, and varieties not previously known to occur at the Park (Table 2). We detected 36 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.

- Four species new to the park species list were detected (Table 2).

Percent cover of vegetation in the groundcover, shrub, and canopy strata.

- Absolute canopy cover was showed variability across all sampling locations ($\bar{x}$ = 68.05%, SD = 27.51; Table 3).
- Saw palmetto (*Serenoa repens*) and wax myrtle (*Morella cerifera*) were the most frequently occurring shrub species (f = 64.52).
- Saw palmetto had the highest relative cover ($\bar{x}$ = 36.12%, SD = 36.86; Table 4) and absolute cover ($\bar{x}$ = 24.42%, SD = 31.48; Table 5) of all shrub species.
- Waxmyrtle had the second highest relative cover ($\bar{x}$ = 17.63%, SD = 26.28; Table 4) and the second highest absolute cover ($\bar{x}$ = 5.26%, SD = 7.18; Table 5) in the shrub stratum.
- Saw palmetto had the highest relative cover ($\bar{x}$ = 12.05%, SD = 26.50), while Virginia live oak (*Quercus virginiana*) had the second highest cover ($\bar{x}$ = 11.26%, SD = 16.52; Table 6) in the groundcover stratum.
- Muscadine grape (*Vitis rotundifolia*) had the highest absolute cover in the groundcover stratum ($\bar{x}$ = 1.85%, SD = 3.28), followed by seashore dropseed (*Sporobolus virginicus*); ($\bar{x}$ = 1.77%, SD = 9.84; Table 7).
- Leaf litter was the most common ground condition, with a relative cover of 88.30% (SD 15.42; Table 6) and an absolute cover of 88.70% (SD 16.67; Table 7).

Frequency of species in the groundcover stratum.

- Virginia live oak (f = 58.06), *Smilax* spp. (f = 45.16), saw palmetto (f = 45.16), and redbay (*Persea borbonia*; f = 41.94) were the most frequently occurring species in the groundcover stratum, respectively (Table 6).
- Leaf litter was the most frequently occurring ground condition 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 eastern redcedar (*Juniperus virginiana* var. *silicicola*; $\bar{x}$ = 66.30 cm, SD = 1.41, 2 individuals

measured; Table 8), followed by Virginia live oak ($\bar{x}$ = 50.07 cm, SD = 12.42, 71 individuals measured; Table 8)

- The average DBH of redbay was 9.90 (SD=6.71, 4 individuals measured). The average of swamp bay (*Persea palustris*) was 24.91 (SD=4.65, 12 individuals measured). Thirteen standing dead redbay and one standing dead swamp bay were measured.

Woody species seedling counts in the groundcover stratum.

- Virginia live oak had the highest estimated seedling density at the park (3.92/m², SD=8.07; Table 9).
- Redbay seedlings were estimated at 0.58/m² (SD= .68; Table 9).

Table 2. New vascular plant species, subspecies, or varieties found at Cumberland Island National Seashore, 2012.

Order	Family	Species	Nativity
Asparagales	Amaryllidaceae	<i>Allium</i> sp.	Native
Poales	Poaceae	<i>Andropogon gyrans</i> var. <i>gyrans</i>	Native
Poales	Poaceae	<i>Aristida spiciformis</i>	Native
Magnoliales	Magnoliaceae	<i>Liriodendron tulipifera</i>	Native

Table 3. Average canopy cover for vegetation monitoring macroplots at Cumberland Island National Seashore, 2012. Average canopy cover is based on data pooled across observers at each sampling location.

Sampling Location	Average	Standard Deviation
CUIS002	60.42	6.05
CUIS003	83.25	2.41
CUIS004	87.83	1.66
CUIS005	70.17	1.42
CUIS006	81.83	4.14
CUIS007	80.67	4.93
CUIS008	70.00	1.75
CUIS009	54.67	4.06
CUIS011	83.75	3.46
CUIS013	50.00	1.00
CUIS037	84.58	3.54
CUIS038	29.50	1.75
CUIS039	83.75	3.03
CUIS040	91.92	3.38
CUIS041	78.50	3.12
CUIS042	90.00	2.82
CUIS043	78.58	1.18
CUIS045	0.00	0.00
CUIS046	0.00	0.00
CUIS047	82.75	1.89
CUIS048	4.75	1.64
CUIS049	57.92	8.50
CUIS050	86.67	1.88
CUIS052	84.75	1.09
CUIS053	87.25	1.32
CUIS054	87.58	3.15
CUIS055	71.00	3.36
CUIS056	23.33	2.27
CUIS057	87.08	4.56
CUIS059	89.25	1.25
CUIS060	87.92	1.76
Park Average	68.05	27.51

Table 4. Percentage of vegetation cover (relative cover) and frequency (Freq) of occurrence of shrub species in vegetation monitoring sampling locations at Cumberland Island National Seashore, 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).

Species	Freq	Avg	SD	2	3	4	5	6	7	8	9	11	13	37	38	39	40	41	42	43	45	46	47	48	49	50	52	53	54	55	56	57	59	60
Baccharis halimifolia	3.23	0.03	0.17																					0.96										
Callicarpa americana	3.23	0.15	0.83												4.64																			
Hibiscus grandiflorus	3.23	0.33	1.84																						10.26									
Ilex glabra	6.45	0.73	3.06			6.73																		15.87										
Ilex opaca	22.58	0.98	2.47		1.70		0.85	5.66	3.76	4.93		1.86								11.65														
Ilex vomitoria	3.23	1.86	10.34					57.55																										
Iva frutescens	3.23	3.23	17.96																			100.00												
Lyonia ferruginea	51.61	9.06	13.10		15.38	22.51				33.80	7.79	18.12	0.25	8.83						34.58	44.66			7.45	6.85		16.16	7.55			38.85		14.22	3.79
Lyonia lucida	3.23	0.92	5.14																					28.61										
Morella cerifera	64.52	17.63	26.28	1.07	37.34	4.97	5.08	5.66	25.30		2.09	40.38	17.19	0.91	26.36	66.54		41.89	6.08		96.27		60.05	7.21					22.76	2.40	77.09			
Persea borbonia	54.84	2.62	5.59		0.27	0.19	0.85	5.66	3.76	5.63	0.12	5.37	0.25		0.31		27.08		15.56				4.74	0.72		1.86							4.04	4.84
Photinia pyrifolia	3.23	0.00	0.02																					0.12										
Pinus palustris	3.23	0.59	3.31																												18.44			
Pinus serotina	3.23	0.50	2.81																					15.63										
Pinus taeda	35.48	2.92	6.28				16.92	12.26	0.25			0.27	20.68		0.62	4.56		13.51	1.70	19.42									0.32					
Prunus serotina	3.23	0.04	0.24																				1.35											
Quercus chapmanii	3.23	0.22	1.21						6.76																									
Quercus geminata	3.23	0.00	0.02																					0.12										
Quercus laurifolia	3.23	2.35	13.10														72.92																	
Quercus myrtifolia	3.23	0.07	0.37			2.05																												
Quercus sp.	3.23	0.25	1.39						7.77																									
Quercus virginiana	25.81	1.57	5.91		0.27		6.94		1.00			0.27	32.42						4.38				1.35						1.92					
Rhus copallinum	3.23	0.06	0.32																					1.80										
Sabal palmetto	16.13	5.02	18.03	5.50					5.51												3.73								53.85		86.96			
Salix caroliniana	3.23	0.27	1.50																						8.33									

Table 5. Percentage of area covered (absolute cover) and frequency of occurrence of shrub species sampled in vegetation monitoring sampling locations at Cumberland Island National Seashore, 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].

Species	Freq	Avg	SD	2	3	4	5	6	7	8	9	11	13	37	38	39	40	41	42	43	45	46	47	48	49	50	52	53	54	55	56	57	59	60
Baccharis halimifolia	3.23	0.03	0.15																					0.83										
Callicarpa americana	3.23	0.05	0.28												1.56																			
Hibiscus grandiflorus	3.23	0.16	0.90																						5.00									
Ilex glabra	6.45	0.68	2.75			7.19																		13.75										
Ilex opaca	22.58	0.18	0.40		0.65		0.10	0.63	1.56	0.73		0.73								1.25														
Ilex vomitoria	3.23	0.20	1.14					6.35																										
Iva frutescens	3.23	0.02	0.11																			0.63												
Lyonia ferruginea	51.61	4.16	5.75		5.83	24.06				5.00	6.98	7.10	0.10	6.04						14.81	4.79		3.44	5.94		14.27	6.77			10.13		9.90	3.75	
Lyonia lucida	3.23	0.80	4.45																					24.79										
Morella cerifera	64.52	5.26	7.18	0.73	14.17	5.31	0.63	0.63	10.52		1.88	15.83	7.29	0.63	8.88	18.23		3.23	2.60		16.15		27.71	6.25					7.40	0.63	14.38			
Persea borbonia	54.84	0.84	1.54		0.10	0.21	0.10	0.63	1.56	0.83	0.10	2.10	0.10		0.10		1.35		6.67				2.19	0.63		1.67						2.81	4.79	
Photinia pyrifolia	3.23	0.00	0.02																					0.10										
Pinus palustris	3.23	0.11	0.62																												3.44			
Pinus serotina	3.23	0.44	2.43																					13.54										
Pinus taeda	35.48	0.58	1.64				2.08	1.35	0.10			0.10	8.77		0.21	1.25		1.04	0.73	2.08									0.10					
Prunus serotina	3.23	0.02	0.11																				0.63											
Quercus chapmanii	3.23	0.09	0.51						2.81																									
Quercus geminata	3.23	0.00	0.02																					0.10										
Quercus laurifolia	3.23	0.12	0.65														3.65																	
Quercus myrtifolia	3.23	0.07	0.39			2.19																												
Quercus sp.	3.23	0.10	0.58						3.23																									
Quercus virginiana	25.81	0.59	2.47		0.10		0.85		0.42			0.10	13.75						1.88				0.63						0.63					
Rhus copallinum	3.23	0.05	0.28																					1.56										
Sabal palmetto	16.13	0.91	3.25	3.75					2.29												0.63								17.50			4.17		
Salix caroliniana	3.23	0.13	0.73																						4.06									

Table 6. Percentage of vegetation cover (relative cover) and frequency of occurrence of groundcover species in vegetation monitoring sampling locations at Cumberland Island National Seashore, 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	Avg	SD	Freq	2	3	4	5	6	7	8	9	11	13	37	38	39	40	41	42	43	45	46	47	48	49	50	52	53	54	55	56	57	59	60	
<i>Ampelopsis arborea</i>	0.43	2.38	3.23																						13.24										
<i>Andropogon glomeratus</i>	0.34	1.88	3.23																					10.45											
<i>Andropogon virginicus</i>	1.02	3.98	9.68	1.22												19.88		10.50																	
<i>Arundinaria gigantea</i>	0.02	0.13	3.23				0.75																												
Asteraceae	0.01	0.06	3.23																						0.33										
<i>Axonopus</i> sp.	0.02	0.10	3.23																		0.55														
<i>Bignonia capreolata</i>	0.95	2.57	19.35				11.26			3.91				2.48				1.40					8.45										1.95		
<i>Boehmeria cylindrica</i>	0.07	0.37	3.23																						2.05										
<i>Carphephorus odoratissimus</i>	0.07	0.37	3.23																										2.06						
<i>Cenchrus tribuloides</i>	0.74	4.14	3.23																		23.03														
<i>Chamaesyce polygonifolia</i>	0.02	0.12	3.23																		0.66														
<i>Chasmanthium laxum</i>	2.81	7.68	22.58		29.15		0.15			8.59			2.88					9.80		30.86			5.76												
<i>Cirsium horridulum</i>	0.11	0.59	3.23																		3.29														
<i>Cladium mariscus</i> ssp. <i>jamaicense</i>	1.55	8.56	6.45																			0.25		47.65											
<i>Cnidoscolus stimulosus</i>	0.03	0.15	3.23															0.84																	
Cyperaceae	0.41	1.29	22.58		2.24		0.75		0.85						1.51														0.41		0.25	6.82			
<i>Cyperus</i> sp.	0.00	0.02	3.23																		0.11														
<i>Decodon verticillatus</i>	0.07	0.42	3.23																						2.32										
<i>Desmodium</i> sp.	0.02	0.11	3.23																				0.64												
<i>Dichantherium</i> sp.	2.61	7.18	25.81									33.98			9.79			0.70	0.36	18.52			0.64							5.21	11.59				
<i>Dichondra carolinensis</i>	0.06	0.35	3.23																														1.95		
<i>Elephantopus tomentosus</i>	0.03	0.18	3.23																														0.97		
<i>Eremochloa ophiuroides</i>	2.93	7.73	19.35						0.85				32.66			24.46		8.40												15.63		8.77			
<i>Eupatorium capillifolium</i>	1.09	3.42	19.35				1.50																0.64	2.99	12.91				14.40		1.26				

Species	Avg	SD	Freq	2	3	4	5	6	7	8	9	11	13	37	38	39	40	41	42	43	45	46	47	48	49	50	52	53	54	55	56	57	59	60		
<i>Oenothera humifusa</i>	0.32	1.77	3.23																		9.87															
<i>Oplismenus hirtellus</i>	0.05	0.21	6.45																				0.64									0.97				
<i>Opuntia humifusa</i>	0.02	0.14	3.23												0.75																					
<i>Panicum</i> sp.	0.95	2.08	25.81		2.24		6.91	2.34	7.80				0.48	2.48			5.28											2.06								
<i>Parietaria floridana</i>	0.11	0.59	3.23																		3.29															
<i>Parthenocissus quinquefolia</i>	0.03	0.19	3.23				1.05																													
<i>Persea borbonia</i>	3.94	6.47	41.94	1.46	17.94	6.41			5.08	7.81	9.09	9.71		24.75	0.75		1.65		15.55				8.96											13.07		
<i>Phylla nodiflora</i>	0.70	3.55	6.45																		19.74							2.06								
<i>Pinus palustris</i>	0.43	2.26	9.68						0.17								0.66															12.59				
<i>Pinus serotina</i>	0.21	1.16	3.23																					6.47												
<i>Pinus taeda</i>	0.85	1.94	32.26		0.45		7.06	0.93				5.83						0.14	0.90	2.47								2.06	6.25			0.19				
<i>Pleopeltis polypodioides</i>	0.18	0.88	6.45						0.85			4.85																								
Poaceae	1.67	3.18	29.03					2.34					6.72		1.51			8.40		6.17			4.48		6.95			12.35				2.92				
<i>Polygonum</i> sp.	0.16	0.89	3.23																						4.96											
<i>Prunus serotina</i>	0.09	0.38	6.45						0.85																									1.95		
<i>Pteridium aquilinum</i>	2.33	12.96	3.23																					72.14												
<i>Quercus chapmanii</i>	0.02	0.09	3.23																					0.50												
<i>Quercus geminata</i>	2.32	12.89	3.23			71.79																														
<i>Quercus laurifolia</i>	1.87	7.34	6.45														24.75				33.33															
<i>Quercus</i> sp.	0.44	2.44	3.23						13.56																											
<i>Quercus virginiana</i>	11.26	16.52	58.06	6.10	16.14				6.78	51.56	9.09	34.95	14.41	67.33	4.52		4.95	4.20	9.04	6.17							14.44	17.54		18.23		34.31	29.41			
<i>Rhynchospora</i> sp.	0.51	2.71	6.45												0.75																		15.11			
<i>Rubus argutus</i>	0.06	0.36	3.23																						1.99											
<i>Rubus cuneifolius</i>	0.31	1.75	3.23				9.76																													
<i>Rubus trivialis</i>	0.14	0.63	6.45						3.39																									0.97		
<i>Sabal palmetto</i>	0.41	1.95	6.45																									2.06					10.72			
<i>Salvia lyrata</i>	0.03	0.18	3.23																															0.97		

Species	Avg	SD	Freq	2	3	4	5	6	7	8	9	11	13	37	38	39	40	41	42	43	45	46	47	48	49	50	52	53	54	55	56	57	59	60				
<i>Schizachyrium littorale</i>	0.44	2.46	3.23																		13.71																	
<i>Scleria triglomerata</i>	5.40	11.07	25.81	29.27	2.24			28.04		23.44			36.02					29.55	5.42				13.44															
<i>Serenoa repens</i>	12.05	26.50	45.16	9.76		12.82				3.91	81.82			2.48	0.15			0.70								50.00	1.76	71.93	6.17	2.60			29.41	100.00				
<i>Sideroxylon tenax</i>	0.58	2.59	9.68					14.02					0.10										3.84															
<i>Smilax auriculata</i>	2.63	7.57	19.35					31.31	0.85											3.29				2.99								23.39	19.61					
<i>Smilax bona-nox</i>	0.71	3.79	6.45																				21.13									0.97						
<i>Smilax glauca</i>	0.02	0.11	3.23																				0.64															
<i>Smilax laurifolia</i>	0.34	1.21	9.68							5.93						3.06	1.65																					
<i>Smilax</i> sp.	4.42	10.99	45.16	8.29	0.45	2.56				0.78		0.97			5.57			0.70	24.41	2.47						50.00	0.70		30.86		1.26		7.84					
<i>Solidago</i> sp.	0.50	2.81	3.23																											15.63								
<i>Spartina bakeri</i>	1.10	6.12	3.23																			34.08																
<i>Spartina patens</i>	0.25	1.38	3.23																		7.68																	
<i>Sporobolus virginicus</i>	2.11	11.75	3.23																			65.42																
<i>Stenotaphrum secundatum</i>	0.01	0.07	3.23																										0.41									
<i>Stillingia sylvatica</i>	0.28	1.58	3.23																													8.82						
<i>Symplocos tinctoria</i>	0.24	1.31	3.23	7.32																																		
<i>Toxicodendron radicans</i>	0.07	0.28	9.68				1.50																							0.41			0.19					
<i>Uniola paniculata</i>	0.11	0.59	3.23																		3.29																	
<i>Vaccinium arboreum</i>	0.03	0.18	3.23							1.02																												
<i>Vaccinium myrsinites</i>	0.23	0.94	9.68							5.08									0.90													1.26						
<i>Vitis rotundifolia</i>	9.98	20.18	32.26	36.59			0.75		38.14						9.79		61.06	17.51	37.07				19.85				80.99					7.56						
<i>Woodwardia virginica</i>	0.02	0.09	3.23																					0.50														
Ground Condition																																						
Bare Ground	7.34	14.21	83.87	3.57	0.42	1.49	16.60	5.49	14.35	0.79		3.52	1.28	2.95	29.23	5.22		1.90	0.47	4.85	73.33		1.28	13.96	2.53			9.26	3.30	2.63	0.43	23.71	0.43	4.46				
Exposed Humus	0.13	0.73	3.23																						4.05													
Leaf Litter/ Duff	88.70	16.67	100.00	95.17	99.36	97.24	80.95	94.51	84.41	92.15	99.79	95.82	98.51	95.53	69.41	94.78	100.00	96.83	99.32	93.54	26.67	42.44	98.51	83.16	93.42	95.28	99.79	88.27	92.41	86.03	99.57	69.52	99.36	87.96				
Open Water	2.01	10.34	6.45																			57.56				4.72												
Tree Base	1.36	2.36	41.94				1.23		1.25	7.06				1.27				1.27		1.39			0.21	1.23				2.47	4.28	6.88		6.77		6.89				

Species	Avg	SD	Freq	2	3	4	5	6	7	8	9	11	13	37	38	39	40	41	42	43	45	46	47	48	49	50	52	53	54	55	56	57	59	60
Upland Non-Vascular/ Lichen	0.46	0.89	51.61	1.26	0.21	1.27	1.23				0.21	0.66	0.21	0.25	1.36				0.21	0.23				1.64			0.21			4.45			0.21	0.69

Table 7. Percentage of area covered (absolute cover) and frequency of occurrence by groundcover species sampled in vegetation monitoring sampling locations at Cumberland Island National Seashore, 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].

Species	Avg	SD	Freq	2	3	4	5	6	7	8	9	11	13	37	38	39	40	41	42	43	45	46	47	48	49	50	52	53	54	55	56	57	59	60
<i>Ampelopsis arborea</i>	0.27	1.50	3.23																						8.33									
<i>Andropogon glomeratus</i>	0.14	0.79	3.23																					4.38										
<i>Andropogon virginicus</i>	0.19	0.73	9.68	0.21												2.71		3.13																
<i>Arundinaria gigantea</i>	0.01	0.04	3.23				0.21																											
Asteraceae	0.01	0.04	3.23																						0.21									
<i>Axonopus</i> sp.	0.01	0.04	3.23																		0.21													
<i>Bignonia capreolata</i>	0.23	0.73	19.35				3.13			0.21				0.21				0.42					2.75									0.42		
<i>Boehmeria cylindrica</i>	0.04	0.23	3.23																						1.29									
<i>Carphephorus odoratissimus</i>	0.01	0.04	3.23																										0.21					
<i>Cenchrus tribuloides</i>	0.28	1.57	3.23																		8.75													
<i>Chamaesyce polygonifolia</i>	0.01	0.04	3.23																		0.25													
<i>Chasmanthium laxum</i>	0.33	0.79	22.58		2.71		0.04			0.46			1.25					2.92		1.04			1.88											
<i>Cirsium horridulum</i>	0.04	0.22	3.23																		1.25													
<i>Cladium mariscus</i> ssp. <i>jamaicense</i>	0.97	5.39	6.45																			0.21		30.00										
<i>Cnidoscolus stimulosus</i>	0.01	0.04	3.23															0.25																
Cyperaceae	0.08	0.27	22.58		0.21		0.21		0.21						0.42															0.04		0.04	1.46	
<i>Cyperus</i> sp.	0.00	0.01	3.23																		0.04													
<i>Decodon verticillatus</i>	0.05	0.26	3.23																						1.46									
<i>Desmodium</i> sp.	0.01	0.04	3.23																				0.21											
<i>Dichanthelium</i> sp.	0.25	0.63	25.81										1.46		2.71			0.21	0.08	0.63			0.21							0.42	1.92			
<i>Dichondra carolinensis</i>	0.01	0.07	3.23																														0.42	
<i>Elephantopus tomentosus</i>	0.01	0.04	3.23																														0.21	
<i>Eremochloa ophiuroides</i>	0.75	2.62	19.35						0.21				14.17			3.33		2.50												1.25		1.88		
<i>Eupatorium capillifolium</i>	0.38	1.48	19.35				0.42																0.21	1.25	8.13			1.46		0.21				
<i>Eupatorium</i> sp.	0.16	0.48	16.13						0.71						2.50			0.83					0.42								0.42			

Species	Avg	SD	Freq	2	3	4	5	6	7	8	9	11	13	37	38	39	40	41	42	43	45	46	47	48	49	50	52	53	54	55	56	57	59	60	
<i>Opuntia humifusa</i>	0.01	0.04	3.23												0.21																				
<i>Panicum</i> sp.	0.18	0.48	25.81		0.21		1.92	0.21	1.92				0.21	0.21			0.67												0.21						
<i>Parietaria floridana</i>	0.04	0.22	3.23																		1.25														
<i>Parthenocissus quinquefolia</i>	0.01	0.05	3.23				0.29																												
<i>Persea borbonia</i>	0.46	0.91	41.94	0.25	1.67	0.21			1.25	0.42	0.21	0.42		2.08	0.21		0.21		3.58				2.92										0.83		
<i>Phyla nodiflora</i>	0.25	1.35	6.45																		7.50								0.21						
<i>Pinus palustris</i>	0.07	0.37	9.68						0.04								0.08														2.08				
<i>Pinus serotina</i>	0.09	0.49	3.23																					2.71											
<i>Pinus taeda</i>	0.11	0.36	32.26		0.04		1.96	0.08				0.25						0.04	0.21	0.08								0.21	0.50		0.04				
<i>Pleopeltis polypodioides</i>	0.01	0.05	6.45						0.21			0.21																							
<i>Poaceae</i>	0.45	1.03	29.03					0.21					2.92		0.42			2.50		0.21		1.46		4.38				1.25				0.63			
<i>Polygonum</i> sp.	0.10	0.56	3.23																					3.13											
<i>Prunus serotina</i>	0.02	0.08	6.45						0.21																							0.42			
<i>Pteridium aquilinum</i>	0.97	5.43	3.23																					30.21											
<i>Quercus chapmanii</i>	0.01	0.04	3.23																					0.21											
<i>Quercus geminata</i>	0.08	0.42	3.23			2.33																													
<i>Quercus laurifolia</i>	0.14	0.59	6.45														3.13		1.13																
<i>Quercus</i> sp.	0.11	0.60	3.23						3.33																										
<i>Quercus virginiana</i>	1.25	1.91	58.06	1.04	1.50				1.67	2.75	0.21	1.50	6.25	5.67	1.25		0.63	1.25	2.08	0.21						1.71	0.42		1.46		7.33	1.88			
<i>Rhynchospora</i> sp.	0.09	0.45	6.45												0.21																2.50				
<i>Rubus argutus</i>	0.04	0.22	3.23																					1.25											
<i>Rubus cuneifolius</i>	0.09	0.49	3.23				2.71																												
<i>Rubus trivialis</i>	0.03	0.15	6.45						0.83																								0.21		
<i>Sabal palmetto</i>	0.08	0.41	6.45																									0.21				2.29			
<i>Salvia lyrata</i>	0.01	0.04	3.23																													0.21			
<i>Schizachyrium littorale</i>	0.17	0.94	3.23																		5.21														
<i>Scleria triglomerata</i>	1.26	3.30	25.81	5.00	0.21			2.50		1.25			15.63					8.79	1.25				4.38												
<i>Serenoa repens</i>	0.39	0.71	45.16	1.67		0.42				0.21	1.88			0.21	0.04			0.21								0.21	0.21	1.71	0.63	0.21			1.88	2.50	
<i>Sideroxylon tenax</i>	0.08	0.31	9.68					1.25					0.04									1.25													
<i>Smilax auriculata</i>	0.38	1.05	19.35					2.79	0.21												1.25		1.25		1.25						5.00	1.25			

Species	Avg	SD	Freq	2	3	4	5	6	7	8	9	11	13	37	38	39	40	41	42	43	45	46	47	48	49	50	52	53	54	55	56	57	59	60				
<i>Smilax bona-nox</i>	0.23	1.23	6.45																				6.88										0.21					
<i>Smilax glauca</i>	0.01	0.04	3.23																				0.21															
<i>Smilax laurifolia</i>	0.07	0.27	9.68						1.46							0.42	0.21																					
<i>Smilax</i> sp.	0.43	1.16	45.16	1.42	0.04	0.08				0.04		0.04			1.54			0.21	5.63	0.08						0.21	0.08		3.13		0.21		0.50					
<i>Solidago</i> sp.	0.04	0.22	3.23																											1.25								
<i>Spartina bakeri</i>	0.92	5.13	3.23																			28.54																
<i>Spartina patens</i>	0.09	0.52	3.23																		2.92																	
<i>Sporobolus virginicus</i>	1.77	9.84	3.23																			54.79																
<i>Stenotaphrum secundatum</i>	0.00	0.01	3.23																										0.04									
<i>Stillingia sylvatica</i>	0.05	0.26	3.23																													1.46						
<i>Symplocos tinctoria</i>	0.04	0.22	3.23	1.25																																		
<i>Toxicodendron radicans</i>	0.02	0.08	9.68				0.42																						0.04			0.04						
<i>Uniola paniculata</i>	0.04	0.22	3.23																		1.25																	
<i>Vaccinium arboreum</i>	0.01	0.04	3.23							0.25																												
<i>Vaccinium myrsinites</i>	0.05	0.23	9.68							1.25									0.21												0.21							
<i>Vitis rotundifolia</i>	1.85	3.28	32.26	6.25			0.21		9.38						2.71		7.71	5.21	8.54				6.46				9.58				1.25							
<i>Woodwardia virginica</i>	0.01	0.04	3.23																				0.21															
Ground Condition																																						
Bare Ground	7.52	14.62	83.87	3.54	0.42	1.46	16.92	5.42	14.38	0.79		3.54	1.25	2.92	32.29	5.21		1.88	0.46	4.38	74.58		1.25	14.17	2.50			9.38	3.38	2.71	0.42	24.79	0.42	4.58				
Exposed Humus	0.13	0.72	3.23																						4.00													
Leaf Litter/Duff	88.30	15.42	100.00	94.38	97.50	95.42	82.50	93.33	84.58	92.50	97.50	96.46	96.46	94.38	76.67	94.58	97.50	95.42	97.50	84.42	27.13	45.63	96.46	84.38	92.29	93.33	97.50	89.38	94.38	88.54	97.50	72.71	96.46	90.42				
Open Water	2.15	11.12	6.45																			61.88				4.63												
Tree Base	1.38	2.42	41.94				1.25		1.25	7.08				1.25				1.25		1.25			0.21	1.25				2.50	4.38	7.08		7.08		7.08				
Upland Non-Vascular/Lichen	0.47	0.92	51.61	1.25	0.21	1.25	1.25				0.21	0.67	0.21	0.25	1.50				0.21	0.21				1.67			0.21			4.58			0.21	0.71				

Table 8. Average canopy species size, measured as diameter (cm) at breast height (DBH) for species sampled in vegetation monitoring macroplots at Cumberland Island National Seashore, 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].

Species	Avg	SD	2	3	4	5	6	7	8	9	11	13	37	38	39	40	41	42	43	45	47	48	49	50	52	53	54	55	56	57	59	60	
<i>Ilex cassine</i>	6.65	1.20																								6.65 (2)							
<i>Ilex opaca</i>	16.98	6.02		22.21 (11)					30.70 (1)										11.30 (4)							10.23 (3)	9.80 (1)	17.67 (3)					
<i>Juniperus virginiana</i> var. <i>silicicola</i>	66.30	1.41																												66.30 (2)			
<i>Lyonia ferruginea</i>	7.52	2.43	7.67 (10)	6.85 (37)	6.21 (48)				6.27 (3)	8.27 (18)	10.20 (2)							7.53 (25)			7.33 (3)			5.70 (40)	7.76 (18)			7.24 (8)			8.79 (22)	8.01 (7)	
<i>Morella cerifera</i>	5.09	1.23								7.47 (3)		4.00 (1)		4.75 (4)						4.62 (6)							4.60 (1)						
<i>Nyssa sylvatica</i> var. <i>biflora</i>	20.20																						20.20 (1)										
<i>Osmanthus americanus</i>	6.86	1.39			6.86 (7)																												
<i>Persea borbonia</i>	9.90	6.71																													9.90 (4)		
<i>Pinus elliotii</i>	42.97	12.75																			42.97 (11)												
<i>Pinus palustris</i>	24.91	4.65						7.30 (4)								42.53 (8)																	
<i>Pinus serotina</i>	16.95	17.47																						16.95 (2)									
<i>Pinus taeda</i>	26.03	10.20	10.05 (2)	39.22 (6)		9.80 (35)	22.45 (2)		48.85 (2)		8.90 (1)	8.27 (34)		21.33 (3)	16.11 (55)		13.96 (25)	43.70 (1)	50.00 (1)								22.74 (10)	49.03 (4)					
<i>Prunus serotina</i>	5.30																					5.30 (1)											
<i>Quercus chapmanii</i>	5.50				5.50 (1)																												
<i>Quercus geminata</i>	12.30	6.08			12.30 (16)																												
<i>Quercus laurifolia</i>	24.87	10.89	8.50 (1)										34.80 (1)				31.30 (2)																
<i>Quercus myrtifolia</i>	9.74	3.33			9.74 (19)																												
<i>Quercus nigra</i>	32.93	12.43															32.93 (3)																
<i>Quercus virginiana</i>	50.07	12.42				101.50 (1)	46.15 (2)	33.00 (4)	57.30 (2)	68.03 (4)		34.16 (10)	72.20 (2)					23.90 (2)	40.60 (2)				24.00 (1)	33.65 (10)	55.06 (5)	30.51 (13)				83.50 (2)	33.13 (7)	64.48 (4)	
<i>Sabal palmetto</i>	33.19	6.66															33.60 (1)										32.77 (7)						
<i>Salix caroliniana</i>	9.10	4.41																					9.10 (11)										
<i>Serenoa repens</i>	17.50		17.50 (1)																														

[illegible]

Table 9. Seedling frequency for canopy and shrub species in vegetation monitoring macroplots at Cumberland Island National Seashore, 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].

Species	Seedlings	Seedlings per m ²	SD	2	3	4	5	6	7	8	9	11	13	37	38	39	40	41	42	43	46	47	48	50	52	53	54	55	56	57	59	60
<i>Ilex glabra</i>	1	0.08				0.08																										
<i>Ilex opaca</i>	5	0.21	0.06						0.25																0.17							
<i>Ilex vomitoria</i>	9	0.75						0.75																								
<i>Iva frutescens</i>	3	0.25																		0.25												
<i>Ligustrum japonicum</i>	1	0.08																												0.08		
<i>Lyonia ferruginea</i>	21	0.29	0.25		0.50									0.08					0.67				0.08		0.33						0.08	
<i>Lyonia lucida</i>	8	0.67																				0.67										
<i>Morella cerifera</i>	40	0.37	0.32		0.25		0.50					0.33				1.08		0.17	0.08			0.58	0.08					0.25				
<i>Persea borbonia</i>	90	0.58	0.68	0.17	0.50	0.08			0.42	0.42	0.083	0.17		1.08	0.08		0.17		2.50			0.83	0.08								1.00	
<i>Pinus palustris</i>	33	0.92	1.37						0.08								0.17												2.50			
<i>Pinus serotina</i>	7	0.58																					0.58									
<i>Pinus taeda</i>	182	1.52	4.04		0.25		13.00	0.17				0.17						0.08	0.33	0.17						0.08	0.83		0.08			
<i>Prunus serotina</i>	4	0.17	0.12						0.08																					0.25		
<i>Quercus chapmanii</i>	1	0.08																					0.08									
<i>Quercus geminata</i>	23	1.92			1.92																											
<i>Quercus laurifolia</i>	33	1.38	0.77														1.92		0.83													
<i>Quercus sp.</i>	26	2.17							2.17																							
<i>Quercus virginiana</i>	847	3.92	8.07	2.50	0.50				0.75	4.08	0.583	1.33	2.08	10.00	1.17		0.75	0.50	1.17	0.42					2.42	0.42		1.25		34.75	5.92	
<i>Sabal palmetto</i>	15	0.63	0.77																								0.08			1.17		
<i>Serenoa repens</i>	54	0.35	0.29	0.58		0.17				0.08	0.417			0.08			0.08							0.08	0.08	0.92	0.33	0.33		0.50	0.83	
<i>Sideroxylon tenax</i>	5	0.14	0.10					0.08					0.08									0.25										
<i>Sporobolus virginicus</i>	1	0.08																			0.08											
<i>Symplocos tinctoria</i>	3	0.25		0.25																												
<i>Vaccinium arboreum</i>	3	0.25							0.25																							
<i>Vaccinium myrsinites</i>	5	0.14	0.10						0.25									0.08											0.08			

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-m² 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.
- Fraedrich S. W., T. C. Harrington, R. J. Rabaglia, M. D. Ulyshen, A. E. Mayfield III, J. L. Hanula, J. M. Eickwort, and D. R. Miller. 2008. A fungal symbiont of the redbay ambrosia beetle causes a lethal wilt in redbay and other Lauraceae in the southeastern United States. *Plant Disease* 92:215–224.

- Haack, R. A. 2006. Exotic bark- and wood-boring Coleoptera in the United States: Recent establishments and interceptions. *Canadian Journal of Forest Research* 36:269-288.
- 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.
- Rabaglia, R. 2003. *Xyleborus glabratus*. Online record, URL:
<http://spfnic.fs.fed.us/exfor/data/pestreports.cfm?pestidval=148&langdisplay=english>
(Accessed 2/14/2012).
- 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 CUIS.

Table A-1. Vascular plant species known to occur at Cumberland Island National Seashore (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</i> var. <i>pusilla</i>	X	
Asterales	Asteraceae	<i>Coreopsis basal</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.)

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>Symphyotrichum dumosum</i>	X	
Asterales	Asteraceae	<i>Symphyotrichum pilosum</i> var. <i>pilosum</i>	X	
Asterales	Asteraceae	<i>Symphyotrichum subulatum</i>	X	
Asterales	Asteraceae	<i>Symphyotrichum 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	
Caryophyllales	Amaranthaceae	<i>Atriplex patula</i>	X	

Table A-1. (Continued.)

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 ohimensis</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	
Fabales	Fabaceae	<i>Aeschynomene indica</i>	X	
Fabales	Fabaceae	<i>Centrosema virginianum</i>	X	

Table A-1. (Continued.)

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	
Lamiales	Lamiaceae	<i>Lamium amplexicaule</i>	X	
Lamiales	Lamiaceae	<i>Mentha</i> X <i>gentilis</i>	X	
Lamiales	Lamiaceae	<i>Salvia lyrata</i>	X	

Table A-1. (Continued.)

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	
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	

Table A-1. (Continued.)

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</i> , unknown	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>Dichanthelium commutatum</i>	X	
Poales	Poaceae	<i>Dichanthelium scabriusculum</i>	X	
Poales	Poaceae	<i>Digitaria sanguinalis</i>	X	
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

Table A-1. (Continued.)

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
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	

Table A-1. (Continued.)

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 Cumberland Island National Seashore, 2012.

Species	2	3	4	5	6	7	8	9	11	13	37	38	39	40	41	42	43	45	46	47	48	49	50	52	53	54	55	56	57	56	60
<i>Acer rubrum</i>																			X			X									
<i>Allium</i> sp.																													X		
<i>Ampelopsis arborea</i>																						X				X					
<i>Andropogon glomeratus</i>								X													X										
<i>Andropogon gyrans</i> var. <i>gyrans</i>	X																														
<i>Andropogon virginicus</i>	X				X					X		X	X		X	X	X										X				
<i>Aristida</i> sp.					X																										
<i>Aristida spiciformis</i>																					X										
<i>Arundinaria gigantea</i>				X																											
<i>Asimina parviflora</i>												X																			
<i>Asimina</i> sp.				X																											
Asteraceae				X																		X									
<i>Axonopus</i> sp.																		X													
<i>Azolla caroliniana</i>																													X		
<i>Baccharis halimifolia</i>																			X		X									X	
<i>Bambusa</i> sp.																														X	
<i>Befaria racemosa</i>																					X										
<i>Bignonia capreolata</i>				X			X			X					X					X										X	
<i>Boehmeria cylindrica</i>				X																		X								X	
<i>Callicarpa americana</i>				X								X																			
<i>Carphephorus odoratissimus</i>																					X					X					
<i>Cenchrus tribuloides</i>															X			X												X	
<i>Centella asiatica</i>																										X					
<i>Cephalanthus occidentalis</i>																						X									
<i>Chamaesyce polygonifolia</i>																		X													
<i>Chasmanthium laxum</i>		X		X		X	X			X					X		X			X						X					
<i>Cirsium horridulum</i>																		X												X	
<i>Cirsium nuttallii</i>												X	X																		
<i>Cirsium</i> sp.																														X	
<i>Cladium mariscus</i> ssp. <i>jamaicense</i>																		X			X										
<i>Cnidocolus stimulosus</i>										X					X					X										X	
<i>Crinum</i> sp.																														X	
<i>Croton punctatus</i>																		X													
Cyperaceae		X		X		X						X														X		X	X		
<i>Cyperus haspan</i>																			X												
<i>Cyperus</i> sp.																		X												X	
<i>Decodon verticillatus</i>																						X									
<i>Desmodium</i> sp.															X					X										X	
<i>Dichanthelium</i> sp.		X							X			X			X	X	X			X	X						X	X			

Table B-1. (Continued.)

Species	2	3	4	5	6	7	8	9	11	13	37	38	39	40	41	42	43	45	46	47	48	49	50	52	53	54	55	56	57	58	60
<i>Dichondra carolinensis</i>																													X		
<i>Diodia virginiana</i>													X																		
<i>Elephantopus tomentosus</i>										X																			X		
<i>Epidendrum conopseum</i>																															X
<i>Eremochloa ophiuroides</i>						X				X			X		X												X		X		
<i>Eupatorium capillifolium</i>				X		X							X							X	X	X				X		X	X		
<i>Eupatorium</i> sp.				X		X						X			X				X	X								X			
<i>Eustachys petraea</i>													X					X													
<i>Fabaceae</i>																													X		
<i>Fimbristylis</i> sp.																		X													
<i>Galactia elliotii</i>																					X							X			
<i>Galium hispidulum</i>						X						X	X																		
<i>Galium obtusum</i>						X									X						X					X			X		
<i>Gelsemium sempervirens</i>		X		X										X		X											X				
<i>Gnaphalium obtusifolium</i> var. <i>obtusifolium</i>			X		X																							X			
<i>Gnaphalium</i> sp.																		X													
<i>Gordonia lasianthus</i>																				X											
<i>Helianthemum corymbosum</i>	X			X	X	X				X		X	X		X					X							X	X			
<i>Heterotheca subaxillaris</i>																		X													
<i>Hibiscus grandiflorus</i>																						X									
<i>Houstonia procumbens</i>	X			X	X	X				X		X			X			X					X						X		
<i>Hydrocotyle bonariensis</i>				X	X								X					X	X				X								
<i>Hydrocotyle umbellata</i>																													X		
<i>Hypericum hypericoides</i>						X						X	X																		
<i>Ilex ambigua</i>				X																											
<i>Ilex cassine</i>																				X					X	X					
<i>Ilex glabra</i>			X																		X										
<i>Ilex opaca</i>		X		X	X	X	X		X	X		X		X		X	X			X				X	X	X	X	X			
<i>Ilex vomitoria</i>					X	X																									
<i>Indigofera caroliniana</i>															X																
<i>Iva frutescens</i>																			X												
<i>Juncus effusus</i>																													X		
<i>Juncus roemerianus</i>																						X									
<i>Juncus</i> sp.				X																											
<i>Juniperus silicicola</i>		X		X	X									X												X			X		
<i>Juniperus virginiana</i>		X												X																	
<i>Juniperus virginiana</i> var. <i>silicicola</i>																												X			

Table B-1. (Continued.)[illegible]

Table B-1. (Continued.)

Species	2	3	4	5	6	7	8	9	11	13	37	38	39	40	41	42	43	45	46	47	48	49	50	52	53	54	55	56	57	56	60
<i>Phytolacca americana</i>				X																											
<i>Pinus elliotii</i>																				X											
<i>Pinus glabra</i>															X																
<i>Pinus palustris</i>						X								X														X			
<i>Pinus serotina</i>																					X		X								
<i>Pinus taeda</i>	X	X		X	X	X	X	X	X	X		X	X		X	X	X										X	X		X	
<i>Plantago virginica</i>				X																										X	
<i>Pleopeltis polypodioides</i>				X		X		X	X		X				X						X			X	X	X	X		X	X	X
<i>Pluchea</i> sp.																										X					
Poaceae				X	X	X				X		X			X		X	X		X		X					X		X	X	
<i>Polygonum</i> sp.																							X								
<i>Pontederia cordata</i>																							X								
<i>Prunus serotina</i>						X						X		X			X			X	X									X	
<i>Pteridium aquilinum</i>																						X									
<i>Ptilimnium capillaceum</i>																														X	
<i>Quercus chapmanii</i>				X		X							X								X										
<i>Quercus geminata</i>				X									X								X										
<i>Quercus hemisphaerica</i>																													X		
<i>Quercus laurifolia</i>	X					X	X				X			X			X								X		X				
<i>Quercus myrtifolia</i>			X																												
<i>Quercus nigra</i>															X																
<i>Quercus</i> sp.						X									X																
<i>Quercus virginiana</i>	X	X		X	X	X	X	X	X	X	X	X		X	X	X	X			X		X	X	X	X	X	X	X	X	X	X
<i>Rhus copallinum</i>																						X									
<i>Rhynchospora</i> sp.						X	X					X				X												X			
<i>Rubus argutus</i>																							X								
<i>Rubus cuneifolius</i>				X																											
<i>Rubus trivialis</i>					X	X																					X		X	X	
<i>Sabal palmetto</i>	X	X		X		X				X					X			X		X					X	X			X		
<i>Sabatia</i> sp.																											X				
<i>Saccharum giganteum</i>																						X									
<i>Salix caroliniana</i>																							X								
<i>Salvia lyrata</i>																														X	
<i>Saururus cernuus</i>				X																			X				X				
<i>Schizachyrium littorale</i>																		X													
<i>Scleria triglomerata</i>	X	X			X		X			X	X				X	X	X			X					X		X	X			
<i>Senna obtusifolia</i>				X																											
<i>Serenoa repens</i>	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	X	X	X		X	X

Table B-1. (Continued.)

Species	2	3	4	5	6	7	8	9	11	13	37	38	39	40	41	42	43	45	46	47	48	49	50	52	53	54	55	56	57	58	60
<i>Setaria magna</i>																			X												
<i>Sideroxylon</i> sp.																													X		
<i>Sideroxylon tenax</i>						X	X			X		X	X		X						X				X						
<i>Smilax auriculata</i>			X		X	X	X					X						X	X	X	X								X	X	
<i>Smilax bona-nox</i>														X						X									X		
<i>Smilax glauca</i>																X				X											
<i>Smilax laurifolia</i>						X							X	X									X			X					
<i>Smilax</i> sp.	X	X	X	X			X		X			X			X	X	X						X	X		X	X	X		X	
<i>Solidago sempervirens</i>																			X												
<i>Solidago</i> sp.																					X							X			
<i>Spartina bakeri</i>								X											X												
<i>Spartina patens</i>																		X													
<i>Spirodela polyrrhiza</i>																													X		
<i>Sporobolus virginicus</i>																			X												
<i>Stenotaphrum secundatum</i>																										X					
<i>Stillingia sylvatica</i>																X												X			
<i>Symplocos tinctoria</i>	X																X														
<i>Tillandsia recurvata</i>									X					X						X										X	
<i>Tillandsia usneoides</i>	X	X		X		X	X	X	X		X		X	X	X					X			X	X	X	X	X		X	X	X
<i>Toxicodendron radicans</i>				X										X					X			X				X			X		
<i>Tracheobionta</i>						X																									
<i>Ulmus americana</i>																										X					
<i>Uniola paniculata</i>																		X													
<i>Vaccinium arboreum</i>	X	X	X	X		X	X		X	X	X				X	X	X			X			X	X	X	X	X	X			X
<i>Vaccinium corymbosum</i>				X																X		X									
<i>Vaccinium myrsinites</i>			X			X									X							X						X			
<i>Vaccinium stamineum</i>			X																												X
<i>Verbascum thapsus</i>																															
<i>Viola</i> sp.																													X		
<i>Vitis rotundifolia</i>	X	X		X		X	X		X		X	X	X	X	X	X				X				X		X		X			X
<i>Woodwardia virginica</i>																						X	X								
<i>Yucca filamentosa</i>														X						X											
<i>Zanthoxylum clava-herculis</i>				X																											

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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