



Terrestrial Vegetation Monitoring at Cape Hatteras National Seashore

2019 Data Summary

Natural Resource Data Series NPS/SECN/NRDS—2022/1341





ON THIS PAGE

The showy inflorescence and structure of seashore marsh-mallow (*Kosteletzkya pentacarpos*) in an irregularly flooded tidal high salt marsh on Ocracoke Island in Cape Hatteras National Seashore. NPS photo / M. Forbes Boyle.

ON THE COVER

From left, Wylie Paxton (Appalachian/Piedmont/Coastal Fire Management Zone) and Elizabeth Rico (Southeast Coast Network) using digital flora resources to identify dune grasses at Cape Hatteras National Seashore. NPS photo / M. Forbes Boyle.

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M. Forbes Boyle and Elizabeth Rico

Southeast Coast Inventory and Monitoring Network
National Park Service
Cumberland Island National Seashore
101 Wheeler Street
Saint Marys, Georgia 31558

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National Park Service
Natural Resource Stewardship and Science
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The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

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

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

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of the Appalachian/Piedmont/Coastal Fire Management Zone who provided field support (and brought a burst of energy when needed!) for a week. Both Allyson Arulanantham and Wylie Paxton participated in field data collection efforts, which included sampling on double-observer (repeat sampling) quality control plots—a very critical phase of our field approach. Their efforts, and the efforts of Rob Klein (lead Fire Ecologist for the Zone) to help coordinate their participation, enabled us to successfully and efficiently complete this monitoring effort.



Staff from the Fire Ecology division of the Appalachian/Piedmont/Coastal Fire Management Zone provided field assistance at Cape Hatteras National Seashore. Allyson Arulanantham in the foreground and Wiley Paxton in the background, with SECN's Elizabeth Rico. NPS photo / M. Forbes Boyle.

Executive Summary

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

The first year of conducting this monitoring effort at four SECN parks, including 52 plots on Cape Hatteras National Seashore (CAHA), was 2019. Twelve vegetation plots were established at Cape Hatteras NS in July and August. Data collected in each plot included species richness across multiple spatial scales, species-specific cover and constancy, species-specific woody stem seedling/sapling counts and adult tree (greater than 10 centimeters [3.9 inches {in}]) diameter at breast height (DBH), overall tree health, landform, soil, observed disturbance, and woody biomass (i.e., fuel load) estimates.

This report summarizes the baseline (year 1) terrestrial vegetation data collected at Cape Hatteras National Seashore in 2019. Data were stratified across four dominant broadly defined habitats within the park (Maritime Tidal Wetlands, Maritime Nontidal Wetlands, Maritime Open Uplands, and Maritime Upland Forests and Shrublands) and four land parcels (Bodie Island, Buxton, Hatteras Island, and Ocracoke Island). Noteworthy findings include:

- A total of 265 vascular plant taxa (species or lower) were observed across 52 vegetation plots, including 13 species not previously documented within the park.
- The most frequently encountered species in each broadly defined habitat included:
 - Maritime Tidal Wetlands: saltmeadow cordgrass (*Spartina patens*), swallow-wort (*Patalias palustre*), and marsh fimbry (*Fimbristylis castanea*)
 - Maritime Nontidal Wetlands: common wax-myrtle (*Morella cerifera*), saltmeadow cordgrass, eastern poison ivy (*Toxicodendron radicans* var. *radicans*), and saw greenbriar (*Smilax bona-nox*)
 - Maritime Open Uplands: sea oats (*Uniola paniculata*), dune camphorweed (*Heterotheca subaxillaris*), and seabeach evening-primrose (*Oenothera humifusa*)
 - Maritime Upland Forests and Shrublands: : loblolly pine (*Pinus taeda*), southern/eastern red cedar (*Juniperus silicicola + virginiana*), common wax-myrtle, and live oak (*Quercus virginiana*).
- Five invasive species identified as either a Severe Threat (Rank 1) or Significant Threat (Rank 2) to native plants by the North Carolina Native Plant Society (Buchanan 2010) were found during this monitoring effort. These species (and their overall frequency of occurrence within all plots) included: alligatorweed (*Alternanthera philoxeroides*; 2%), Japanese honeysuckle (*Lonicera japonica*; 10%), Japanese stilt-grass (*Microstegium vimineum*; 2%), European common reed (*Phragmites australis*; 8%), and common chickweed (*Stellaria media*; 2%).
- Eighteen rare species tracked by the North Carolina Natural Heritage Program (Robinson 2018) were found during this monitoring effort, including two species—cypress panicgrass (*Dichanthelium caeruleum*) and Gulf Coast spikerush (*Eleocharis cellulosa*)—listed as State Endangered by the Plant Conservation Program of the North Carolina Department of Agriculture and Consumer Services (NCPCP 2010).
- Southern/eastern red cedar was a dominant species within the tree stratum of both Maritime Nontidal Wetland and Maritime Upland Forest and Shrubland habitat types. Other dominant tree species within CAHA forests included loblolly pine, live oak, and Darlington oak (*Quercus hemisphaerica*).
- One hundred percent of the live swamp bay (*Persea palustris*) trees measured in these plots were experiencing declining vigor and observed with symptoms like those caused by laurel wilt disease (LWD). To date, LWD has not been confirmed within Dare County, North Carolina.
- Downed woody biomass (fuel loads) were highest in the Buxton land parcel. Duff and litter contributed to the highest proportion of fuel loads across the park.

List of Terms

Aspect: The compass direction that a slope faces.

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

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

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

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

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

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

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

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

Global / State Status: Conservation status assessment ranks developed by NatureServe and individual state Natural

Heritage Programs used to determine the extinction risk of species and ecosystems at the global and state scales. Global codes are as follows:

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

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

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

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

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

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

Slope: The rise and fall of a land surface.

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

Terrain Shape Index (TSI): A quantitative expression of the geometric shape (ranging from concave to convex) of the land surface. Negative TSI values indicate convex shape, positive values indicate concavity, and values around 0 indicate flat surfaces.

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

Introduction

Overview

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

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

Determining trends in vegetation communities over time and identifying plant stressors is vital to understanding the ecological health of terrestrial ecosystems within SECN parks. Collectively, this information can be used to guide management actions that sustain park’s ecological integrity and support plant conservation across a diversity of spatial scales. The Southeast Coast Network collects long-term data on vegetation communities within its parks using a protocol that is largely based on the forest monitoring approaches used by the Cumberland Piedmont Network (White et al. 2011) and Gulf Coast Network (Carlson et al. 2018).

This report provides a summary of data collected in July and August 2019 at Cape Hatteras National Seashore (CAHA) as part of the SECN’s terrestrial vegetation monitoring effort. This report is intended to provide CAHA resource managers and partners with (a) baseline information on the composition, abundance, and structure of vegetation across broad habitat types, (b) documentation of observable stressors to park vegetation resources, and (c) a summary of ancillary data associated with terrestrial ecosystems (e.g., soil nutrient status and fuel abundance).

Monitoring Objectives

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

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

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

Methods

Study Area

Cape Hatteras National Seashore (CAHA) covers approximately 9,903 hectares (24,470 acres [ac]) and is located along a 70-mile chain of three barrier islands in eastern North Carolina—Bodie, Hatteras, and Ocracoke Islands (Figure 1). These islands form a substantial portion of the northern Outer Banks and are separated from mainland North Carolina by the Pamlico Sound. Bodie Island is separated from Hatteras Island to the south by Pea Island National Wildlife Refuge. Although located within the Seashore’s administrative boundary, it is managed by the U.S. Fish and Wildlife Service. The Outer Banks were formed following the most recent glaciation and are composed of relatively young coarse sand substrates deposited over limestone and unconsolidated soil materials. The topography is fairly flat except for undulating dune fields and beach dunes, ranging from 3 meters (10 ft) to 9 meters (30 ft); the highest elevation is on Jockey’s Ridge—a live unstable dune that reaches 35 meters (115 ft). Like most barrier islands along the southeastern coast, the vegetation communities along Cape Hatteras National Seashore range from open beach and foredune grasslands on the ocean-facing side to tidal marshes on the sound-facing side. Between is a mixture of interdune swales, backdunes, and enclosed wetlands. Wide sections within the Seashore—like those found within Buxton Woods—also contain a mixture of upland maritime forest on side slopes and older dune ridges and swamp forest in older dune swales. Open upland vegetation is found on foredunes and occasional backdunes within the CAHA landscape. Dominant species include sea oats (*Uniola paniculata*) and American beachgrass (*Calamagrostis breviligulata* ssp. *breviligulata*). Shrub dominated backdunes can contain stunted trees such as live oak (*Quercus virginiana*) and loblolly pine (*Pinus taeda*) along with common wax-myrtle (*Morella cerifera*), northern bayberry (*Morella pensylvanica*), and yaupon (*Ilex vomitoria*). The canopy of maritime forests found in the park are dominated by various combinations of live oak, Darlington oak (*Quercus hemisphaerica*), loblolly pine, and swamp bay (*Persea palustris*). Swamp forests and shrublands located within old dune swales are dominated by swamp tupelo (*Nyssa biflora*), stiff dogwood (*Swida foemina*), swamp bay, supplejack (*Berchemia scandens*), and sweetgum (*Liquidambar styraciflua*). Tidally influenced and nontidally influenced graminoid-dominated wetlands are composed of smooth cordgrass (*Spartina alterniflora*), needlegrass rush (*Juncus roemerianus*), saltmeadow cordgrass (*Spartina patens*),

giant cordgrass (*Spartina cynosuroides*), cattails (*Typha* sp.), and common threesquare (*Schoenoplectus pungens* var. *pungens*).

Due to its extreme location between Pamlico Sound and the Atlantic Ocean, Cape Hatteras National Seashore ecosystems have always been subjected to high frequencies of storm-, wind-, tide-, and wave-driven processes. Historic and current vegetation composition and structure are largely a result of these highly dynamic processes. In the early 20th century, two major land use changes were implemented due to increased human growth and visitation along the coast. First was the construction of artificial water control structures and drainage ditches for advancing mosquito control and increasing waterfowl habitat. This led to a shift in hydrological patterns within the interior of the park’s landscape. The second was the construction and build-up of primary dunes along the length of the Seashore. Vegetation was also planted on these sites to facilitate stabilization. American beachgrass, rather than the more historically dominant sea oats, was planted extensively in the 1930’s and 1950’s across the constructed dune system of the Outer Banks (van der Valk 1975). American beachgrass reaches its southern range limit within eastern North Carolina. Due to its extensive planting in the early-mid 20th century, it is difficult to determine the exact natural southern limit of this species. A third widespread impact to the Seashore’s ecological processes resulted in the construction and continued maintenance of North Carolina Highway 12, which runs through the middle of the Seashore. Current vegetation patterns and processes across the Outer Banks are impacted and will continue to be impacted by rising sea-levels. Vegetation communities are vulnerable to overwash—which moves sand from the island’s ocean-side to the sound-side—brought on by more frequent and higher intensity storms. Rising global air and sea temperatures are thought to increase the frequency of these storms (IPCC 2019). Erosion and accretion patterns, including the island’s natural westward (inland) migration patterns, brought on by rising seas and intense storms will also impact vegetation communities on both sides of these barrier islands. Other threats to the Seashore’s terrestrial vegetation include the expansion of nonnative invasive plants, over-browsing by white-tailed deer (*Odocoileus virginianus*), and root damage caused by feral hogs (*Sus scrofa*; Byrne and Corbett 2012).

Cape Hatteras National Seashore Vegetation Sampling Units

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

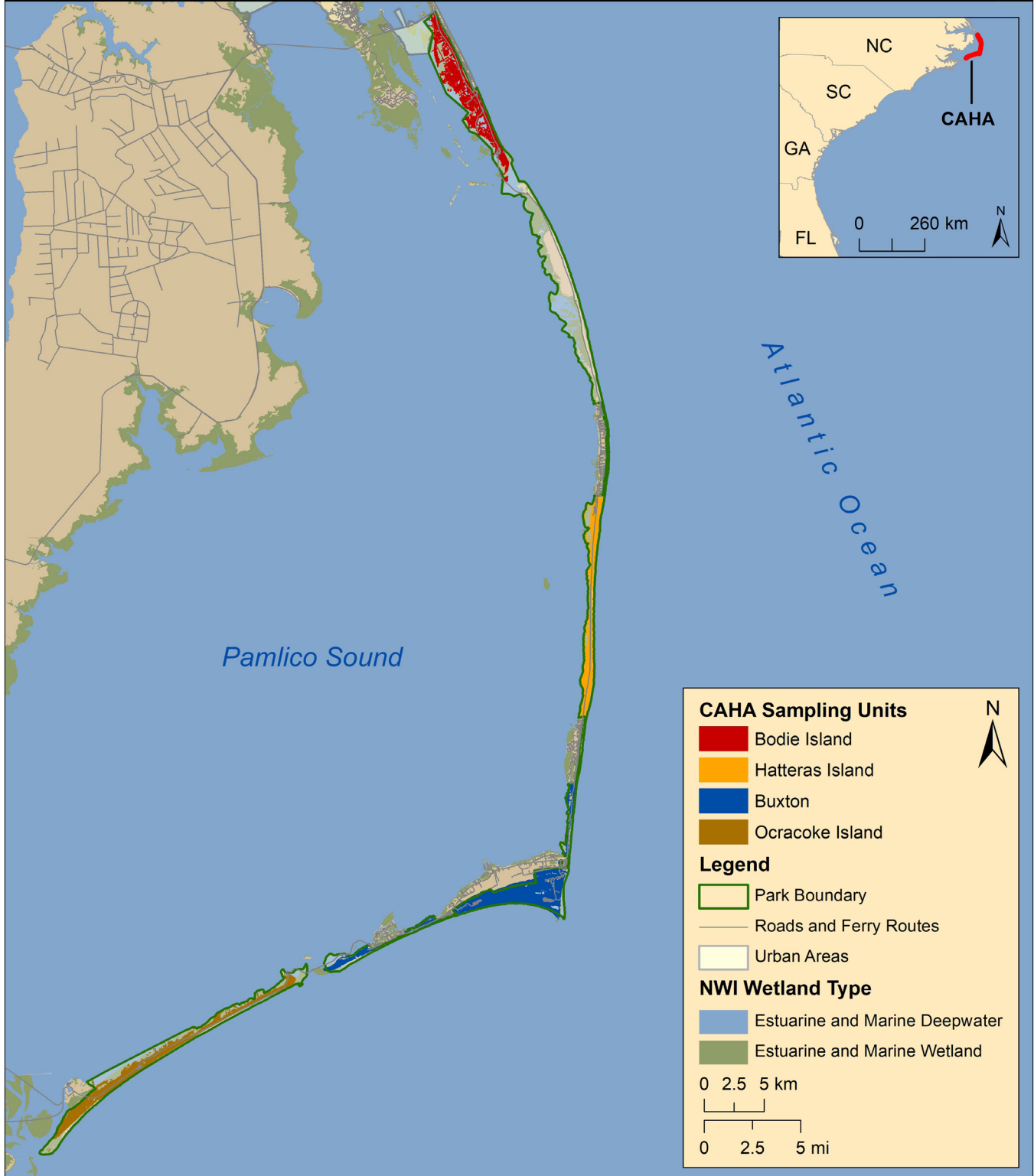


Figure 1. Location of Cape Hatteras National Seashore along the North Carolina Outer Banks, Dare and Hyde Counties. The map also shows the location of targeted land parcels (sampling units) within the park.

Invasive plants listed as Rank 1 (Severe Threat) or Rank 2 (Significant Threat) by the North Carolina Native Plant Society (Buchanan 2010) that have been documented on the North Carolina Outer Banks from recent flora compilations (Stalter and Lamont 1997; Sorrie 2021) include:

Rank 1

- tree of heaven (*Ailanthus altissima*)
- mimosa (*Albizia julibrissin*)
- alligatorweed (*Alternanthera philoxeroides*)
- Asian bittersweet (*Celastrus orbiculatus*)
- Autumn olive (*Elaeagnus umbellata*)
- English ivy (*Hedera helix*)
- bicolor lespedeza (*Lespedeza bicolor*)
- sericea lespedeza (*Lespedeza cuneata*)
- Chinese privet (*Ligustrum sinense*)
- Japanese honeysuckle (*Lonicera japonica*)
- Japanese stilt-grass (*Microstegium vimineum*)
- Asian spiderwort (*Murdannia keisak*)
- parrotfeather (*Myriophyllum aquaticum*)
- common reed (*Phragmites australis*)
- kudzu (*Pueraria montana*)
- multiflora rose (*Rosa multiflora*)
- Chinese wisteria (*Wisteria sinensis*)

Rank 2

- hairy jointgrass (*Arthraxon hispidus*)
- paper mulberry (*Broussonetia papyrifera*)
- leatherleaf clematis (*Clematis terniflora*)
- water-hyacinth (*Eichhornia crassipes*)

- henbit (*Lamium purpureum*)
- purple loosestrife (*Lythrum salicaria*)
- Eurasian watermilfoil (*Myriophyllum spicatum*)
- lady's thumb (*Persicaria maculosa*)
- Johnson grass (*Sorghum halepense*)
- common chickweed (*Stellaria media*)
- Japanese wisteria (*Wisteria floribunda*)
- common cocklebur (*Xanthium strumarium*)

Stalter and Lamont (1997; 1999) report 641 (76%) native and 207 (24%) non-native vascular plant taxa from the Outer Banks (Cape Lookout to the North Carolina-Virginia border), while Sorrie (2021) reports 781 (78%) native and 221 (22%) non-native taxa from a similar geography. Many of these non-native plants, as well as most of the invasive species listed above, occupy ruderal sites, manicured lawns, and roadsides or have only a single site occurrence. A few of these species do pose a landscape-scale threat to Cape Hatteras National Seashore's natural ecosystems, including alligatorweed and common reed.

Despite these stressors, the park hosts a diverse flora, and plays a crucial role in providing habitat for many rare species, including the federally threatened seabeach amaranth (*Amaranthus pumilus*); several North Carolina listed species such as cypress panicgrass (*Dichanthelium caeruleum*) and Gulf Coast spikerush (*Eleocharis cellulosa*); and a host of other rare plants tracked by the state's Natural Heritage Program (Robinson 2018). Cape Hatteras National Seashore has 1,244 known native vascular plant genera, species, subspecies, and varieties according to records accessed through NPSpecies (2019). This total seems high when compared to the species documented from the entire North Carolina Outer Banks (including Bogue Banks and Cape Lookout) by Stalter and Lamont (1997) and Sorrie (2021), see above for total taxa. In a pilot vegetation monitoring effort conducted by the Southeast Coast Network (SECN), 135 taxa were detected across 24 sites within the park (Byrne et al. 2012).

Sampling Design

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

Fifty-two vegetation plots were established and sampled on the Bodie Island, Buxton, Hatteras Island, and Ocracoke Island land parcels of Cape Hatteras National Seashore from July through August 2019 (Figures 2, 3, and 4). These plots were located in the following broadly defined habitats of the park: Maritime Tidal Wetlands (6 plots), Maritime Nontidal Wetlands (17 plots), Maritime Open Uplands (20 plots), and Maritime Upland Forests and Shrublands (9 plots). Plot locations were determined using the generalized random-tessellation stratified (GRTS) sampling methodology, which creates a spatially balanced array of sample points across an area of interest while maintaining flexibility in a project's sample size (Stevens and Olsen 2004).

Cape Hatteras National Seashore
Hatteras Island and Bodie Island
Site Locations

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

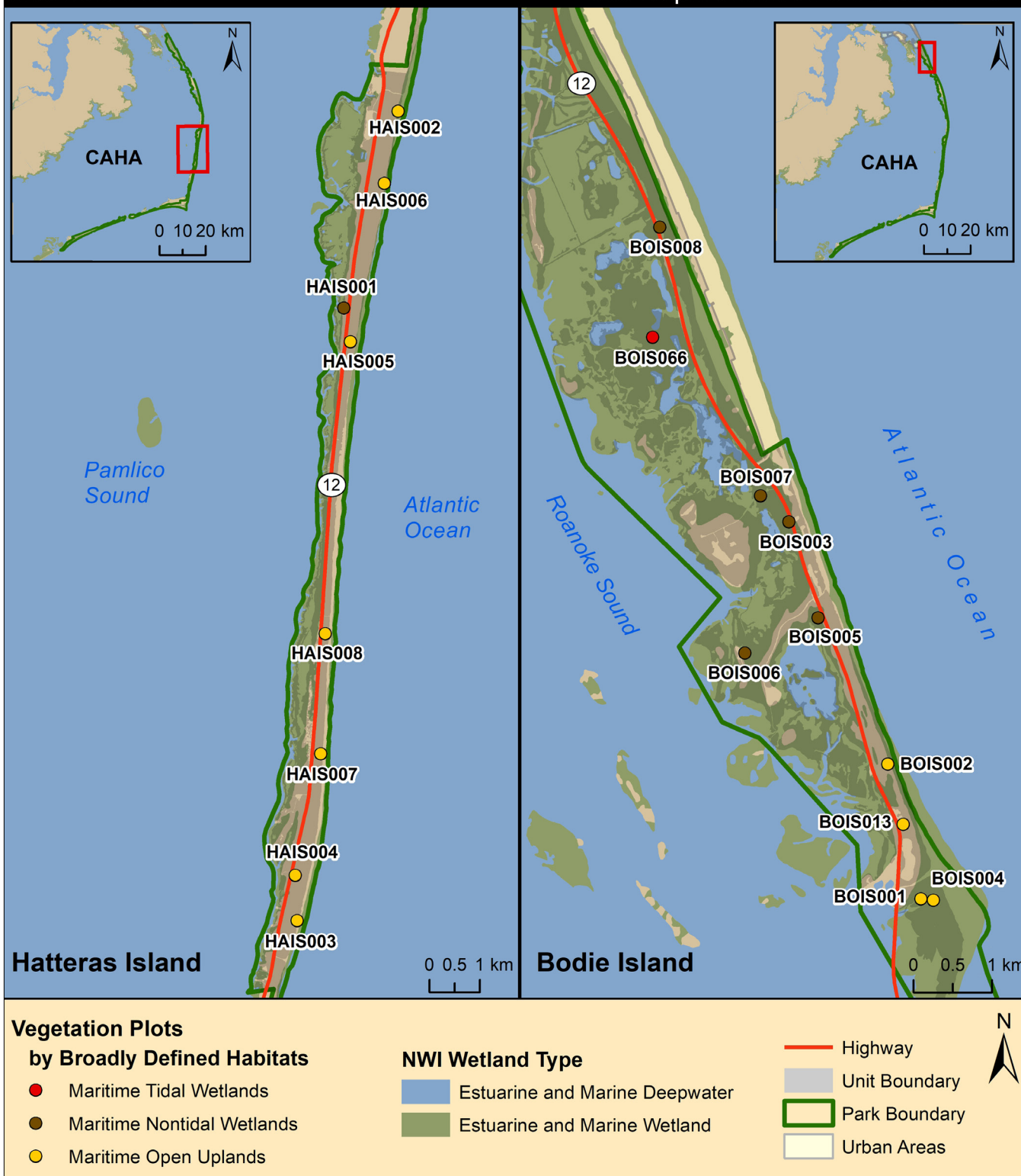


Figure 2. Southeast Coast Network terrestrial vegetation monitoring plot locations within the Hatteras Island and Bodie Island land parcels of Cape Hatteras National Seashore.

Cape Hatteras National Seashore Buxton Site Locations

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

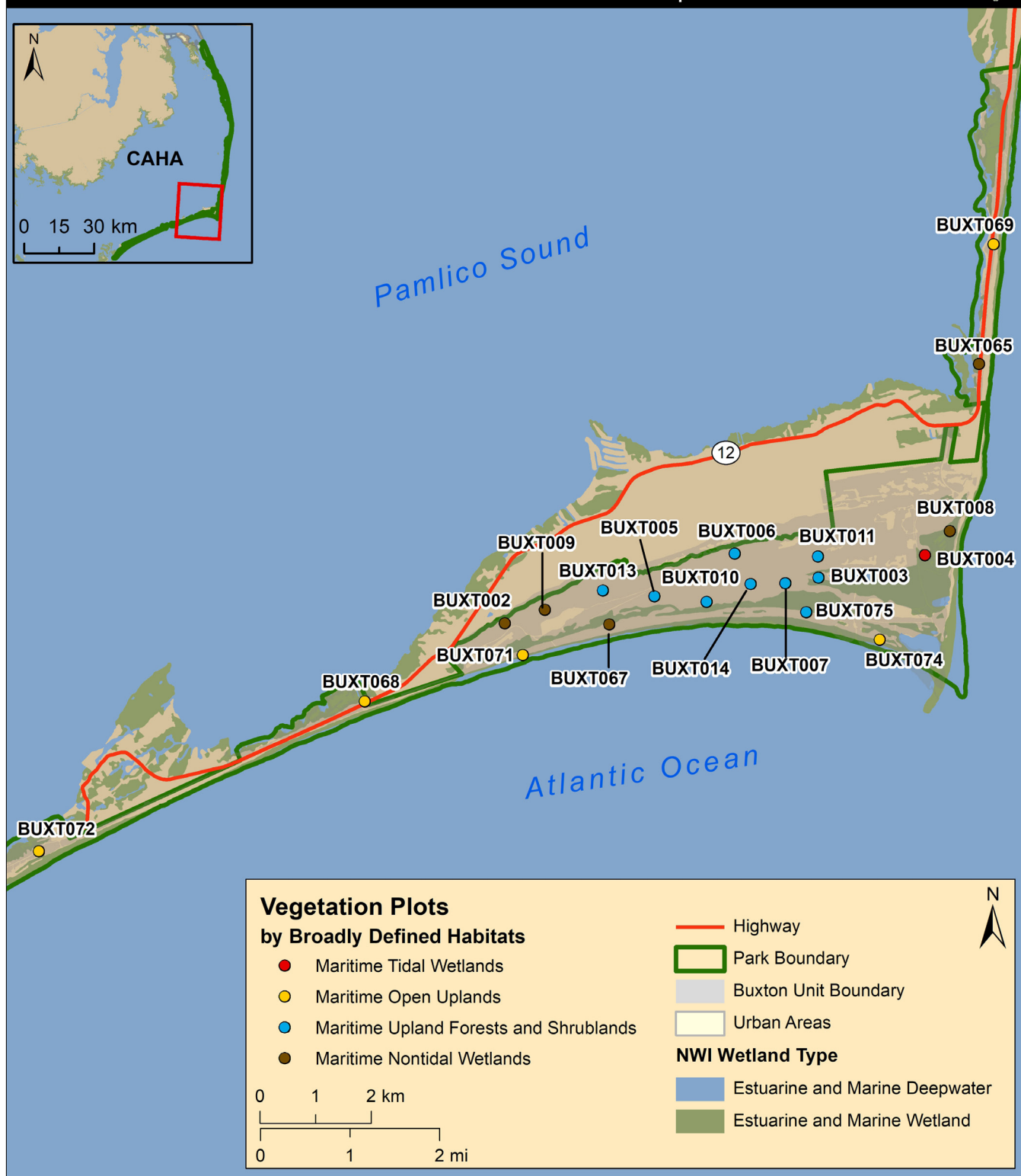


Figure 3. Southeast Coast Network terrestrial vegetation monitoring plot locations within the Buxton land parcel of Cape Hatteras National Seashore.

Cape Hatteras National Seashore Ocracoke Island Site Locations

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

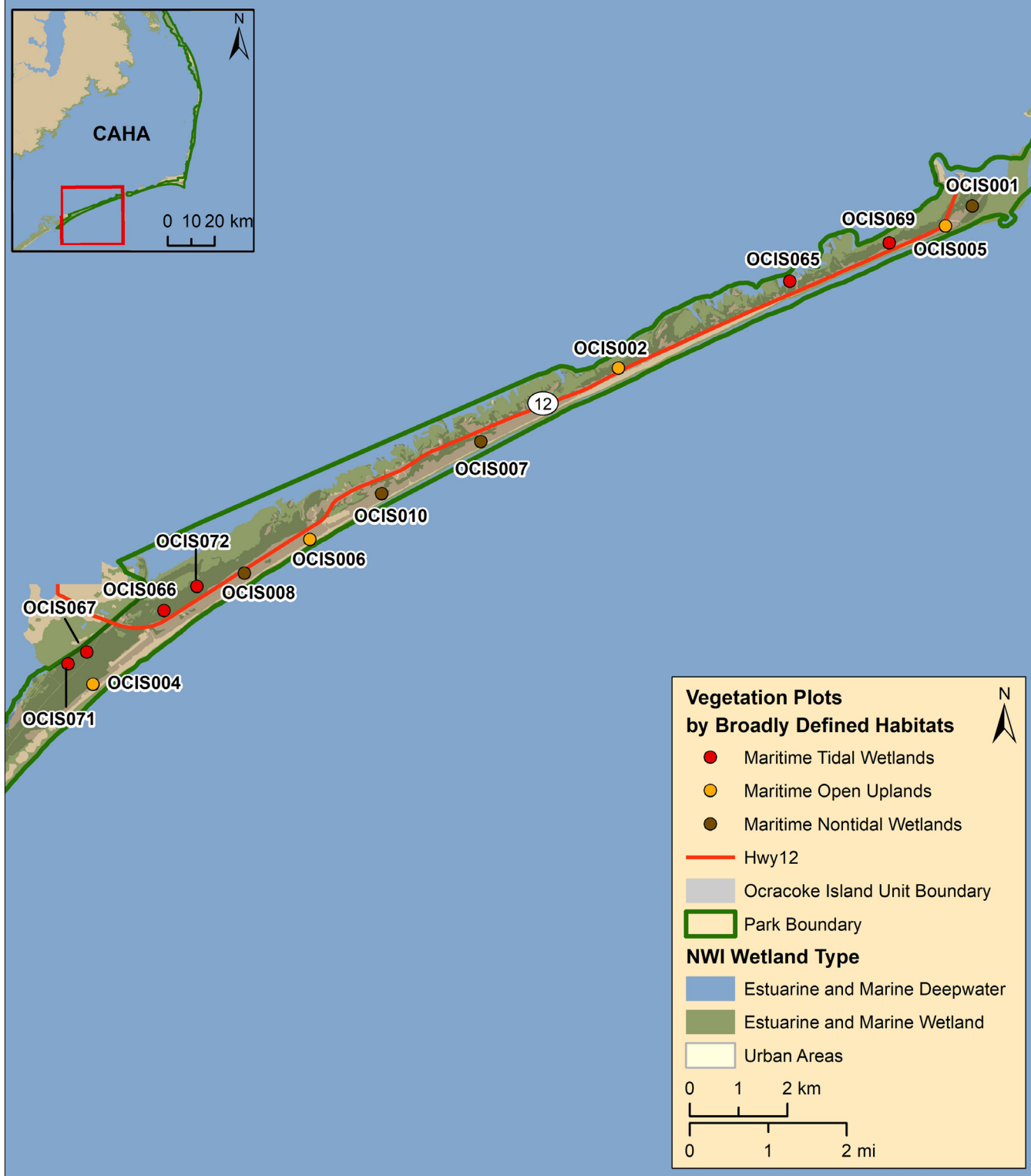


Figure 4. Southeast Coast Network terrestrial vegetation monitoring plot locations within the Ocracoke Island land parcel of Cape Hatteras National Seashore.

Nomenclature Standard, Growth Form Determination, and Conservation Status

Species nomenclature for this report follows the Flora of the Southern and Mid-Atlantic States (Weakley 2019). Every attempt was made to identify all plants to species, variety, or subspecies; when this was not possible, the lowest level of identifiable taxa (e.g., genera, family) was used. Occasionally, a taxonomic concept was created by ‘lumping’ several species of the same genus of known occurrence within a park. For example, both southern red cedar (*Juniperus silicicola*) and eastern red cedar (*J. virginiana*) occur on the park; both species occur in abundance in the natural and semi-natural habitats targeted by this monitoring effort; the species can often be difficult to distinguish based on vegetative features; and, finally, no other species within the genus *Juniperus* are known to occur within the park. A taxonomic concept was created—*Juniperus [silicicola + virginiana]*—that combined the two species into a single concept. This ‘lumped’ taxon is of finer scale taxonomic resolution than if these records had been identified as *Juniperus* sp. Once the final list was determined, each species was cross-referenced with the USDA Plants Database (USDA 2020) to determine growth

form, native status, federal/state noxious status, and to provide a unique common name. When a single taxon linked to multiple growth forms, the lead author subjectively chose a single growth form to link with the taxa. The species list was also cross-referenced with the 727 protected plants in North Carolina (Robinson 2018) to determine the state and federal conservation status (e.g., Endangered, Threatened, Significantly Rare) of each species and the North Carolina Native Plant Society list of invasive plants (Buchanan 2010).

Sampling Methodology

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

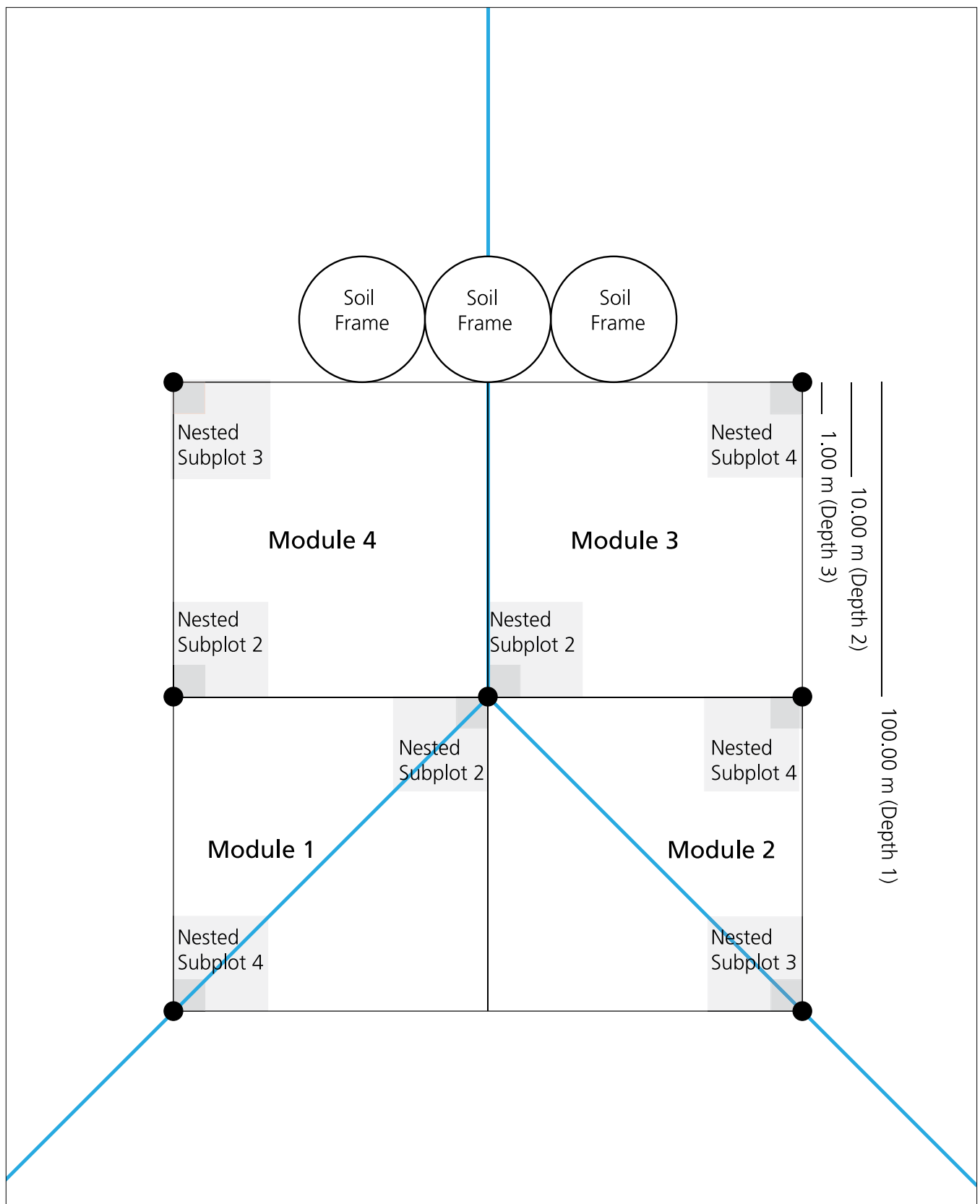


Figure 5. The layout of the sampling plot for the Southeast Coast Network, which is a modified version of the standard Level 5 Carolina Vegetation Survey plot. Ideal location of rebar used as permanent structures to monument the plot are black shaded circles. Blue lines represent location of the 3 25-meter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

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

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

Cover Class	Cover Range (%)	Geometric Mean
1	0–0.1	0.03
2	0.1–1	0.32
3	1–2	1.41
4	2–5	3.16
5	5–10	7.07
6	10–25	15.81
7	25–50	35.36
8	50–75	61.24
9	75–95	84.41
10	95–100	97.47

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

a height class was determined (5–15 centimeters [2–5.9 in]; 15–30 centimeters [5.9–11.8 in]; 30–50 centimeters [11.8–19.7 in]; or 50–137 centimeters [19.7–53.9 in]) within the two 1 square meter (10.8 ft²) nested depth ‘quadrats’ used for detecting overall species presence (see above).

Surface fuels were assessed at each plot site using the planar transect method for the standard fuel size classes (1-hour [0–0.6 cm], 10-hour [0.6–2.5 cm], 100-hour [2.5–7.6 cm], and 1000-hour [> 7.6 cm]), and duff and litter depths (Brown 1974). Counts of each fuel size class were tallied across three fuel transects, with diameter and decay class recorded for each piece of 1000-hour fuel. These field data were incorporated into equations using constant multipliers defined by Brown (1974)—including quadratic mean diameter, nonhorizontal correction factor, specific gravity, and bulk density—to estimate fuel load weight (units=tons/acre) within each plot.

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

Results and Discussion

Two-hundred sixty-five vascular plant species were detected during this monitoring effort (Appendix A), including 13 species, subspecies, or varieties not detected in previous lists documented in Stalter and Lamont (1997), Byrne et al. (2012), or NPSpecies (2019; Table 2). Native richness ranged from five to 45 species per plot and at least one non-native plant was encountered in 24 of the 52 plots (Table 3). Non-native species were less frequently observed in Maritime Tidal Wetland and Maritime Upland Forest and Shrubland broadly defined habitat types (Table 3). A total of five invasive plants categorized as Rank 1 or Rank 2 by the North Carolina Native Plant Society (Buchanan 2010) were observed in these monitoring plots. These species included alligatorweed, Japanese stilt-grass, common reed, Japanese honeysuckle, and

common chickweed (Appendix A). Alternatively, 18 vascular plants listed as rare by the North Carolina Natural Heritage Program (Robinson 2018) were observed in these monitoring plots, including the state endangered Gulf Coast spikerush and cypress panicgrass. The full list of these rare species is available in Appendix A. In the southeastern Coastal Plain, small-scale vegetation diversity patterns are largely influenced by complex edaphic factors, those factors' associated relationship with steep environmental gradients (e.g, hydrology and substrate texture), and the variability of timing and impact from disturbance events (e.g., fire; Sorrie and Weakley 2001). What follows is a synopsis of vegetation and environmental data stratified by each of the broadly defined habitats sampled within the park.

Table 2. Vascular plant species, subspecies, or varieties not reported from Stalter and Lamont (1997), Byrne et al. (2012), or NPSpecies (2019) but found at Cape Hatteras National Seashore in 2019 through this current monitoring effort.

Scientific Name	Common Name ¹	Growth Form ¹	Native Status ¹	Global Rank ²	State Rank (North Carolina) ²
<i>Buchnera floridana</i>	American bluehearts	Forb/herb	Native	n/a	n/a
<i>Carex howei</i>	prickly bog sedge	Graminoid	Native	n/a	n/a
<i>Carex seorsa</i>	weak stellate sedge	Graminoid	Native	G5	S3
<i>Chasmanthium sessiliflorum</i> var. <i>sessiliflorum</i>	longleaf woodoats	Graminoid	Native	G5	S2S3
<i>Eupatorium leucolepis</i>	justiceweed	Forb/herb	Native	G5	S4?
<i>Galium aparine</i>	stickywilly	Forb/herb	Native	G5	S5
<i>Gonolobus suberosus</i> var. <i>suberosus</i>	angularfruit milkvine	Vine	Native	G5	S5
<i>Lycopus angustifolius</i>	taperleaf water horehound	Forb/herb	Native	G4	S1
<i>Pluchea baccharis</i>	rosy camphorweed	Forb/herb	Native	G4	S2S3
<i>Schizachyrium scoparium</i> var. <i>scoparium</i>	little bluestem	Graminoid	Native	G5	S5
<i>Smilax smallii</i>	lanceleaf greenbrier	Shrub, Vine	Native	G5	S4?
<i>Symphotrichum simmondsii</i>	Simmonds' aster	Forb/herb	Native	G4	S2S3
<i>Vaccinium formosum</i>	southern blueberry	Shrub	Native	G5	S5

¹ Information obtained from the PLANTS database (USDA 2020)

² Conservation Status obtained from NatureServe Explorer 2.0 (NatureServe 2020), (Global Ranks - G4: Apparently Secure; G5: Secure) (State Ranks – S1: Critically Imperiled; S2: Imperiled; S3: Vulnerable; S4: Apparently Secure; S5: Secure)

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

Broadly Defined Habitat	Plot	Native ¹	Non-native ¹	Unknown ¹	T ¹	S ¹	V ¹	H ¹	G ¹	T ²	S ²	V ²	H ²	G ²	T ³	S ³	V ³	H ³	G ³	T ⁴	S ⁴	V ⁴	H ⁴	G ⁴
Maritime Tidal Wetlands	OCIS065	12.1	0.0	0.0	0.0	2.0	1.0	5.0	4.0	0.0	1.0	1.0	3.0	4.0	0.0	0.0	0.0	2.0	3.0	0.0	0.0	0.0	1.0	2.0
	OCIS066	24.1	0.0	0.0	0.0	4.0	3.0	9.0	8.0	0.0	2.0	3.0	7.0	8.0	0.0	1.0	3.0	6.0	6.0	0.0	1.0	2.0	4.0	4.0
	OCIS067	20.1	2.0	0.0	2.0	1.0	4.0	5.0	10.0	1.0	1.0	1.0	2.0	7.0	0.0	1.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	3.0
	OCIS069	23.1	0.0	0.0	2.0	5.0	2.0	6.0	8.0	1.0	2.0	2.0	4.0	6.0	0.0	1.0	2.0	2.0	3.0	0.0	0.0	1.0	2.0	2.0
	OCIS071	14.1	0.0	1.0	0.0	1.0	1.0	4.0	9.0	0.0	0.0	1.0	2.0	6.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	3.0
	OCIS072	23.1	0.0	0.0	0.0	2.0	2.0	7.0	12.0	0.0	1.0	2.0	6.0	8.0	0.0	1.0	2.0	5.0	5.0	0.0	1.0	2.0	3.0	3.0
	average	19.3	0.3	0.2	0.7	2.5	2.2	6.0	8.5	0.2	1.3	1.5	3.8	6.1	0.0	0.8	1.2	2.4	4.1	0.0	0.4	1.0	1.8	2.9
	standard deviation	5.1	0.7	0.4	0.9	1.5	1.1	1.6	2.4	0.2	0.8	0.9	2.0	1.4	0.0	0.4	1.1	2.1	1.2	0.0	0.4	0.9	1.6	0.7
Maritime Upland Forests and Shrubland	BUXT003	33.0	0.0	0.0	9.0	4.0	8.0	4.0	8.0	7.0	3.0	5.0	1.0	5.0	5.0	2.0	4.0	1.0	2.0	4.0	1.0	2.0	0.0	1.0
	BUXT005	33.0	1.0	1.0	6.0	4.0	10.0	5.0	10.0	6.0	4.0	8.0	3.0	7.0	4.0	2.0	4.0	1.0	2.0	2.0	1.0	2.0	0.0	1.0
	BUXT006	26.0	0.0	0.0	8.0	3.0	7.0	3.0	5.0	8.0	2.0	5.0	2.0	4.0	5.0	1.0	3.0	2.0	3.0	2.0	1.0	2.0	1.0	1.0
	BUXT007	31.0	0.0	1.0	6.0	3.0	8.0	8.0	7.0	5.0	2.0	5.0	5.0	5.0	3.0	1.0	3.0	3.0	2.0	1.0	1.0	1.0	1.0	1.0
	BUXT010	36.0	0.0	1.0	7.0	3.0	9.0	9.0	9.0	6.0	2.0	6.0	3.0	4.0	2.0	1.0	2.0	1.0	2.0	2.0	1.0	1.0	0.0	1.0
	BUXT011	30.0	0.0	0.0	9.0	2.0	8.0	8.0	3.0	7.0	2.0	6.0	3.0	2.0	4.0	2.0	5.0	1.0	1.0	2.0	1.0	4.0	1.0	0.0
	BUXT013	39.0	0.0	0.0	8.0	6.0	9.0	8.0	8.0	8.0	4.0	8.0	4.0	5.0	5.0	2.0	5.0	2.0	3.0	3.0	1.0	2.0	1.0	1.0
	BUXT014	42.0	0.0	1.0	9.0	3.0	7.0	12.0	12.0	7.0	2.0	5.0	6.0	4.0	4.0	1.0	3.0	2.0	1.0	2.0	1.0	1.0	1.0	0.0
	BUXT075	36.0	2.0	1.0	3.0	2.0	2.0	15.0	17.0	2.0	1.0	1.0	8.0	7.0	1.0	0.0	0.0	4.0	2.0	0.0	0.0	0.0	2.0	2.0
	average	34.0	0.3	0.6	7.2	3.3	7.6	8.0	8.8	6.1	2.3	5.4	3.8	4.7	3.7	1.3	3.1	1.7	1.9	2.1	0.8	1.6	0.7	0.9
	standard deviation	4.8	0.7	0.5	2.0	1.2	2.3	3.8	4.1	1.8	0.9	2.2	2.1	1.7	1.5	0.6	1.4	1.0	0.7	1.0	0.4	1.1	0.6	0.5

¹ Total species richness at the full plot (400 square meters [4,305.6 ft²]) depth

² Mean species richness at the modular (100 square meters [1,076.3 ft²]) depth

³ Mean species richness at the nested 10 square meters (107.6 ft²) depth

⁴ Mean species richness at the nested 1 square meter (10.8 ft²) depth

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

Broadly Defined Habitat	Plot	Native ¹	Non-native ¹	Unknown ¹	T ¹	S ¹	V ¹	H ¹	G ¹	T ²	S ²	V ²	H ²	G ²	T ³	S ³	V ³	H ³	G ³	T ⁴	S ⁴	V ⁴	H ⁴	G ⁴
Maritime Nontidal Wetlands	BOIS003	40.0	3.0	1.0	2.0	5.0	10.0	15.0	12.0	2.0	3.0	7.0	12.0	7.0	1.0	1.0	3.0	6.0	3.0	0.0	1.0	1.0	4.0	2.0
	BOIS005	36.0	1.0	0.0	0.0	6.0	6.0	12.0	13.0	0.0	4.0	5.0	9.0	11.0	0.0	2.0	3.0	5.0	6.0	0.0	1.0	2.0	2.0	3.0
	BOIS006	31.0	0.0	0.0	3.0	5.0	3.0	7.0	13.0	2.0	3.0	2.0	4.0	7.0	0.0	1.0	2.0	1.0	3.0	0.0	0.0	1.0	1.0	2.0
	BOIS007	37.0	1.0	0.0	6.0	5.0	11.0	10.0	6.0	4.0	5.0	7.0	7.0	4.0	2.0	3.0	4.0	3.0	2.0	1.0	2.0	2.0	2.0	1.0
	BOIS008	28.0	3.0	0.0	0.0	6.0	6.0	7.0	12.0	0.0	4.0	3.0	5.0	7.0	0.0	2.0	2.0	3.0	3.0	0.0	1.0	1.0	1.0	2.0
	BOIS066	5.0	0.0	0.0	0.0	1.0	0.0	1.0	3.0	0.0	0.0	0.0	1.0	3.0	0.0	0.0	0.0	1.0	2.0	0.0	0.0	0.0	1.0	1.0
	BUXT002	16.0	0.0	0.0	3.0	2.0	2.0	4.0	5.0	2.0	1.0	2.0	3.0	4.0	1.0	0.0	1.0	2.0	2.0	0.0	0.0	1.0	2.0	1.0
	BUXT004	45.0	2.0	1.0	6.0	4.0	8.0	13.0	17.0	4.0	3.0	6.0	9.0	13.0	2.0	2.0	3.0	4.0	7.0	0.0	1.0	1.0	3.0	3.0
	BUXT008	17.0	2.0	0.0	0.0	1.0	2.0	7.0	9.0	0.0	1.0	2.0	5.0	6.0	0.0	0.0	1.0	4.0	4.0	0.0	0.0	0.0	3.0	3.0
	BUXT009	37.0	2.0	0.0	9.0	3.0	8.0	11.0	8.0	5.0	2.0	3.0	9.0	4.0	2.0	1.0	1.0	5.0	2.0	1.0	0.0	0.0	2.0	1.0
	BUXT065	30.0	2.0	1.0	1.0	3.0	7.0	15.0	7.0	1.0	1.0	4.0	8.0	5.0	0.0	0.0	2.0	4.0	3.0	0.0	0.0	1.0	2.0	2.0
	BUXT067	37.0	0.0	0.0	4.0	2.0	3.0	13.0	15.0	2.0	1.0	1.0	9.0	10.0	2.0	0.0	0.0	6.0	7.0	1.0	0.0	0.0	4.0	5.0
	HAIS001	40.0	0.0	0.0	2.0	5.0	7.0	10.0	16.0	1.0	3.0	4.0	5.0	8.0	1.0	2.0	3.0	3.0	3.0	1.0	1.0	3.0	1.0	2.0
	OCIS001	30.0	0.0	2.0	2.0	5.0	4.0	9.0	12.0	2.0	3.0	3.0	5.0	6.0	1.0	2.0	2.0	2.0	2.0	1.0	2.0	2.0	1.0	1.0
	OCIS007	25.0	2.0	1.0	1.0	1.0	6.0	15.0	5.0	1.0	1.0	4.0	10.0	4.0	0.0	1.0	2.0	4.0	2.0	0.0	1.0	1.0	2.0	1.0
	OCIS008	36.0	3.0	3.0	2.0	4.0	7.0	10.0	18.0	2.0	3.0	6.0	6.0	9.0	2.0	2.0	3.0	3.0	2.0	1.0	1.0	2.0	2.0	1.0
	OCIS010	39.0	0.0	0.0	3.0	3.0	5.0	17.0	11.0	3.0	3.0	3.0	10.0	8.0	2.0	1.0	2.0	4.0	3.0	1.0	1.0	1.0	2.0	2.0
	average	33.9	1.0	1.0	2.1	3.3	5.6	12.7	12.0	1.6	2.1	3.4	7.4	7.1	1.0	1.2	1.9	3.5	3.2	0.6	0.8	1.3	2.0	2.0
	standard deviation	5.6	1.3	1.2	1.1	1.5	1.6	3.1	4.8	0.8	1.0	1.4	2.1	2.3	0.6	0.7	0.9	1.2	1.8	0.4	0.5	0.7	1.0	1.2

¹ Total species richness at the full plot (400 square meters [4,305.6 ft²]) depth

² Mean species richness at the modular (100 square meters [1,076.3 ft²]) depth

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Broadly Defined Habitat	Plot	Native ¹	Non-native ¹	Unknown ¹	T ¹	S ¹	V ¹	H ¹	G ¹	T ²	S ²	V ²	H ²	G ²	T ³	S ³	V ³	H ³	G ³	T ⁴	S ⁴	V ⁴	H ⁴	G ⁴
Maritime Open Uplands	BOIS001	31.0	1.0	0.0	1.0	2.0	2.0	14.0	13.0	0.0	1.0	1.0	11.0	8.0	0.0	1.0	0.0	6.0	4.0	0.0	0.0	0.0	3.0	2.0
	BOIS002	22.0	0.0	0.0	0.0	1.0	2.0	11.0	8.0	0.0	0.0	1.0	8.0	6.0	0.0	0.0	0.0	6.0	4.0	0.0	0.0	0.0	4.0	2.0
	BOIS004	33.0	0.0	1.0	2.0	2.0	1.0	14.0	15.0	1.0	1.0	1.0	11.0	10.0	0.0	0.0	0.0	7.0	5.0	0.0	0.0	0.0	4.0	4.0
	BOIS013	22.0	1.0	0.0	0.0	1.0	1.0	7.0	14.0	0.0	1.0	1.0	5.0	8.0	0.0	0.0	0.0	2.0	4.0	0.0	0.0	0.0	1.0	3.0
	BUXT068	38.0	1.0	1.0	3.0	4.0	4.0	15.0	14.0	2.0	2.0	3.0	10.0	7.0	1.0	1.0	1.0	5.0	3.0	0.0	0.0	1.0	2.0	2.0
	BUXT069	20.0	4.0	0.0	1.0	0.0	3.0	12.0	8.0	1.0	0.0	3.0	9.0	5.0	0.0	0.0	2.0	5.0	3.0	0.0	0.0	1.0	4.0	3.0
	BUXT071	21.0	0.0	0.0	2.0	1.0	2.0	12.0	4.0	1.0	1.0	1.0	10.0	3.0	0.0	0.0	0.0	6.0	2.0	0.0	0.0	0.0	4.0	1.0
	BUXT072	25.0	0.0	0.0	1.0	2.0	3.0	13.0	6.0	1.0	1.0	2.0	8.0	4.0	0.0	0.0	1.0	4.0	2.0	0.0	0.0	0.0	2.0	1.0
	BUXT074	18.0	0.0	0.0	0.0	1.0	0.0	12.0	5.0	0.0	0.0	0.0	8.0	4.0	0.0	0.0	0.0	4.0	2.0	0.0	0.0	0.0	3.0	2.0
	HAIS002	18.0	0.0	0.0	0.0	1.0	2.0	9.0	6.0	0.0	1.0	1.0	7.0	5.0	0.0	0.0	1.0	5.0	3.0	0.0	0.0	0.0	4.0	2.0
	HAIS003	17.0	0.0	0.0	0.0	1.0	0.0	11.0	5.0	0.0	1.0	0.0	8.0	4.0	0.0	0.0	0.0	4.0	2.0	0.0	0.0	0.0	2.0	2.0
	HAIS004	36.0	2.0	1.0	2.0	2.0	5.0	16.0	14.0	1.0	1.0	3.0	11.0	8.0	1.0	1.0	2.0	5.0	4.0	0.0	0.0	1.0	3.0	2.0
	HAIS005	23.0	1.0	0.0	1.0	3.0	3.0	11.0	6.0	1.0	2.0	2.0	8.0	5.0	0.0	1.0	1.0	4.0	3.0	0.0	1.0	1.0	3.0	2.0
	HAIS006	23.0	0.0	0.0	1.0	2.0	1.0	11.0	8.0	0.0	1.0	1.0	10.0	5.0	0.0	0.0	0.0	7.0	3.0	0.0	0.0	0.0	4.0	1.0
	HAIS007	24.0	2.0	0.0	0.0	1.0	5.0	14.0	6.0	0.0	0.0	3.0	11.0	4.0	0.0	0.0	1.0	7.0	2.0	0.0	0.0	1.0	5.0	2.0
	HAIS008	24.0	1.0	0.0	1.0	1.0	1.0	14.0	8.0	0.0	1.0	1.0	12.0	6.0	0.0	0.0	0.0	9.0	4.0	0.0	0.0	0.0	6.0	2.0
	OCIS002	23.0	0.0	0.0	2.0	3.0	7.0	8.0	3.0	2.0	1.0	4.0	5.0	2.0	1.0	1.0	2.0	2.0	1.0	0.0	0.0	2.0	1.0	1.0
	OCIS004	14.0	1.0	0.0	0.0	1.0	1.0	10.0	3.0	0.0	1.0	1.0	9.0	3.0	0.0	1.0	1.0	5.0	2.0	0.0	0.0	1.0	3.0	1.0
	OCIS005	21.0	1.0	0.0	1.0	2.0	3.0	11.0	5.0	1.0	1.0	2.0	9.0	4.0	0.0	0.0	1.0	5.0	2.0	0.0	0.0	0.0	2.0	2.0
	OCIS006	20.0	1.0	1.0	1.0	1.0	2.0	13.0	5.0	1.0	0.0	2.0	8.0	3.0	0.0	0.0	1.0	5.0	2.0	0.0	0.0	1.0	3.0	1.0
	average	22.5	0.9	0.2	0.9	1.7	2.8	11.9	6.3	0.6	0.9	1.7	9.0	4.4	0.2	0.3	0.9	5.3	2.5	0.1	0.2	0.5	3.2	1.6
	standard deviation	5.8	0.7	0.4	0.7	0.8	2.3	2.3	3.2	0.6	0.6	1.3	1.9	1.7	0.2	0.2	0.7	1.9	0.7	0.1	0.2	0.5	1.5	0.4

¹ Total species richness at the full plot (400 square meters [4,305.6 ft²]) depth

² Mean species richness at the modular (100 square meters [1,076.3 ft²]) depth

³ Mean species richness at the nested 10 square meters (107.6 ft²) depth

⁴ Mean species richness at the nested 1 square meter (10.8 ft²) depth

Maritime Tidal Wetlands

Within Cape Hatteras National Seashore, this broadly defined habitat type includes both graminoid- and herbaceous-dominated marshes and occasionally red cedar forests that are influenced by tidal patterns, salinity fluctuations, and sediment deposition (Figure 6). Although not sampled during this monitoring effort, tidal salt marshes along with their embedded salt pans exhibit the highest salinity levels among Maritime Tidal Wetlands due to daily fluctuations of sea water. Brackish tidal marshes within the park are dominated by needlegrass rush and experience daily fluctuations of lower salinity water—often a combination of sea water and freshwater from the Pamlico and Albemarle Sounds. These marshes also were not sampled during this monitoring effort. For an explanation of why these higher salinity marshes (‘low’ marshes) were excluded from this effort, despite their occasional dominance on the sound side of Cape Hatteras National Seashore, refer to the SECN terrestrial vegetation monitoring protocol (Boyle et al. 2019). Tidal wetlands that were sampled within the park included freshwater sites at the upper margins of brackish marsh, where salinity levels are minimal. These sites are typically saturated throughout the year and can experience frequent or infrequent flooding from tidal fluctuations—either

lunar- or wind-driven. Unlike tidal salt and brackish marshes which are fairly homogenous in vegetation composition, tidal freshwater wetlands are often characterized by a patchy mosaic of vegetation diversity. They can be composed of zones of tall or short graminoids, or an array of herbaceous plants. This broadly defined habitat was sampled solely on Ocracoke Island during this sampling effort. Vegetation associations sampled in Cape Hatteras National Seashore that belong to this broadly defined habitat type include (descriptions from NatureServe 2020):

- Seaside-tansy Tidal Shrub Flat (CEGL003924; 2 plots): Low-statured shrublands occurring along tidal marsh edges, often in narrow bands adjacent to other tidal shrublands; typically dominated by bushy seaside tansy (*Borrchia frutescens*) (Global Status: G4—Apparently Secure; State (NC) Status: No Status Rank)
- Mid and Southern Atlantic High Salt Marsh (CEGL004197; 4 plots): Tidal marshes that experience irregular flooding and are at slightly higher elevations than adjacent, regularly flooded low salt marshes; typically dominated by saltmeadow cordgrass. (Global Status: G4—Apparently Secure; State (NC) Status: No Status Rank)



Figure 6. Six Maritime Tidal Wetland sites were sampled during this monitoring effort. These ‘freshwater’ marshes are typically permanently saturated and experience flooding of oligohaline water from the ‘Sound’-side of the Outer Banks. These sites were all located on Ocracoke Island.

Species Diversity and Abundance

Native species richness ranged from 12 to 24 (mean = 19.3), and collectively graminoids represented the most diverse growth form across all spatial scales of this broadly defined habitat type (Table 3). The invasive common reed was observed in one of the six plots. There were no other invasive species encountered. Gulf Coast spikerush, which is listed as State Endangered by the Plant Conservation Program of the North Carolina Department of Agriculture and Consumer Services (NCPCP 2010), was located on half of these plots. A complete species list, along with constancy and average cover per species, is located in Appendix B, Table B-1. Species with high constancy in this habitat are listed below, by growth form:

Vines

- Swallow-wort (*Baccharis halimifolia*; 83%)

Herbs/Forbs/Graminoids

- Saltmeadow cordgrass (100%)
- Marsh fimbry (*Fimbristylis castanea*; 83%)
- Seashore marsh-mallow (*Kosteletzkya pentacarpos*; 67%)

- Bushy seaside tansy; 67%)
- Common threesquare; 67%)
- Saltgrass (*Distichlis spicata*; 67%)
- Rose of Plymouth (*Sabatia stellaris*; 67%)
- Marsh bristlegrass (*Setaria parviflora*; 67%)

Most of the vascular plant species observed in these plots are common throughout the Outer Banks of North Carolina. However, plots within this broadly defined habitat also included several rare species to the state, including saltwater false willow (*Baccharis angustifolia*), the state endangered Gulf Coast spikerush, creeping spikerush (*Eleocharis fallax*), and beaked spikerush (*Eleocharis rostellata*).

Woody Stem Metrics

The tree and sapling strata were not present in plots of this broadly defined habitat at Cape Hatteras National Seashore, and seedlings were not abundant (Table 4). Woody species that were present in these plots are listed in Appendix B, Table B-2.

Table 4. Woody stem abundance and canopy metrics on Southeast Coast Network vegetation plots located at Cape Hatteras National Seashore [m—meters; ha—hectares].

Broadly Defined Habitat	Plot	Tree Basal Area (m ² /ha)	Tree Density (400 m ²)	Sapling Basal Area (m ² /ha)	Sapling Density (80 m ²)	Seedling Density (8 m ²)	Mean Canopy Cover (%)	Mean Height (m)
Maritime Tidal Wetlands	OCIS065	0.0	0.0	0.0	0.0	0.0	0.0	1.0
	OCIS066	0.0	0.0	0.0	0.0	1.0	0.0	1.0
	OCIS067	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OCIS069	0.0	0.0	0.0	0.0	3.0	0.0	0.0
	OCIS071	0.0	0.0	0.0	0.0	2.0	0.0	0.0
	OCIS072	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	average	0.0	0.0	0.0	0.0	1.0	0.0	0.3
	standard deviation	0.0	0.0	0.0	0.0	1.3	0.0	0.5
Maritime NonTidal Wetlands	BOIS003	1.0	3.0	3.6	68.0	29.0	40.0	3.0
	BOIS005	0.0	0.0	0.1	18.0	28.0	2.0	2.0
	BOIS006	0.0	0.0	3.2	76.0	58.0	2.0	3.0
	BOIS007	0.5	2.0	3.5	248.0	54.0	46.0	4.0
	BOIS008	0.0	0.0	0.0	2.0	28.0	4.0	3.0
	BOIS066	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BUXT002	1.7	3.0	9.2	58.0	28.0	78.0	8.0
	BUXT004	0.0	0.0	0.6	20.0	10.0	8.0	3.0
	BUXT008	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BUXT009	5.1	16.0	8.3	75.0	22.0	57.0	5.0
	BUXT065	0.0	0.0	0.3	15.0	21.0	0.0	2.0
	BUXT067	0.2	1.0	0.2	22.0	9.0	10.0	2.0
	HAIS001	11.5	20.0	5.0	137.0	44.0	74.0	7.0
	OCIS001	0.0	0.0	2.7	40.0	90.0	11.0	4.0
	OCIS007	0.0	0.0	0.9	43.0	151.0	8.0	2.0
	OCIS008	6.8	17.0	1.3	45.0	155.0	50.0	4.0
	OCIS010	2.2	8.0	6.4	36.0	60.0	25.0	4.0
	average	1.7	4.1	2.7	53.1	46.3	24.3	3.2
	standard deviation	3.2	6.8	3.0	61.2	46.5	27.3	2.1

Table 4 (continued). Woody stem abundance and canopy metrics on Southeast Coast Network vegetation plots located at Cape Hatteras National Seashore [m—meters; ha—hectares].

Broadly Defined Habitat	Plot	Tree Basal Area (m ² /ha)	Tree Density (400 m ²)	Sapling Basal Area (m ² /ha)	Sapling Density (80 m ²)	Seedling Density (8 m ²)	Mean Canopy Cover (%)	Mean Height (m)
Maritime Open Uplands	BOIS001	0.0	0.0	0.1	12.0	22.0	0.0	2.0
	BOIS002	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BOIS004	0.0	0.0	0.0	0.0	22.0	0.0	1.0
	BOIS013	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BUXT068	0.0	0.0	3.2	18.0	5.0	17.0	2.0
	BUXT069	0.0	0.0	0.0	9.0	8.0	0.0	0.0
	BUXT071	0.0	0.0	0.0	0.0	19.0	0.0	0.0
	BUXT072	0.0	0.0	0.9	21.0	8.0	0.0	3.0
	BUXT074	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	HAIS002	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	HAIS003	0.0	0.0	0.0	0.0	6.0	0.0	0.0
	HAIS004	0.4	1.0	0.4	28.0	9.0	11.0	4.0
	HAIS005	0.0	0.0	3.5	47.0	13.0	7.0	2.0
	HAIS006	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	HAIS007	0.0	0.0	0.0	1.0	0.0	0.0	0.0
	HAIS008	0.0	0.0	0.0	0.0	1.0	0.0	0.0
	OCIS002	0.0	0.0	0.3	12.0	27.0	0.0	1.0
	OCIS004	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OCIS005	0.0	0.0	1.7	6.0	6.0	1.0	3.0
	OCIS006	0.0	0.0	0.2	10.0	5.0	0.0	0.0
	average	0.0	0.1	0.5	8.2	7.6	1.8	0.9
	standard deviation	0.1	0.2	1.1	12.4	8.6	4.6	1.2
Maritime Upland Forests and Shrublands	BUXT003	34.2	37.0	2.1	30.0	137.0	62.0	11.0
	BUXT005	25.8	27.0	1.7	20.0	121.0	66.0	13.0
	BUXT006	24.6	22.0	1.8	21.0	119.0	82.0	19.0
	BUXT007	20.6	35.0	1.9	47.0	35.0	57.0	10.0
	BUXT010	19.5	48.0	5.0	46.0	64.0	86.0	8.0
	BUXT011	39.4	22.0	1.5	57.0	219.0	82.0	21.0
	BUXT013	23.3	26.0	2.8	40.0	99.0	84.0	13.0
	BUXT014	17.6	29.0	1.9	36.0	93.0	86.0	9.0
	BUXT075	0.0	0.0	0.0	1.0	6.0	19.0	2.0
	average	22.8	27.3	2.1	33.1	99.2	69.2	11.8
	standard deviation	11.1	13.2	1.3	17.1	62.0	21.7	5.6

Disturbance and Threats

There were no observed current or historical disturbances on these plots (Table 5). Throughout their range, freshwater tidal and high salt marshes have been impacted by draining,

ditching, and other factors that shift their natural hydrology. The sites that were sampled during this effort at Cape Hatteras National Seashore appear to be relatively secure from these threats.

Table 5. Disturbance observations and abundance (% cover) measured on vegetation monitoring plots at Cape Hatteras National Seashore.

Broadly Defined Habitat	Plot	Powerline Right-of-Way	Flood Scour	Saltwater Intrusion	Visitor Use Activity
Maritime Tidal Wetlands	OCIS065	–	–	–	–
	OCIS066	–	–	–	–
	OCIS067	–	–	–	–
	OCIS069	–	–	–	–
	OCIS071	–	–	–	–
	OCIS072	–	–	–	–
Maritime Nontidal Wetlands	BOIS003	–	–	–	–
	BOIS005	–	–	–	–
	BOIS006	–	–	–	–
	BOIS007	–	–	–	–
	BOIS008	–	–	–	–
	BOIS066	–	–	–	–
	BUXT002	–	40	–	–
	BUXT004	–	–	–	–
	BUXT008	–	–	–	–
	BUXT009	–	–	–	–
	BUXT065	100	–	–	–
	BUXT067	–	–	–	–
	H AIS001	–	–	–	–
	OCIS001	–	–	–	–
	OCIS007	–	–	–	–
	OCIS008	–	–	–	–
	OCIS010	–	–	–	–
Maritime Open Uplands	BOIS001	–	–	–	–
	BOIS002	–	–	–	–
	BOIS004	–	–	–	–
	BOIS013	–	–	–	10
	BUXT068	–	–	–	–
	BUXT069	–	–	–	–
	BUXT071	–	–	–	–
	BUXT072	–	–	–	–
	BUXT074	–	–	–	–
	H AIS002	–	–	–	–
	H AIS003	–	–	–	–
	H AIS004	–	–	–	–
	H AIS005	–	–	–	–
	H AIS006	–	–	–	–
	H AIS007	–	–	–	–
	H AIS008	–	–	–	–
	OCIS002	–	–	10	–
	OCIS004	–	–	–	–
	OCIS005	–	–	–	–
	OCIS006	–	–	–	–

Table 5 (continued). Disturbance observations and abundance (% cover) measured on vegetation monitoring plots at Cape Hatteras National Seashore.

Broadly Defined Habitat	Plot	Powerline Right-of-Way	Flood Scour	Saltwater Intrusion	Visitor Use Activity
Maritime Upland Forests and Shrublands	BUXT003	–	–	–	–
	BUXT005	–	–	–	–
	BUXT006	–	–	–	–
	BUXT007	–	–	–	–
	BUXT010	–	–	–	–
	BUXT011	–	–	–	–
	BUXT013	–	–	–	–
	BUXT014	–	–	–	–
	BUXT075	–	–	–	–

Geomorphology and Soil

Like much of the Outer Banks, these plots were located on very flat (0°) landforms with terrain shape indices equal to 0 (Table 6). Standing water was only observed on one of these plots, although flooding and/or inundation is probably common

at other times during the year. Collectively, soils within these sites had a slightly higher pH and greater exchangeable cations (in parts per million (ppm)) compared to sites within other broadly defined habitats of Cape Hatteras National Seashore (Table 7).

Table 6. Local landform and hydrologic condition from vegetation monitoring plots at Cape Hatteras National Seashore.

Broadly Defined Habitat	Plot	Slope (°)	Aspect (°)	TSI ¹ (°)	Landform Type	Water Source	Submerged (%)
Maritime Tidal Wetlands	OCIS065	0.0	–	0.000	tidal flat	Flood zones	10
	OCIS066	0.0	–	0.000	flat plain	Flood zones	0
	OCIS067	0.0	–	0.000	flat plain	Flood zones	0
	OCIS069	0.0	–	0.000	flat plain	Flood zones	0
	OCIS071	0.0	–	0.000	flat plain	Flood zones	0
	OCIS072	0.0	–	0.000	flat plain	Flood zones	0
Maritime Upland Forests and Shrublands	BUXT003	0.0	–	0.000	flat plain	None	0
	BUXT005	0.0	–	0.000	flat plain	None	0
	BUXT006	10.0	320	0.375	rolling upland	None	0
	BUXT007	0.0	–	0.000	flat plain	None	0
	BUXT010	1.5	225	2.375	rolling upland	None	0
	BUXT011	0.0	–	0.000	flat plain	None	0
	BUXT013	14.0	307	2.000	rolling upland	None	0
	BUXT014	–	–	–	rolling upland	None	0
	BUXT075	–	–	–	seep/swale	None	0

¹ Terrain Shape Index: the larger the value, the higher degree of microsite concavity; the lower the value, the higher degree of microsite convexity; “0” values indicate a completely flat shape.

Table 6 (continued). Local landform and hydrologic condition from vegetation monitoring plots at Cape Hatteras National Seashore.

Broadly Defined Habitat	Plot	Slope (°)	Aspect (°)	TSI ¹ (°)	Landform Type	Water Source	Submerged (%)
Maritime Nontidal Wetlands	BOIS003	0	–	0	flat plain	Permanent water	88
	BOIS005	0	–	0	flat plain	Flood zones	0
	BOIS006	0	–	0	flat plain	Permanent water	90
	BOIS007	0	–	0	flat plain	Other water	20
	BOIS008	0	–	0	flat plain	Ditch/Canal	10
	BOIS066	0	–	0	tidal flat	Permanent water	100
	BUXT002	0	–	0	seep/swale	Flood zones	0
	BUXT004	0	–	0	tidal flat	Flood zones	0
	BUXT008	0	–	0	flat plain	Flood zones	0
	BUXT009	0	–	0	backswamp	Permanent water	60
	BUXT065	0	–	0	flat plain	Flood zones	0
	BUXT067	0	–	0	seep/swale	Flood zones	0
	HAIS001	0	–	0	flat plain	Flood zones	0
	OCIS001	0	–	0	flat plain	Flood zones	0
	OCIS007	–	–	–	seep/swale	Flood zones	0
	OCIS008	0	–	0	flat plain	Flood zones	0
	OCIS010	–	–	–	seep/swale	Flood zones	0
Maritime Open Wetlands	BOIS001	–	–	–	rolling upland	None	0
	BOIS002	–	–	–	rolling upland	None	0
	BOIS004	–	–	–	rolling upland	None	0
	BOIS013	–	–	–	rolling upland	None	0
	BUXT068	–	–	–	seep/swale	None	0
	BUXT069	–	–	–	rolling upland	None	0
	BUXT071	–	–	–	back slope	None	0
	BUXT072	–	–	–	seep/swale	None	0
	BUXT074	–	–	–	rolling upland	None	0
	HAIS002	–	–	–	rolling upland	None	0
	HAIS003	–	–	–	rolling upland	None	0
	HAIS004	0	–	0	seep/swale	Flood zones	0
	HAIS005	--	–	–	seep/swale	None	0
	HAIS006	–	–	–	rolling upland	None	0
	HAIS007	–	–	–	seep/swale	None	0
	HAIS008	–	–	–	seep/swale	None	0
	OCIS002	–	–	–	flat plain	Flood zones	0
	OCIS004	–	–	–	seep/swale	None	0
	OCIS005	–	–	0	seep/swale	Flood zones	0
	OCIS006	–	–	–	seep/swale	None	0

¹ Terrain Shape Index: the larger the value, the higher degree of microsite concavity; the lower the value, the higher degree of microsite convexity; "0" values indicate a completely flat shape.

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

Broadly Defined Habitat	Plot	TEC (ME/100g)	pH H ₂ O 1:1	OM (%)	P ¹	Ca ¹	Mg ¹	K ¹	Na ¹	B ¹	Fe ¹	Mn ¹	Cu ¹	Zn ¹	Al ¹
Maritime Tidal Wetlands	OCIS065	12.86	7.7	0.43	10.0	747.0	243.0	73.00	1480.0	0.85	64.0	0.01	0.53	0.01	39.0
	OCIS066	16.71	8.1	0.31	7.0	2638.0	110.0	33.00	453.0	0.65	39.0	2.00	0.62	0.01	11.0
	OCIS067	7.64	5.3	1.01	10.0	488.0	137.0	20.00	170.0	0.63	80.0	2.00	0.57	0.98	79.0
	OCIS069	12.50	7.1	1.10	25.0	680.0	310.0	87.00	1325.0	1.91	115.0	0.01	0.70	0.78	73.0
	OCIS071	8.05	6.1	0.62	9.0	213.0	223.0	54.00	801.0	0.92	54.0	0.01	0.55	0.77	82.0
	OCIS072	15.90	7.7	0.31	9.0	2575.0	82.0	18.00	392.0	0.63	25.0	0.01	0.65	0.01	20.0
	average	12.30	7.0	0.60	11.7	1223.5	184.2	47.50	770.2	0.90	62.8	0.70	0.60	0.40	50.7
	standard deviation	3.80	1.1	0.30	6.6	1087.4	88.3	28.60	532.3	0.50	31.9	1.00	0.10	0.50	31.4
Maritime Upland Forests and Shrublands	BUXT003	4.97	6.6	1.56	4.0	800.0	35.0	9.00	27.0	0.34	31.0	1.00	0.48	1.87	31.0
	BUXT005	1.19	6.1	0.34	3.0	137.0	24.0	6.00	15.0	0.01	66.0	2.00	0.47	0.75	44.0
	BUXT006	2.13	4.8	1.42	9.0	111.0	30.0	16.00	17.0	0.01	51.0	2.00	0.37	0.78	50.0
	BUXT007	11.28	7.7	0.44	3.0	2105.0	14.0	0.01	49.0	0.26	11.0	0.01	0.63	0.01	4.0
	BUXT010	8.16	7.5	0.99	8.0	1479.0	28.0	6.00	45.0	0.48	23.0	2.00	0.68	0.85	49.0
	BUXT011	2.90	5.3	1.43	2.0	259.0	27.0	7.00	28.0	0.21	52.0	0.01	0.45	0.01	36.0
	BUXT013	6.07	6.7	2.12	5.0	1036.0	23.0	4.00	30.0	0.36	126.0	0.01	0.56	0.01	59.0
	BUXT014	3.57	8.2	0.18	5.0	631.0	21.0	10.00	22.0	0.26	67.0	5.00	0.64	0.43	37.0
	BUXT075	2.53	7.5	0.33	5.0	436.0	17.0	5.00	22.0	0.24	46.0	0.01	0.84	0.01	37.0
	average	4.80	6.7	1.00	4.9	777.1	24.3	7.00	28.3	0.20	52.6	1.30	0.60	0.50	38.6
	standard deviation	3.30	1.1	0.70	2.3	669.2	6.5	4.40	11.7	0.20	33.3	1.70	0.10	0.60	15.6

¹ Anions (P: Phosphorous); Exchangeable Cations (Ca: Calcium, Mg: Magnesium, K: Potassium, Na: Sodium); Extractable Minors (B: Boron, Fe: Iron, Mn: Manganese, Cu: Copper, Zn: Zinc, Al: Aluminum). Data reported in parts per million (ppm).

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

Broadly Defined Habitat	Plot	TEC (ME/100g)	pH H ₂ O 1:1	OM (%)	P ¹	Ca ¹	Mg ¹	K ¹	Na ¹	B ¹	Fe ¹	Mn ¹	Cu ¹	Zn ¹	Al ¹
Maritime Nontidal Wetlands	BOIS003	6.56	5.70	2.82	24.0	593.0	146.0	18.0	83.0	0.49	39.0	2.00	0.61	1.06	115.0
	BOIS005	4.84	5.20	0.93	11.0	208.0	101.0	15.0	160.0	0.24	41.0	2.00	0.69	0.01	52.0
	BOIS006	11.21	5.10	4.00	43.0	261.0	258.0	53.0	484.0	0.65	13.0	0.01	0.83	1.06	125.0
	BOIS007	2.81	5.10	2.46	6.0	80.0	59.0	26.0	108.0	0.01	21.0	0.01	0.55	0.01	35.0
	BOIS008	4.60	5.30	0.80	12.0	141.0	111.0	25.0	215.0	0.23	30.0	0.01	0.64	1.33	76.0
	BOIS066	9.68	5.80	0.69	7.0	152.0	232.0	49.0	982.0	0.83	19.0	0.01	0.35	0.01	63.0
	BUXT002	9.91	6.00	2.42	13.0	1477.0	44.0	12.0	25.0	0.75	110.0	0.01	0.61	2.80	94.0
	BUXT004	6.43	6.90	1.01	10.0	1118.0	38.0	6.0	29.0	0.38	46.0	1.00	0.58	0.77	43.0
	BUXT008	9.07	7.70	0.66	6.0	1657.0	30.0	7.0	42.0	0.44	32.0	2.00	0.43	0.97	4.0
	BUXT009	25.65	5.80	23.35	31.0	3504.0	96.0	38.0	82.0	1.35	207.0	5.00	0.52	4.64	100.0
	BUXT065	6.11	8.20	0.31	6.0	1054.0	55.0	14.0	35.0	0.34	34.0	4.00	0.55	1.02	26.0
	BUXT067	6.09	8.00	0.34	15.0	1105.0	23.0	9.0	32.0	0.34	33.0	3.00	0.58	0.48	68.0
	HAIS001	5.51	5.30	1.71	8.0	141.0	121.0	40.0	307.0	0.49	89.0	1.00	0.49	1.03	78.0
	OCIS001	6.66	7.20	1.99	6.0	915.0	172.0	16.0	76.0	0.74	165.0	0.01	0.53	0.75	66.0
	OCIS007	7.32	8.30	0.28	15.0	1326.0	36.0	8.0	33.0	0.21	32.0	4.00	0.38	0.76	21.0
	OCIS008	14.03	7.10	1.30	21.0	2507.0	69.0	13.0	66.0	0.81	54.0	3.00	0.72	0.01	32.0
	OCIS010	11.77	7.80	1.67	11.0	1932.0	125.0	19.0	137.0	0.70	75.0	2.00	0.52	0.66	39.0
	average	8.70	6.50	2.70	14.4	1068.9	100.9	21.6	170.4	0.50	61.2	1.7.	0.60	1.00	61.0
	standard deviation	5.20	1.20	5.40	10.2	952.3	69.6	14.8	241.4	0.30	53.9	1.6.	0.10	1.10	34.2

¹ Anions (P: Phosphorous); Exchangeable Cations (Ca: Calcium, Mg: Magnesium, K: Potassium, Na: Sodium); Extractable Minors (B: Boron, Fe: Iron, Mn: Manganese, Cu: Copper, Zn: Zinc, Al: Aluminum). Data reported in parts per million (ppm).

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

Broadly Defined Habitat	Plot	TEC (ME/100g)	pH H ₂ O 1:1	OM (%)	P ¹	Ca ¹	Mg ¹	K ¹	Na ¹	B ¹	Fe ¹	Mn ¹	Cu ¹	Zn ¹	Al ¹
Maritime Open Uplands	BOIS001	0.83	5.5	0.01	4.0	62.0	18.0	6.0	12.0	0.01	28.0	1.00	0.47	0.01	43.0
	BOIS002	1.01	5.9	0.18	9.0	70.0	36.0	13.0	21.0	0.23	34.0	2.00	0.82	0.94	41.0
	BOIS004	0.62	5.8	0.01	3.0	48.0	18.0	6.0	11.0	0.32	31.0	0.01	0.56	0.01	38.0
	BOIS013	1.27	5.1	0.20	6.0	59.0	31.0	11.0	15.0	0.01	50.0	3.00	0.51	0.58	51.0
	BUXT068	1.72	6.0	0.55	5.0	121.0	71.0	14.0	31.0	0.38	50.0	1.00	0.70	1.07	49.0
	BUXT069	6.72	8.1	0.11	6.0	1215.0	31.0	9.0	33.0	0.01	23.0	4.00	0.50	0.59	10.0
	BUXT071	3.38	7.7	0.11	8.0	564.0	39.0	9.0	21.0	0.01	42.0	4.00	0.59	0.50	29.0
	BUXT072	1.83	6.9	0.34	9.0	205.0	69.0	12.0	20.0	0.20	55.0	3.00	0.88	0.83	53.0
	BUXT074	6.23	8.4	0.10	6.0	1139.0	24.0	7.0	30.0	0.01	22.0	3.00	0.75	0.01	10.0
	HAIS002	0.93	7.2	0.01	5.0	130.0	21.0	5.0	12.0	0.01	23.0	1.00	0.47	0.48	29.0
	HAIS003	1.99	7.5	0.01	5.0	321.0	25.0	8.0	17.0	0.22	26.0	3.00	0.56	0.49	27.0
	HAIS004	1.43	6.3	0.48	5.0	150.0	44.0	13.0	13.0	0.27	36.0	1.00	0.54	0.99	40.0
	HAIS005	0.91	6.1	0.24	5.0	99.0	21.0	7.0	12.0	0.01	27.0	0.01	0.41	0.46	39.0
	HAIS006	0.83	6.3	0.16	6.0	84.0	24.0	8.0	13.0	0.01	24.0	1.00	0.64	0.72	33.0
	HAIS007	2.76	7.7	0.10	3.0	467.0	24.0	9.0	22.0	0.01	23.0	2.00	0.55	0.44	19.0
	HAIS008	1.27	7.3	0.18	4.0	178.0	28.0	9.0	17.0	0.22	31.0	2.00	0.39	0.53	42.0
	OCIS002	4.35	7.8	0.37	7.0	741.0	40.0	12.0	29.0	0.39	32.0	2.00	0.64	0.01	26.0
	OCIS004	1.85	7.4	0.15	7.0	277.0	35.0	9.0	18.0	0.24	47.0	2.00	0.67	0.51	36.0
	OCIS005	8.65	8.3	0.19	9.0	1578.0	36.0	7.0	39.0	0.20	36.0	2.00	0.62	0.59	28.0
	OCIS006	2.38	7.9	0.11	7.0	368.0	38.0	9.0	26.0	0.28	40.0	3.00	0.45	0.46	31.0
	average	2.50	7.0	0.20	6.0	393.8	33.7	9.2	20.6	0.20	34.0	2.00	0.60	0.50	33.7
	standard deviation	2.20	1.0	0.20	1.8	442.6	14.6	2.6	8.2	0.10	10.3	1.20	0.10	0.30	12.0

¹ Anions (P: Phosphorous); Exchangeable Cations (Ca: Calcium, Mg: Magnesium, K: Potassium, Na: Sodium); Extractable Minors (B: Boron, Fe: Iron, Mn: Manganese, Cu: Copper, Zn: Zinc, Al: Aluminum). Data reported in parts per million (ppm).

Maritime Nontidal Wetlands

This broad category of wetlands includes marshes and shrublands of protected backdunes and barrier island flats that do not experience tidal floods (Figure 7). These sites are often influenced by a high-water table but can be seasonally or permanently saturated. Swamp forests (locally referred to as ‘sedges’) that have developed in older interdune swales of peaty substrates are also included in this broadly defined habitat. These ‘sedges’ are located in the Buxton Woods park unit and are a highly unique vegetation community within the state of North Carolina (Lopazanski et al. 1988). Extreme tidal events or storm surges may occasionally impact any of these sites. Plots of this habitat were located across all land units of Cape Hatteras National Seashore. Vegetation associations sampled within the park that belong to this broadly defined habitat type include (descriptions from NatureServe 2020):

- Marsh Fimbry-Common Threesquare Marsh (CEGL003790; 2 plots): Graminoid-dominated wet swales, typically with standing water present in the spring; dominated by common threesquare and marsh fimbry (Global Status: No Status Rank; State (NC) Status: No Status Rank)
- Atlantic Coast Interdune Swale (CEGL003839; 12 plots): Shrublands occurring within interdune swales, backdunes, and wetland flats characterized by a moderately open to

dense canopy of common wax-myrtle; the substrate is typically composed of sand, or loamy sand (Global Status: G3—Vulnerable; State (NC) Status: No Status Rank)

- Mid-Atlantic Maritime Shrub Swamp (Carolina Willow Type; CEGL004222; 1 plot): This wetland shrub swamp is located in interdune swales within forest-dominated dune flats; the canopy includes scattered Carolina willow (*Salix caroliniana*) (Global Status: G2—Imperiled; State (NC) Status: No Status Rank)
- Mid-Atlantic Maritime Shrub Swamp (Red Bay Type; CEGL004635; 1 plot): An extremely rare maritime swamp forest, known from only two sites on the North Carolina Outer Banks; occurring on peaty soils within interdune swales and seepages adjacent to sand dunes; in both sites, the canopy is dominated by swamp bay (*Persea palustris*) (Global Status: G1—Critically Imperiled; State (NC) Status: No Status Rank)
- Mid-Atlantic Maritime Shrub Swamp (Dogwood Type; CEGL007384; 1 plot): Scrub shrublands developing within old interdune swales of Buxton Woods (only known occurrence) and dominated by a small canopy (< 10 meters [32.8 ft]) of stiff dogwood (Global Status: G1—Critically Imperiled; State (NC) Status: No Status Rank)



Figure 7. Seventeen Maritime Nontidal Wetlands were sampled during this monitoring effort, including swamp forests and tall shrublands within old interdune swales of Buxton Woods.

Species Diversity and Abundance

Native species richness ranged from five to 45 (mean = 31.1) within vegetation plots of this broadly defined habitat type and exhibited both the lowest (5 species) and highest (45 species) full plot richness among plots across all habitat types of the park (Table 3). A total of 200 species were found across these sites, including 75 species that were only found in this specific broad habitat (Appendix B, Table B-1). Ten of the 17 plots within the park's Maritime Nontidal Wetlands had at least one species of nonnative plant (Table 3). Invasive species encountered in these plots included: common chickweed, Japanese stilt-grass, common reed, and Japanese honeysuckle. For all plots within this broadly defined habitat type, species with high constancy are listed below by growth form (Appendix B, Table B-1):

Shrubs

- Common wax-myrtle (88%)

Vines

- Eastern poison ivy (*Toxicodendron radicans* var. *radicans*; 71%)
- Saw greenbriar (*Smilax bona-nox*; 71%)
- Climbing hempweed (*Mikania scandens*; 65%)

Herbs/Forbs/Graminoids

- Saltmeadow cordgrass (82%)

Plots sampled in this habitat type included more than 15 rare plants tracked by the state of North Carolina (Robinson 2018), including shore little bluestem (*Schizachyrium littorale*), beaked spikerush, creeping spikerush, seashore paspalum (*Paspalum vaginatum*), and the State Endangered (NCPCP 2010) cypress panicgrass.

Woody Stem Metrics

Total BA of canopy stems ranged from 0 to 11.5 m²/ha in Maritime Nontidal Wetland plots, with an overall average of 1.7 m²/ha; density of canopy stems ranged from 0 to 20 per plot, with an average of 4.1 (Table 4). The most dominant canopy species included southern/eastern red cedar (mean BA = 1.22 m²/ha, mean density = 68/ha) and Carolina willow (mean BA = 0.24 m²/ha, mean density = 18/ha; Appendix B, Table B-2). Canopy cover within these sites ranged from 0 to 78%, and canopy height ranged from 0 to 8 meters (Table 4). Sapling density at the 80 m² scale ranged from 0 to 248 stems, with an average of 53.1, while seedling density at the 8 m² scale ranged from 0 to 155 stems, with an average of 46.3 across all plots (Table 4). Dominant sapling species included stiff dogwood, common wax-myrtle, and southern/eastern red cedar; dominant seedlings included eastern poison ivy, common wax-myrtle, and yaupon (Appendix B, Table B-2).

Based on stem count, southern/eastern red cedar comprised 62% of the tree stratum, while common wax-myrtle comprised 24% of the sapling and 20% of the seedling strata (Figure 8). The seedling stratum in these habitats was dominated by eastern poison ivy (Figure 8).

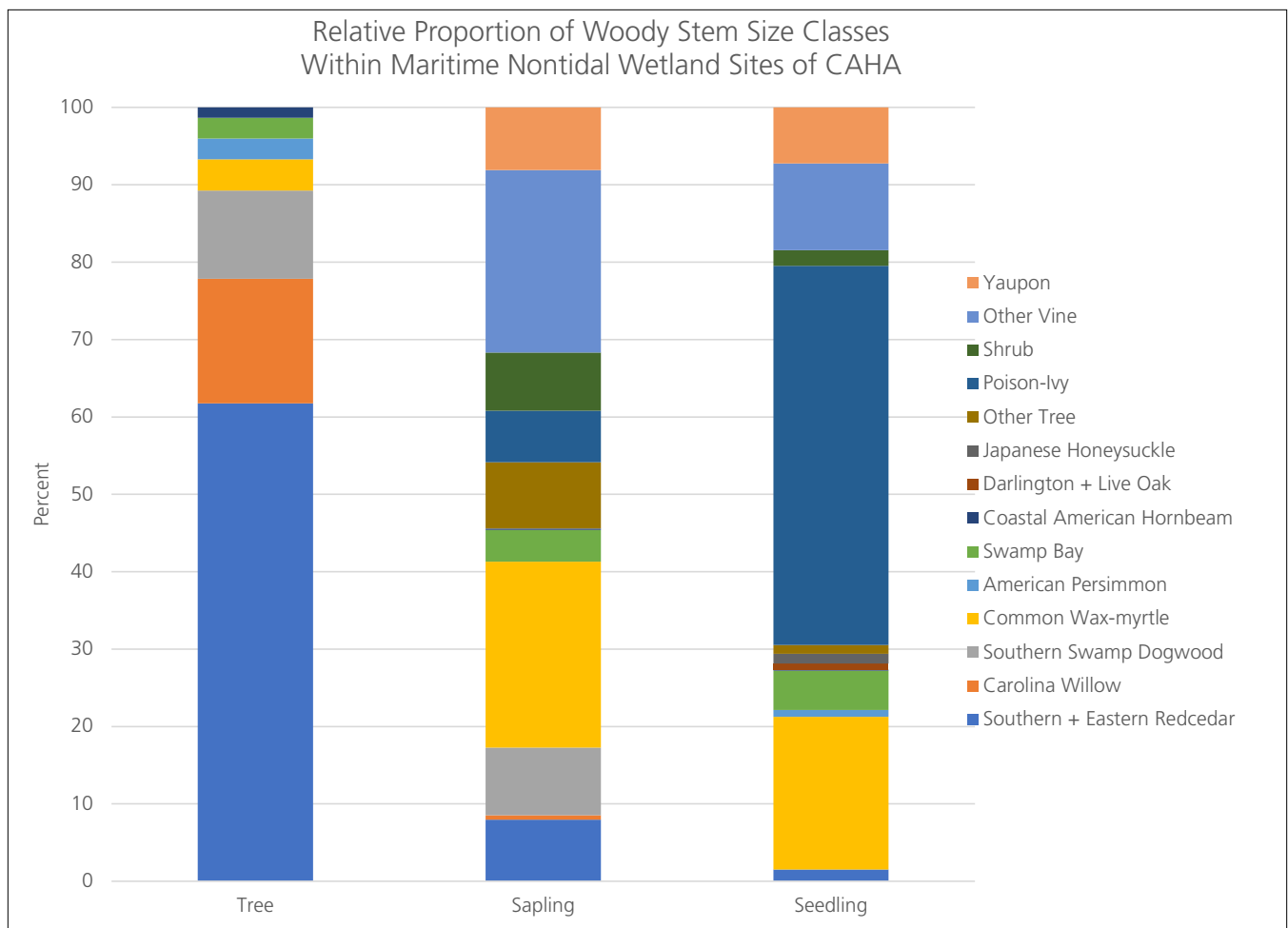


Figure 8. Relative proportion of species groups across three woody stem strata—trees, saplings, and seedlings—within Maritime Nontidal Wetland vegetation monitoring plots of Cape Hatteras National Seashore.

Of the 81 tree stems that were measured across these seven plots, 11 were found to be dead (14%; Figure 9). All of the swamp bay trees measured in this habitat type were observed with symptoms similar to those of the disease brought on

by the laurel wilt fungal pathogen (*Raffaelea lauricola*; see discussion in the Disturbance and Threats paragraph within the Maritime Upland Forests and Shrublands section).

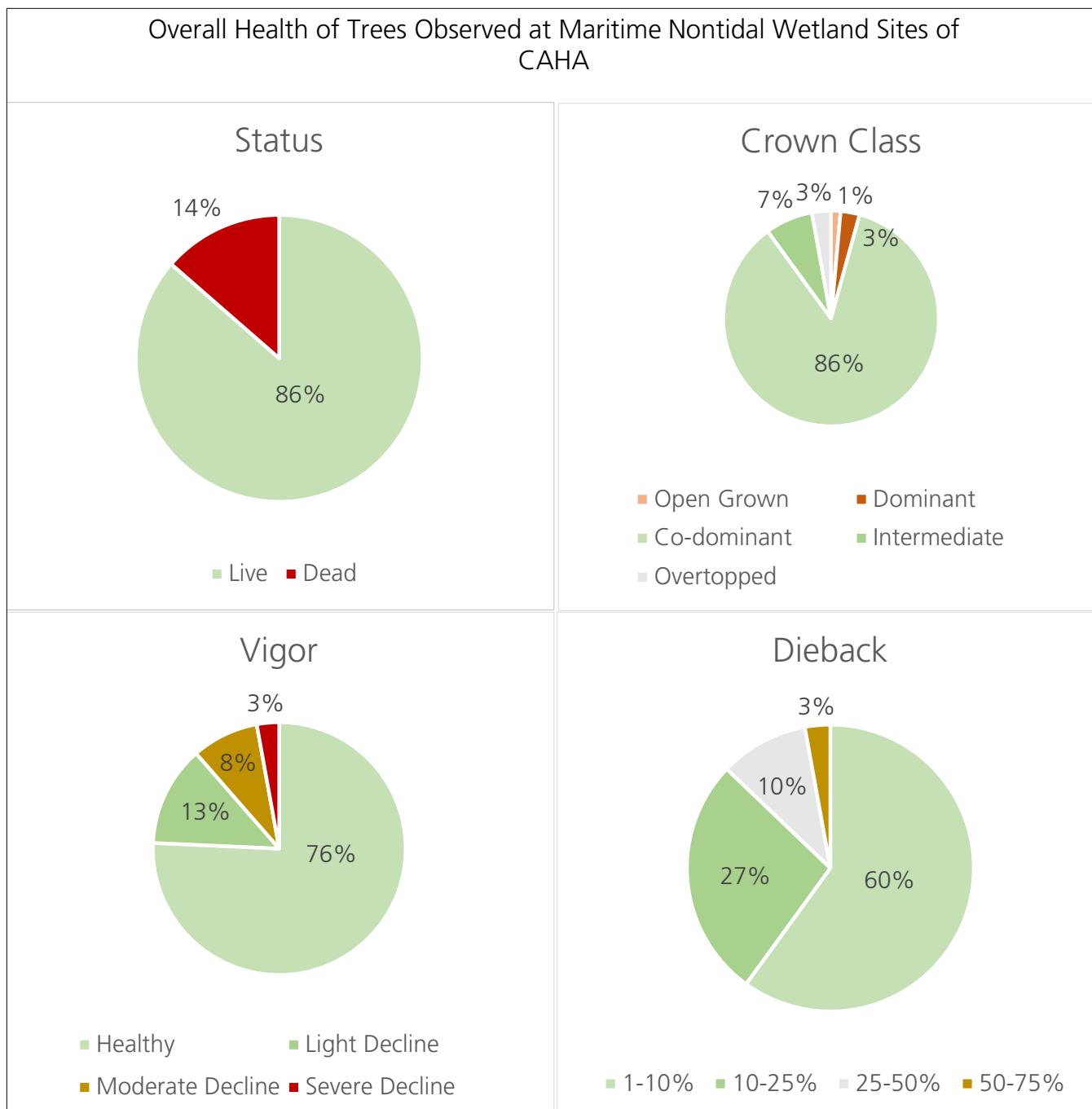


Figure 9. Health status of woody stems greater than or equal to 10 centimeters (3.9 in) DBH ('trees') measured on Maritime Nontidal Wetland vegetation monitoring plots of Cape Hatteras National Seashore.

Disturbance and Threats

There were very few observed current or historical disturbances on these plots, although one plot classified as a Mid-Atlantic Maritime Shrub Swamp (Dogwood Type) (BUXT002) had recently experienced a severe flood scour event and another plot classified as an Atlantic Coast Interdune Swale (BUXT065) was directly in a power line right-of-way (Table 5). Coastal development pressure and altered hydrology from low to high salinity threaten vegetation associations within this broadly defined habitat type throughout their global range. Many of these plant communities sampled during this effort are listed as either Imperiled or Critically Imperiled (NatureServe 2020) with many of their best remaining examples located at Cape Hatteras National Seashore. Although observable stressors were relatively absent from these vegetation plots, monitoring over time will provide insight to how these sites are responding to hydrologic shifts brought on by rising sea levels along the Outer Banks.

Geomorphology and Soil

Like much of the Outer Banks, these plots were located on very flat (0°) landforms with terrain shape indices equal to 0 (Table 6). Standing water was only observed on six of these 11 plots, although flooding and/or inundation is probably common in all sites at other times during the year. Soil pH values ranged from acidic to alkaline, with an average of 6.5 (Table 7).

Maritime Open Uplands

Maritime Open Uplands of the Outer Banks include vegetated areas along coastal foredunes, backdunes, and occasional older dune complexes within the interior of the islands (Figure 10). These sites are strongly influenced by shifting sands and high levels of salt spray from the adjacent ocean. Plants that colonize these sites are typically short-lived and salt-tolerant. The primary grass that stabilizes maritime dunes is sea oats,

which produces many adventitious roots from the main culm that capture sand and allow dunes to form. Other grasses that stabilize dunes along the Outer Banks include American beachgrass, bitter seabeach grass (*Panicum amarum*), and shore little bluestem. Tree and shrub development is limited in these sites because of extreme salt spray and frequent storm overwash, although occasional salt-pruned, low lying shrub zones may be found in protected dune swales. Upland grassland flats with dense vegetation and less open sand occur on the island interior flats of stabilized dunes. Vegetation associations sampled in Cape Hatteras National Seashore that belong to this broadly defined habitat type include (descriptions from NatureServe 2020):

- Sea-oats Dune Grassland (CEGL004040; 16 plots): The characteristic foredune vegetation community along the southeast Atlantic Coast and dominated by sea-oats. (Global Status: G3—Vulnerable; State (NC) Status: No Status Rank)
- Overwash Dune Grassland (CEGL004097; 3 plots): Maritime dry grasslands primarily impacted by wave-deposited sand during spring tides or storms, as opposed to sea-oats grasslands impacted by wind-deposited sand. Occasional wetland indicator plants may be present when overwash sand is deposited atop hydric interdunal swales. (Global Status: G2—Imperiled; State (NC) Status: No Status Rank)
- Mid-Atlantic Coast Backdune Shrub Grassland (CEGL004240; 1 plot): Communities occurring on deep well-drained soils of backdunes and level interdunes, typically within the influence of salt spray and high offshore winds. Stunted shrubs such as common wax-myrtle and northern bayberry may be present. (Global Status: G2—Imperiled; State (NC) Status: No Status Rank)



Figure 10. Twenty plots within Maritime Open Upland habitat were sampled during this monitoring effort, including backdune vegetation on Bodie Island.

Species Diversity and Abundance

Native species richness ranged from 14 to 38 (mean = 23.7) within vegetation plots of this broadly defined habitat type (Table 3). Herbaceous species richness was highest in this broadly defined habitat type than other types across all measured spatial scales (Table 3). A total of 88 species were found across these sites, including 16 species that were only found in this specific broad habitat (Appendix B, Table B-1). Of the 20 plots that were sampled in this broadly defined habitat type of the park, 11 had at least one species of nonnative plant (Table 3) but did not include any species listed as invasive by the North Carolina Native Plant Society (Buchanan 2010). For all plots within this broadly defined habitat type, species with high constancy are listed below by growth form (Appendix B, Table B-1):

Trees

Southern/eastern red cedar (65%)

Vines

Dune greenbriar (60%)

Herbs/Forbs/Graminoids

- Sea-oats (100%)
- Dune camphorweed (*Heterotheca subaxillaris*; 100%)
- Seabeach evening-primrose (*Oenothera humifusa*; 100%)

- Saltmeadow cordgrass (95%)
- Southern horseweed (*Erigeron pusillus*; 95%)
- Dune pennywort (*Hydrocotyle bonariensis*; 95%)

Most of the vascular plant species observed in these plots are common throughout the Outer Banks of North Carolina. However, plots within this broadly defined habitat also included several rare species to the state, such as dune blue curls (*Trichostema nesophilum*) in 30% of the plots, shore little bluestem (20%) of the plots, and broomsedge bluestem (*Andropogon virginicus* var. *decipiens*; 15%; Appendix B, Table B-1).

Woody Stem Metrics

Stems greater than or equal to 10 centimeters (3.9 in) (tree size class) were essentially absent from these plots (Table 4). The sapling size class (< 10 cm [3.9 in]) provided patchy canopy cover in about half the sites, with canopy heights, where present, ranging from one to four meters (Table 4). Sapling density at the 80 square meter scale ranged from 0 to 47 stems, with an overall plot average of 8.2, while seedling density at the 8 meter square scale ranged from 0 to 27 stems, with an average of 7.6 across all plots (Table 4). Dominant sapling species included southern/eastern red cedar and dominant seedlings included eastern poison ivy, dune greenbriar, and northern bayberry (Appendix B, Table B-2).

Disturbance and Threats

There were very few observed current or historical disturbances on these plots (Table 5).

Geomorphology and Soil

Plots within Maritime Open Uplands in Cape Hatteras National Seashore either occurred on flat backdune landforms with 0° slopes or on complex rolling topography with multiple slopes and aspects (Table 6). Soil pH values ranged from acidic to alkaline, with an average of 7.0 (Table 7).

Maritime Upland Forests and Shrublands

Maritime Forests and Shrublands of the North Carolina Outer Banks are located on old, stabilized dunes within wider portions of the barrier islands (Figure 11). These upland communities are typically less exposed to salt spray and tidal inundation than neighboring Open Upland habitats adjacent to the ocean, but occasionally they can flood during strong storm surge events. The largest acreage of maritime forest habitat within Cape Hatteras National Seashore occurs on the Buxton land parcel of Hatteras Island (Figure 1). At approximately 1,215 hectares (3,000 ac), Buxton Woods is the largest maritime forest on the Outer Banks (Lopazanski et al. 1988); nearly one-third of Buxton Woods occurs within the park. All plots sampled within the Maritime Upland Forest and Shrubland broadly defined habitat type were located

within Buxton Woods. Vegetation associations sampled in the park that belong to this broadly defined habitat type include (descriptions from NatureServe 2020):

- Atlantic Coast Maritime Evergreen Forest (CEGL007027; 6 plots): Forests that occur on sand flats and stabilized dunes that are protected from flooding, but experience salt spray. Soils are typically well- to excessively well-drained. This is the typical maritime oak forest from Virginia to South Carolina. (Global Status: G2—Imperiled; State (NC) Status: No Status Rank)
- Mid-Atlantic Coastal Maritime Forest (CEGL006040; 2 plots): Forest communities that occur in backdunes sheltered from overwash and extreme salt spray along the Outer Coastal Plain and barrier islands. The canopy is dominated or co-dominated by loblolly pine. (Global Status: G2—Imperiled; State (NC) Status: No Status Rank)
- Maritime Shrub (Stunted Tree Type; CEGL003833; 1 plot): Salt-pruned shrublands of the Mid-Atlantic Coastal Plain with a canopy typically less than 3 meters (9.8 ft) in height. These communities occur on the leading edge of maritime forests, between unstable foredunes and more stable forests of backdunes. (Global Status: G3—Vulnerable; State (NC) Status: No Status Rank)



Figure 11. Nine Maritime Upland Forest and Shrubland sites were sampled during this monitoring effort, and all were located on the Buxton Unit of the park. Across their range, these vegetation communities have been severely impacted by human growth along barrier islands and the adjacent inland maritime strand. Coastal development has fragmented these habitats, leading to increased prevalence of invasive plant species and the reduction of salt-protected zones within the typical maritime forest interior.

Species Diversity and Abundance

Native species richness ranged from 26 to 42 (mean = 34.0) within plots of this broadly defined habitat type in Cape Hatteras National Seashore and were the highest among all other habitat types at the full plot scale (Table 3). Two of the nine Maritime Upland Forest and Shrubland plots contained at least one nonnative species (Table 3) but did not include any species listed as invasive by the North Carolina Native Plant Society (Buchanan 2010). A total of 119 vascular plant species were found collectively within these nine plots; 37 of these were only found in this broadly defined habitat type (Appendix B, Table B-1). Species with high constancy are listed below, by growth form (Appendix B, Table B-1):

Trees

- Southern/eastern red cedar (100%)
- Loblolly pine (100%)
- Live oak (89%)
- Swamp bay (89%)
- Common persimmon (89%)

Shrubs

- Common wax-myrtle (89%)
- Yaupon (89%)

Vines

- Muscadine (89%)
- Virginia creeper (*Parthenocissus quinquefolia*; 89%)
- Saw greenbriar (89%)
- Eastern poison ivy (89%)

Herbs/Forbs/Graminoids

- Slender woodoats (*Chasmanthium laxum*; 89%)
- Forked rush (*Juncus dichotomus*; 67%)

Most of the vascular plant species observed in these plots are common throughout the Outer Banks of North Carolina. However, plots within this broadly defined habitat also included several rare species to the state, such as wood-grass (*Oplismenus setarius*) found in 44% of the plots, broomsedge bluestem (44%), dune blue curls (22%), sand spikerush (*Eleocharis montevidensis*; 11%), and longleaf woodoats (*Chasmanthium sessiliflorum* var. *sessiliflorum*; 11%; Appendix B, Table B-1).

Woody Stem Metrics

Total BA of tree stems ranged from 0 (in the single plot classified as Maritime Shrub (Stunted Tree Top) association) to 39.4 m²/ha in these plots, with an overall average of 22.8 m²/ha; density of canopy stems ranged from 0 to 48 per plot, with an average of 27.3 (Table 4). Canopy height ranged from 2 to 21 meters (average=11.8), and canopy cover ranged from 19 to 86% (average=69.2; Table 4). The most dominant canopy species included loblolly pine (mean BA = 8.94 m²/ha, mean density = 183/ha), live oak (mean BA = 5.87 m²/ha, mean density = 203/ha), and southern/eastern red cedar (mean BA = 3.90 m²/ha, mean density = 175/ha; Appendix B, Table B-2). Sapling density at the 80 square meter scale ranged from 2 to 117 stems, with an average of 60.1, while seedling density at the 8 meter square scale ranged from 6 to 219 stems, with an average of 99.2 across all plots (Table 4). Dominant sapling species included common wax-myrtle, yaupon, loblolly pine and farkleberry (*Vaccinium arboreum*); dominant seedlings included live oak, eastern poison ivy, yaupon, Darlington oak, and swamp bay (Appendix B, Table B-2).

Based on stem count alone, live oak comprised nearly 30% of the relative abundance among species within the tree stratum, while loblolly pine and southern/eastern red cedar comprised 27% and 26%, respectively (Figure 12). The sapling stratum was dominated by common wax-myrtle, while the seedling stratum was comprised of an even distribution of species and species groups (Figure 12).

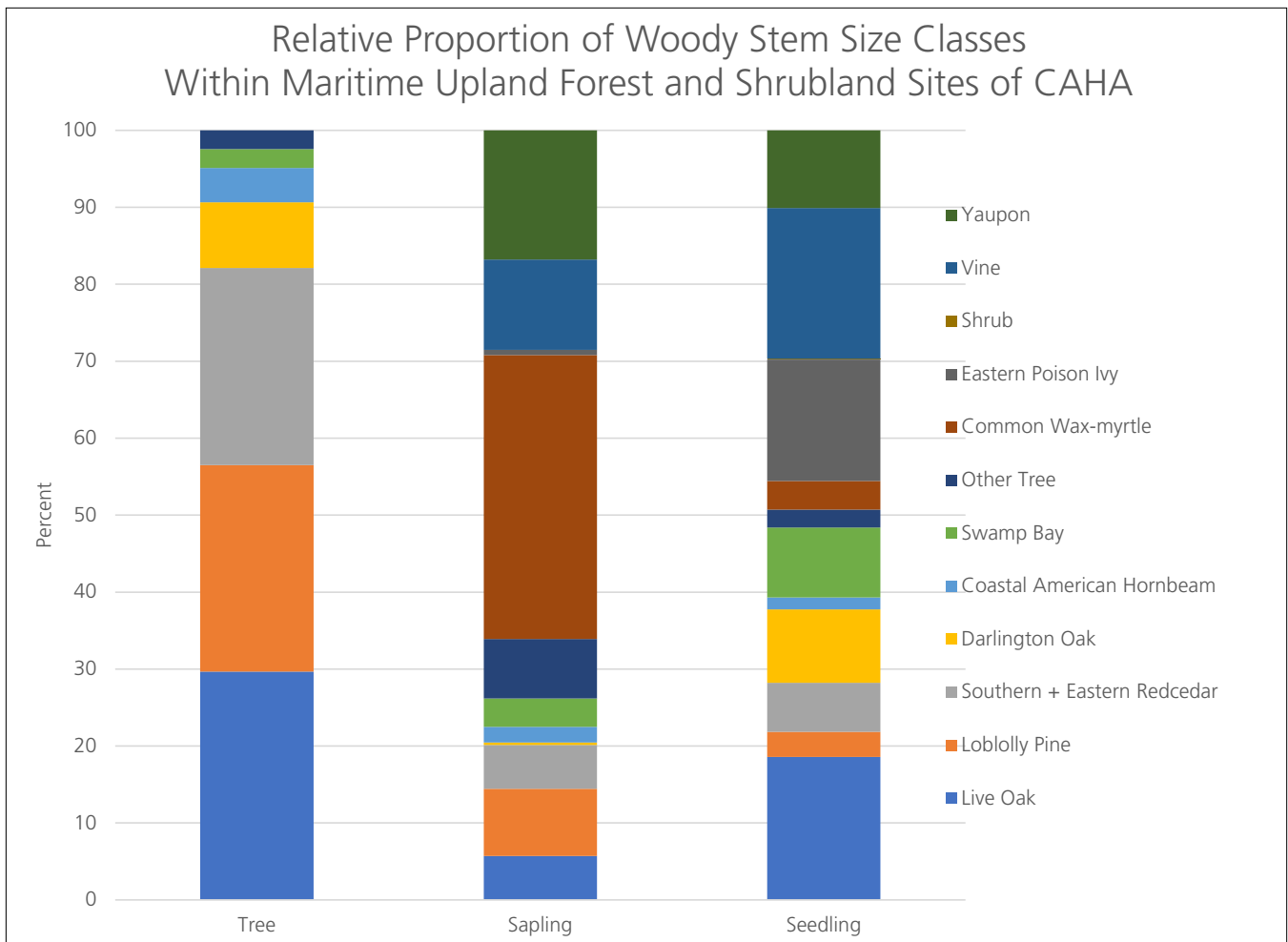


Figure 12. Relative proportion of species groups across three woody stem strata—trees, saplings, and seedlings—within Maritime Upland Forest and Shrubland vegetation monitoring plots of Cape Hatteras National Seashore.

Most of the measured trees in Maritime Upland Forest and Shrubland plots were living (96%; Figure 13). Of the 10 stems that were dead, six of those were swamp bay. The majority of trees were categorized with healthy vigor and minimal (< 10%)

dieback (Figure 13). However, all living swamp bays measured exhibited symptoms similar to those brought on by laurel wilt disease. Several individuals of live oak were observed with moderate and severe declining vigor within these communities.

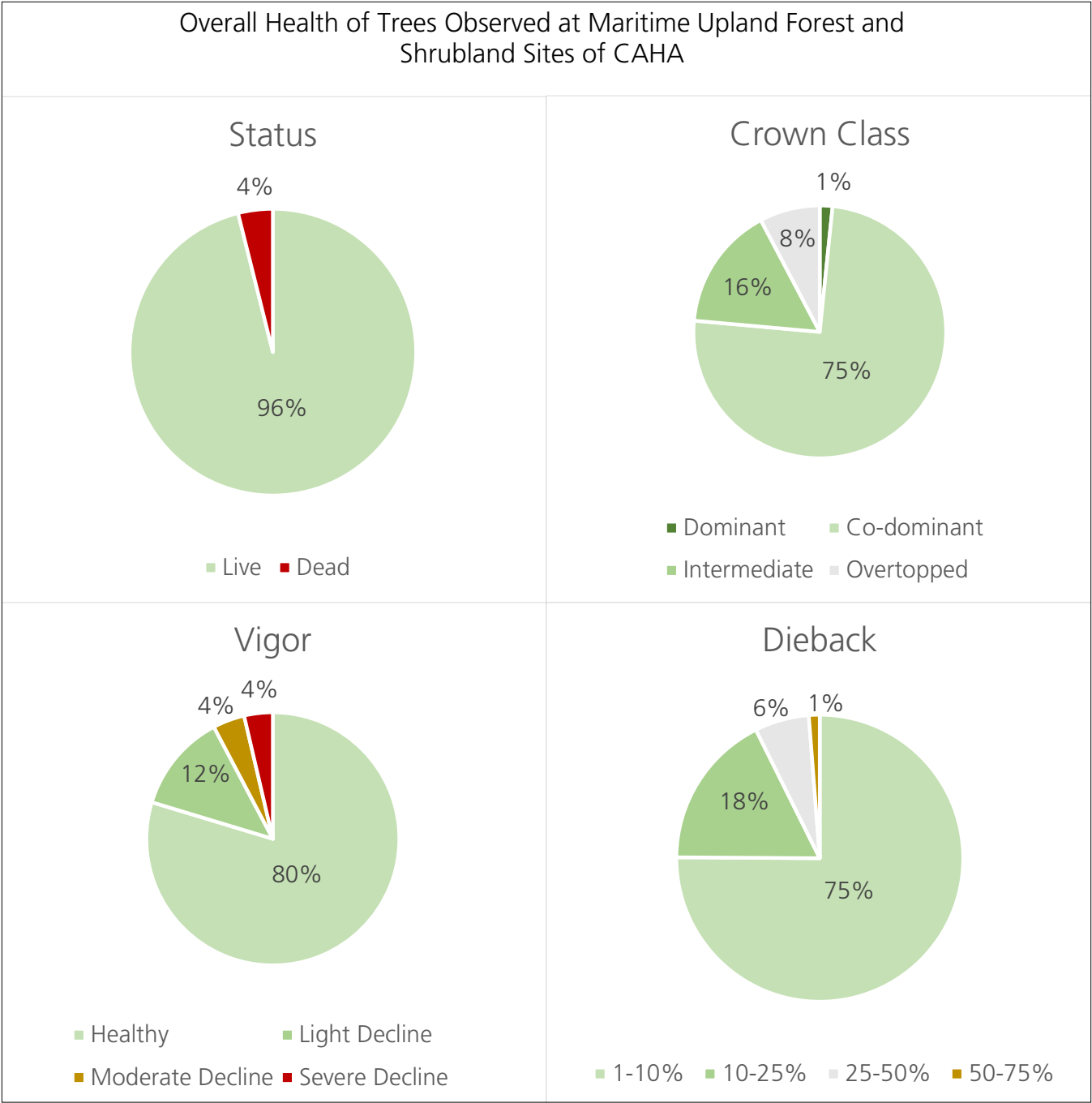


Figure 13. Health status of woody stems greater than or equal to 10 centimeters (3.9 in) DBH ('trees') measured on Maritime Upland Forest and Shrubland vegetation monitoring plots of Cape Hatteras National Seashore.

Disturbance and Threats

There were no observed current or historical disturbances on these plots within Cape Hatteras National Seashore (Table 5). However, the possible detection of laurel wilt disease on a majority of swamp bays within the park could become a serious threat to a frequent species of Maritime Forests and Shrublands, as well as of other broadly defined habitats. The disease is comprised of a fungus (*Raffaelea lauricola*) spread by an invasive, nonnative ambrosia beetle (*Xyleborus glabratus*) and affects several species within the Lauraceae Family (Fraedrich et al. 2008). Infected red bay (*Persea borbonia*) and swamp bay typically die within months after succumbing to the disease. These individuals exhibit crowns of brownish-red dead leaves. As of 2021, laurel wilt disease had not been confirmed in Dare County, North Carolina (USDA Forest Service 2021). It is possible that the declining swamp bay trees observed in this monitoring effort were impacted by another type of ambrosia beetle—there are other species that cause crown and branch dieback—or another disturbance altogether. In either case, long-term monitoring of these sites will detect the degree of mortality in swamp bays across the park.

Geomorphology and Soil

Plots located within Maritime Upland Forests and Shrublands at Cape Hatteras National Seashore occurred on both flat and sloping landforms, ranging from 0 to 14°, and exhibited either flat or concave terrain shapes (Table 6). Standing water was not observed on any of these sites (Table 6). Soil pH values ranged from acidic to alkaline, with an average of 6.7 (Table 7).

Fuel Load Estimates

Results are summarized below for each land parcel within Cape Hatteras National Seashore. It should be noted that there was high variability between fuel loads among vegetation plots in the park, even within similar land parcels and broadly defined habitat types. Variation in fuel loads is typical and related to differences in vegetation structure (e.g., abundance and height) and disturbance history between sites.

Bodie Island & Hatteras Island

Fuel load totals across the seven plots sampled on the Bodie and Hatteras Island land parcels of the park ranged from 5.8 to 70.7 tons/acre (1.3 to 15.8 kg/m²), though most values ranged between 5 to 10 tons/acre (1.3 to 2.5 kg/m²; Figure 14). The elevated value at plot BOIS066 was due to the extremely large duff layer depth—6.3 inches (15.9 cm).

Buxton

Fuel load estimates in the Buxton land parcel were highest among all land parcels within the park, and ranged from 20.9 to 55.2 tons/acre (4.7 to 12.4 kg/m²; Figure 15). Duff and litter biomass contributed to most of the fuel loads within this unit of the park.

Ocracoke Island

Fuel load totals across the 10 plots sampled on the Ocracoke Island land parcel of the park ranged from 4.2 to 46.3 tons/acre (0.9 to 10.4 kg/m²; Figure 16). Duff and litter biomass contributed to most of the fuel loads within this unit of the park.

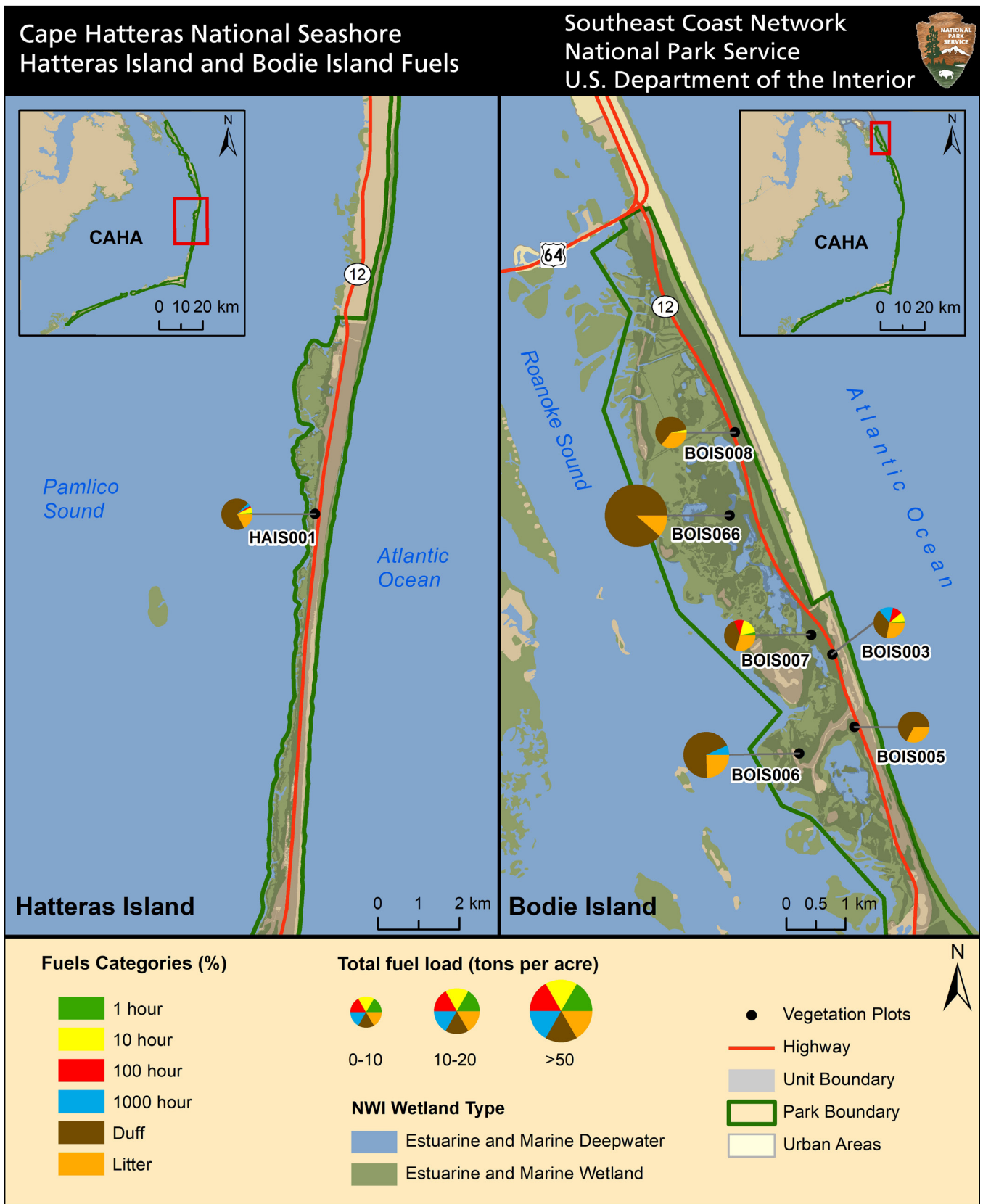


Figure 14. Fuel load estimates from vegetation monitoring plots located on the Hatteras Island and Bodie Island land parcels of Cape Hatteras National Seashore.

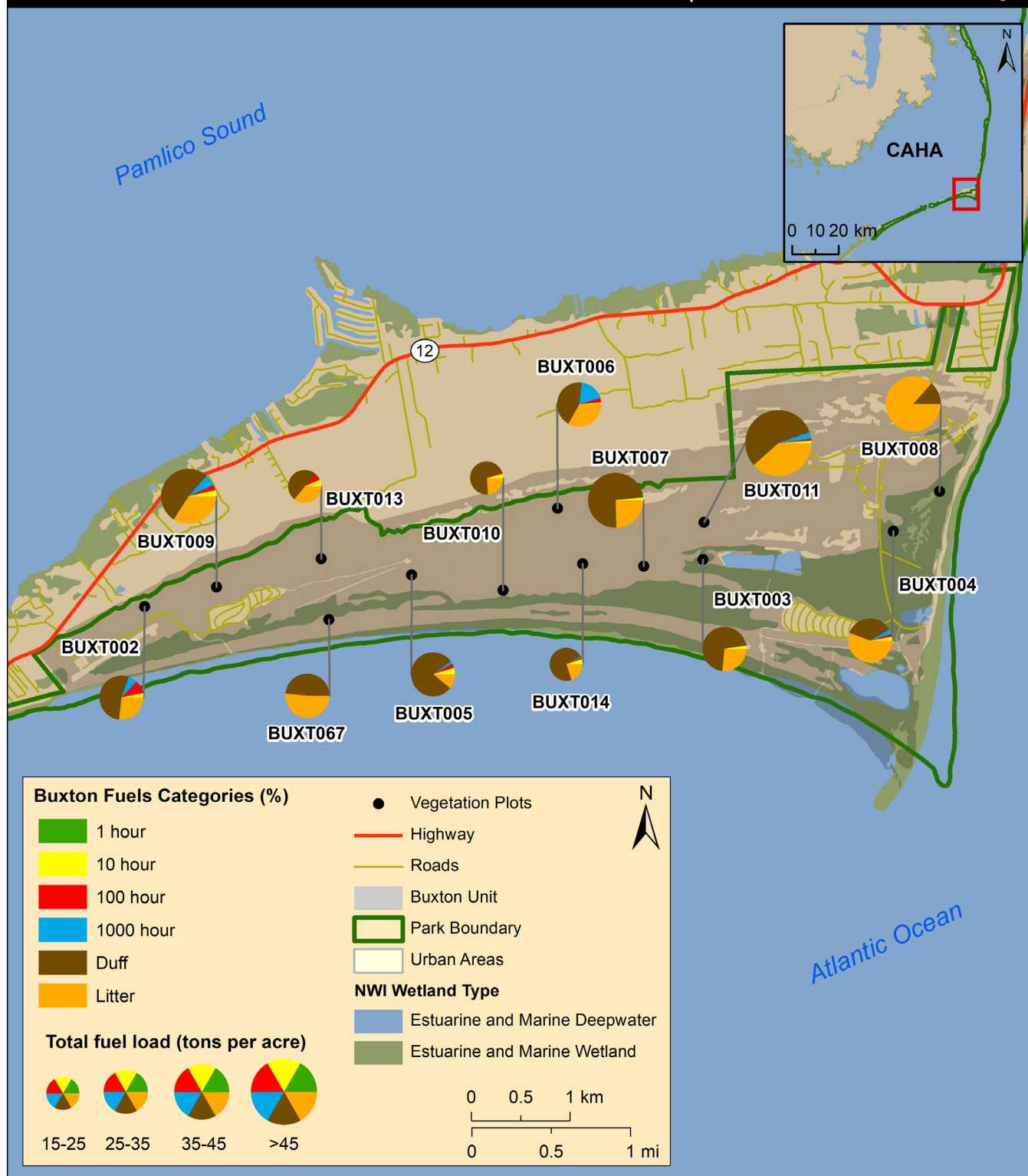


Figure 15. Fuel load estimates from vegetation monitoring plots located on the Buxton land parcel of Cape Hatteras National Seashore.

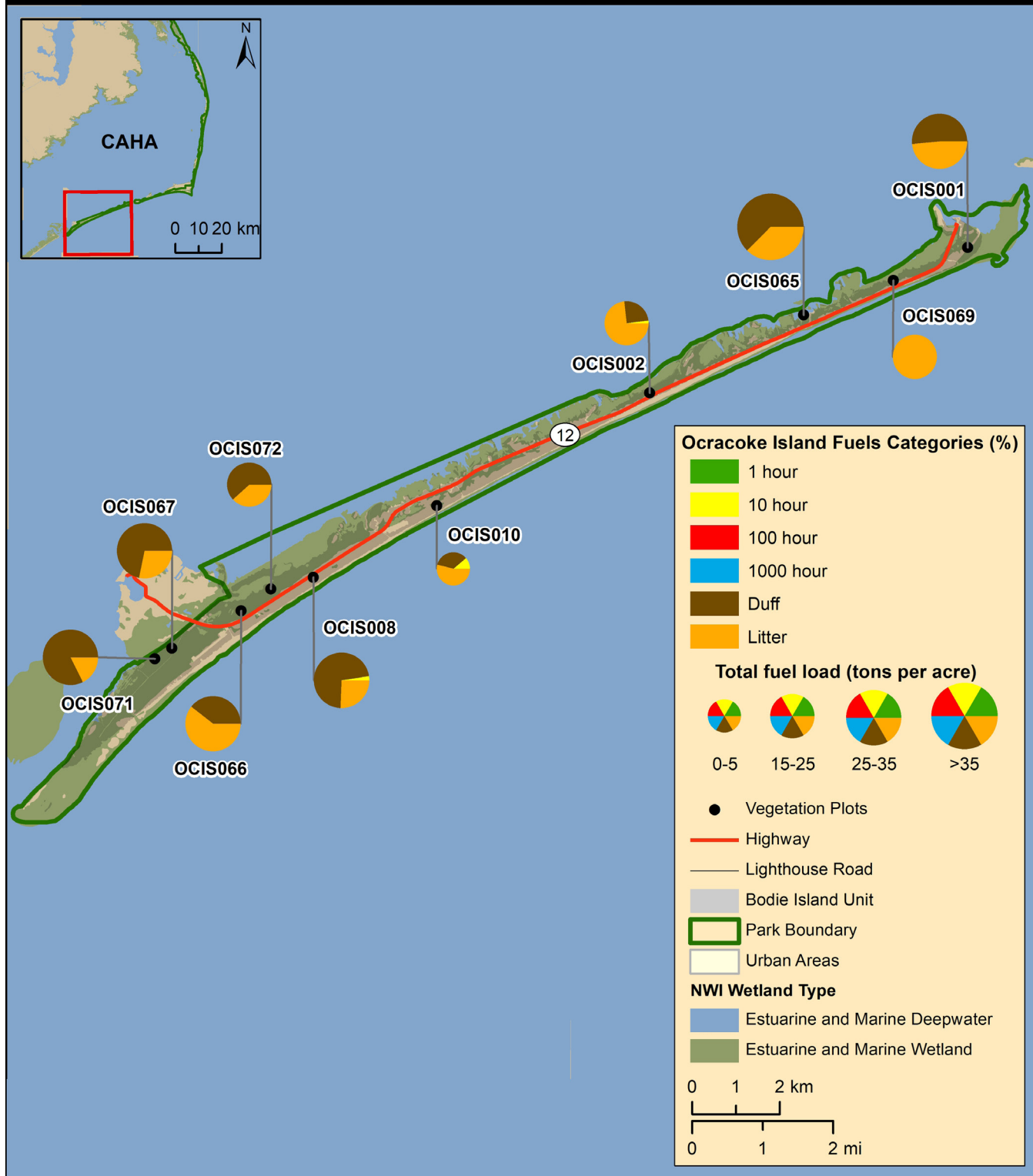


Figure 16. Fuel load estimates from vegetation monitoring plots located on the Ocracoke Island land parcel of Cape Hatteras National Seashore.

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Appendix A. Vascular Plants Observed During the 2019 Southeast Coast Network Terrestrial Vegetation Monitoring Effort at Cape Hatteras National Seashore

Table A-1. Vascular plant species present in 52 vegetation monitoring plots at Cape Hatteras National Seashore, July–August 2019.

Order	Family	Scientific Name	Common Name ¹	Native Status ¹	Growth Form	State Invasive Status ²	North Carolina Rare Plant Status ³
Sapindales	Aceraceae	<i>Acer rubrum</i>	red maple	Native	Tree	–	–
Scrophulariales	Scrophulariaceae	<i>Agalinis maritima</i> var. <i>grandiflora</i>	saltmarsh false foxglove	Native	Forb/herb	–	–
Caryophyllales	Amaranthaceae	<i>Alternanthera philoxeroides</i>	alligatorweed	Non-native	Forb/herb	Rank 1	–
Asterales	Asteraceae	<i>Ambrosia artemisiifolia</i>	annual ragweed	Native	Forb/herb	–	–
Rosales	Rosaceae	<i>Amelanchier canadensis</i>	Canadian serviceberry	Native	Tree, Shrub	–	–
Polypodiales	Blechnaceae	<i>Anchistea virginica</i>	Virginia chainfern	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Andropogon</i>	bluestem	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Andropogon tenuispathus</i>	bushy bluestem	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Andropogon ternarius</i>	splitbeard bluestem	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Andropogon virginicus</i> var. <i>decipiens</i>	broomsedge bluestem	Native	Graminoid	–	Poorly Known in NC
Cyperales	Poaceae	<i>Andropogon virginicus</i> var. <i>virginicus</i>	broomsedge bluestem	Native	Graminoid	–	–
Rosales	Rosaceae	<i>Aronia arbutifolia</i>	red chokeberry	Native	Shrub,	–	–
Gentianales	Asclepiadaceae	<i>Asclepias incarnata</i> var. <i>pulchra</i>	swamp milkweed	Native	Forb/herb	–	–
Gentianales	Asclepiadaceae	<i>Asclepias lanceolata</i>	fewflower milkweed	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Baccharis angustifolia</i>	saltwater false willow	Native	Shrub	–	Rare but Relatively Secure
Asterales	Asteraceae	<i>Baccharis halimifolia</i>	eastern baccharis	Native	Tree, Shrub	–	–
Gentianales	Gentianaceae	<i>Bartonia virginica</i>	yellow screwstem	Native	Forb/herb	–	–
Cornales	Cornaceae	<i>Benthamidia florida</i>	flowering dogwood	Native	Tree, Shrub	–	–
Rhamnales	Rhamnaceae	<i>Berchemia scandens</i>	Alabama supplejack	Native	Vine	–	–
Urticales	Urticaceae	<i>Boehmeria cylindrica</i>	smallspike false nettle	Native	Forb/herb	–	–
Cyperales	Cyperaceae	<i>Bolboschoenus robustus</i>	sturdy bulrush	Native	Graminoid	–	–
Asterales	Asteraceae	<i>Borrchia frutescens</i>	bushy seaside tansy	Native	Subshrub	–	–
Scrophulariales	Scrophulariaceae	<i>Buchnera floridana</i>	American bluehearts	Native	Forb/herb	–	–
Capparales	Brassicaceae	<i>Cakile [edentula + harperi]</i>	American searocket	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Calamagrostis breviligulata</i> ssp. <i>breviligulata</i>	American beachgrass	Native	Graminoid	–	–

¹ Information obtained from the PLANTS database (USDA 2020)² Information obtained from the North Carolina Native Plant Society (Buchanan 2010); Rank 1=Severe Threat; Rank 2=Significant Threat³ Information obtained from the North Carolina Natural Heritage Program (Robinson 2018)

Table A-1 (continued). Vascular plant species present in 52 vegetation monitoring plots at Cape Hatteras National Seashore, July–August 2019.

Order	Family	Scientific Name	Common Name ¹	Native Status ¹	Growth Form	State Invasive Status ²	North Carolina Rare Plant Status ³
Lamiales	Verbenaceae	<i>Callicarpa americana</i>	American beautyberry	Native	Shrub	–	–
Cyperales	Cyperaceae	<i>Carex</i>	sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex comosa</i>	longhair sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex floridana</i>	Florida sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex howei</i>	prickly bog sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex longii</i>	Long's sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex lupulina</i>	hop sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex muehlenbergii</i>	Muhlenberg's sedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Carex seorsa</i>	weak stellate sedge	Native	Graminoid	–	–
Fagales	Betulaceae	<i>Carpinus caroliniana</i> var. <i>caroliniana</i>	American hornbeam	Native	Tree, Shrub	–	–
Cyperales	Poaceae	<i>Cenchrus tribuloides</i>	sanddune sandbur	Native	Graminoid	–	–
Apiales	Apiaceae	<i>Centella asiatica</i>	erect centella	Native	Forb/herb	–	–
Fabales	Fabaceae	<i>Chamaecrista fasciculata</i>	partridge pea	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Chasmanthium laxum</i>	slender woodoats	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Chasmanthium sessiliflorum</i> var. <i>sessiliflorum</i>	longleaf woodoats	Native	Graminoid	–	Rare but Relatively Secure
Apiales	Apiaceae	<i>Cicuta maculata</i> var. <i>maculata</i>	spotted water hemlock	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Cirsium horridulum</i> var. <i>horridulum</i>	yellow thistle	Native	Forb/herb	–	–
Cyperales	Cyperaceae	<i>Cladium jamaicense</i>	Jamaica swamp sawgrass	Native	Graminoid	–	–
Commelinales	Commelinaceae	<i>Commelina erecta</i> var. <i>angustifolia</i>	whitemouth dayflower	Native	Forb/herb	–	–
Solanales	Convolvulaceae	<i>Convolvulus soldanella</i>	seashore false bindweed	Native	Vine, Forb/herb	–	–
Euphorbiales	Euphorbiaceae	<i>Croton punctatus</i>	gulf croton	Native	Subshrub, Forb/herb	–	–
Cyperales	Cyperaceae	<i>Cyperaceae</i>	Sedge Family	Unknown	Graminoid	–	–
Cyperales	Cyperaceae	<i>Cyperus</i>	flatsedge	Unknown	–	–	–
Cyperales	Cyperaceae	<i>Cyperus croceus</i>	Baldwin's flatsedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Cyperus esculentus</i> var. <i>leptostachyus</i>	yellow nutsedge	Non-native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Cyperus filicinus</i>	fern flatsedge	Native	Graminoid	–	–

¹ Information obtained from the PLANTS database (USDA 2020)² Information obtained from the North Carolina Native Plant Society (Buchanan 2010); Rank 1=Severe Threat; Rank 2=Significant Threat³ Information obtained from the North Carolina Natural Heritage Program (Robinson 2018)

Table A-1 (continued). Vascular plant species present in 52 vegetation monitoring plots at Cape Hatteras National Seashore, July–August 2019.

Order	Family	Scientific Name	Common Name ¹	Native Status ¹	Growth Form	State Invasive Status ²	North Carolina Rare Plant Status ³
Cyperales	Cyperaceae	<i>Cyperus grayi</i>	Gray's flatsedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Cyperus odoratus</i> var. <i>odoratus</i>	fragrant flatsedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Cyperus retrorsus</i>	pine barren flatsedge	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Cyperus strigosus</i>	strawcolored flatsedge	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Danthonia sericea</i>	downy danthonia	Native	Graminoid	–	–
Fabales	Fabaceae	<i>Desmodium glabellum</i>	Dillenius' ticktrefoil	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Dichanthelium</i>	rosette grass	Native	–	–	–
Cyperales	Poaceae	<i>Dichanthelium aciculare</i>	needleleaf rosette grass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Dichanthelium acuminatum</i>	tapered rosetted grass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Dichanthelium boscii</i>	Bosc's panicgrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Dichanthelium caerulescens</i>	cypress panicgrass	Native	Graminoid	–	State Endangered
Cyperales	Poaceae	<i>Dichanthelium commutatum</i> var. <i>commutatum</i>	variable panicgrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Dichanthelium dichotomum</i> var. <i>dichotomum</i>	cypress panicgrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Dichanthelium laxiflorum</i>	openflower rosette grass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Dichanthelium meridionale</i>	matting rosette grass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Dichanthelium scoparium</i>	velvet panicum	Native	Graminoid	–	–
Rubiales	Rubiaceae	<i>Diodia virginiana</i>	Virginia buttonweed	Native	Subshrub, Forb/herb	–	–
Ebenales	Ebenaceae	<i>Diospyros virginiana</i>	common persimmon	Native	Tree	–	–
Cyperales	Poaceae	<i>Distichlis spicata</i>	saltgrass	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Eleocharis cellulosa</i>	Gulf Coast spikerush	Native	Graminoid	–	State Endangered
Cyperales	Cyperaceae	<i>Eleocharis fallax</i>	creeping spikerush	Native	Graminoid	–	Significantly Rare-Throughout
Cyperales	Cyperaceae	<i>Eleocharis montevidensis</i>	sand spikerush	Native	Graminoid	–	Significantly Rare-Peripheral
Cyperales	Cyperaceae	<i>Eleocharis rostellata</i>	beaked spikerush	Native	Graminoid	–	Significantly Rare-Other
Asterales	Asteraceae	<i>Elephantopus tomentosus</i>	devil's grandmother	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Eleusine indica</i>	Indian goosegrass	Non-native	Graminoid	–	–

¹ Information obtained from the PLANTS database (USDA 2020)² Information obtained from the North Carolina Native Plant Society (Buchanan 2010); Rank 1=Severe Threat; Rank 2=Significant Threat³ Information obtained from the North Carolina Natural Heritage Program (Robinson 2018)

Table A-1 (continued). Vascular plant species present in 52 vegetation monitoring plots at Cape Hatteras National Seashore, July–August 2019.

Order	Family	Scientific Name	Common Name ¹	Native Status ¹	Growth Form	State Invasive Status ²	North Carolina Rare Plant Status ³
Cyperales	Poaceae	<i>Elymus halophilus</i>	Virginia wildrye	Native	Graminoid	–	Special Concern-Vulnerable
Cyperales	Poaceae	<i>Elymus virginicus</i>	Virginia wildrye	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Eragrostis spectabilis</i>	purple lovegrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Eremochloa ophiuroides</i>	centipede grass	Non-native	Graminoid	–	–
Cyperales	Poaceae	<i>Erianthus giganteus</i>	sugarcane plumegrass	Native	Graminoid	–	–
Asterales	Asteraceae	<i>Erigeron pusillus</i>	Canadian horseweed	Native	Forb/herb	–	–
Celastrales	Celastraceae	<i>Euonymus americanus</i>	bursting-heart	Native	Forb/herb, Subshrub	–	–
Asterales	Asteraceae	<i>Eupatorium capillifolium</i>	dogfennel	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Eupatorium glaucescens</i>	waxy thoroughwort	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Eupatorium hyssopifolium</i>	hyssopleaf thoroughwort	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Eupatorium leucolepis</i>	justiceweed	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Eupatorium pilosum</i>	rough boneset	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Eupatorium rotundifolium</i>	roundleaf thoroughwort	Native	Forb/herb	–	–
Euphorbiales	Euphorbiaceae	<i>Euphorbia [bombensis + polygonifolia]</i>	dixie + seaside sandmat	Native	Forb/herb	–	Significantly Rare-Throughout (?) - only E. bomb
Cyperales	Poaceae	<i>Eustachys petraea</i>	pinewoods fingergrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Festuca octoflora</i>	sixweeks fescue	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Festuca rubra</i>	red fescue	Non-native	Graminoid	–	–
Cyperales	Poaceae	<i>Festuca sciurea</i>	squirreltail fescue	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Fimbristylis caroliniana</i>	Carolina fimbry	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Fimbristylis castanea</i>	marsh fimbry	Native	Graminoid	–	–
Asterales	Asteraceae	<i>Gaillardia pulchella</i> var. <i>drummondii</i>	Indian blanket	Non-native	Forb/herb, Subshrub	–	–
Fabales	Fabaceae	<i>Galactia volubilis</i>	downy milkpea	Native	Vine, Forb/herb	–	–
Rubiales	Rubiaceae	<i>Galium aparine</i>	stickywilly	Native	Forb/herb	–	–
Rubiales	Rubiaceae	<i>Galium bermudense</i>	coastal bedstraw	Native	Forb/herb	–	–
Rubiales	Rubiaceae	<i>Galium circaezans</i>	licorice bedstraw	Native	Subshrub, Forb/herb	–	–
Rubiales	Rubiaceae	<i>Galium obtusum</i>	bluntleaf bedstraw	Native	Forb/herb	–	–

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Table A-1 (continued). Vascular plant species present in 52 vegetation monitoring plots at Cape Hatteras National Seashore, July–August 2019.

Order	Family	Scientific Name	Common Name ¹	Native Status ¹	Growth Form	State Invasive Status ²	North Carolina Rare Plant Status ³
Rubiales	Rubiaceae	<i>Galium tinctorium</i>	stiff marsh bedstraw	Native	Forb/herb	–	–
Rubiales	Rubiaceae	<i>Galium uniflorum</i>	oneflower bedstraw	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Gamochaeta</i>	everlasting	Unknown	–	–	–
Asterales	Asteraceae	<i>Gamochaeta pensylvanica</i>	Pennsylvania everlasting	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Gamochaeta purpurea</i>	spoonleaf purple everlasting	Native	Forb/herb	–	–
Gentianales	Loganiaceae	<i>Gelsemium sempervirens</i>	evening trumpetflower	Native	Vine, Shrub	–	–
Cyperales	Poaceae	<i>Glyceria septentrionalis</i>	floating mannagrass	Native	Graminoid	–	–
Gentianales	Asclepiadaceae	<i>Gonolobus suberosus</i> var. <i>suberosus</i>	angularfruit milkvine	Native	Vine	–	–
Cyperales	Poaceae	<i>Greeneochloa coarctata</i>	Nuttall's reedgrass	Native	Graminoid	–	–
Asterales	Asteraceae	<i>Heterotheca subaxillaris</i>	camphorweed	Native	Forb/herb	–	–
Rubiales	Rubiaceae	<i>Hexasepalum teres</i>	poorjoe	Native	Forb/herb	–	–
Malvales	Malvaceae	<i>Hibiscus moscheutos</i>	crimson-eyed rosemallow	Native	Subshrub, Forb/herb	–	–
Asterales	Asteraceae	<i>Hieracium gronovii</i>	queendevil	Native	Forb/herb	–	–
Apiales	Apiaceae	<i>Hydrocotyle bonariensis</i>	largeleaf pennywort	Native	Forb/herb	–	–
Apiales	Apiaceae	<i>Hydrocotyle umbellata</i>	manyflower marshpennywort	Native	Forb/herb	–	–
Apiales	Apiaceae	<i>Hydrocotyle verticillata</i>	whorled marshpennywort	Native	Forb/herb	–	–
Theales	Clusiaceae	<i>Hypericum crux-andreae</i>	St. Peterswort	Native	Subshrub, Shrub	–	–
Theales	Clusiaceae	<i>Hypericum gentianoides</i>	orange grass	Native	Forb/herb	–	–
Theales	Clusiaceae	<i>Hypericum hypericoides</i>	St. Andrew's cross	Native	Subshrub, Shrub	–	–
Celastrales	Aquifoliaceae	<i>Ilex glabra</i>	inkberry	Native	Shrub	–	–
Celastrales	Aquifoliaceae	<i>Ilex opaca</i>	American holly	Native	Tree, Shrub	–	–
Celastrales	Aquifoliaceae	<i>Ilex vomitoria</i>	yaupon	Native	Tree, Shrub	–	–
Solanales	Convolvulaceae	<i>Ipomoea pandurata</i>	man of the earth	Native	Vine	–	–
Solanales	Convolvulaceae	<i>Ipomoea sagittata</i>	saltmarsh morning-glory	Native	Vine, Forb/herb	–	–
Asterales	Asteraceae	<i>Iva frutescens</i>	Jesuit's bark	Native	Subshrub, Forb/herb	–	–
Asterales	Asteraceae	<i>Iva imbricata</i>	seacoast marsh elder	Native	Forb/herb, Subshrub	–	–
Juncals	Juncaceae	<i>Juncus</i>	rush	Native	–	–	–
Juncals	Juncaceae	<i>Juncus biflorus</i>	bog rush	Native	Graminoid	–	–

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Table A-1 (continued). Vascular plant species present in 52 vegetation monitoring plots at Cape Hatteras National Seashore, July–August 2019.

Order	Family	Scientific Name	Common Name ¹	Native Status ¹	Growth Form	State Invasive Status ²	North Carolina Rare Plant Status ³
Juncales	Juncaceae	<i>Juncus coriaceus</i>	leathery rush	Native	Graminoid	–	–
Juncales	Juncaceae	<i>Juncus dichotomus</i>	forked rush	Native	Graminoid	–	–
Juncales	Juncaceae	<i>Juncus effusus</i> ssp. <i>solutus</i>	common rush	Native	Graminoid	–	–
Juncales	Juncaceae	<i>Juncus megacephalus</i>	bighead rush	Native	Graminoid	–	–
Juncales	Juncaceae	<i>Juncus roemerianus</i>	needlegrass rush	Native	Graminoid	–	–
Juncales	Juncaceae	<i>Juncus tenuis</i>	poverty rush	Native	Graminoid	–	–
Pinales	Cupressaceae	<i>Juniperus [silicicola + virginiana]</i>	eastern redcedar	Native	Tree	–	–
Malvales	Malvaceae	<i>Kosteletzkya pentacarpos</i>	Virginia saltmarsh mallow	Native	Subshrub, Forb/herb	–	–
Asterales	Asteraceae	<i>Krigia virginica</i>	Virginia dwarf dandelion	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Lactuca canadensis</i>	Canada lettuce	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Lactuca graminifolia</i>	grassleaf lettuce	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Leersia oryzoides</i>	rice cutgrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Leersia virginica</i>	whitegrass	Native	Graminoid	–	–
Capparales	Brassicaceae	<i>Lepidium virginicum</i>	Virginia pepperweed	Native	Forb/herb	–	–
Scrophulariales	Scrophulariaceae	<i>Lindernia dubia</i>	yellowseed false pimpernel	Native	Forb/herb	–	–
Dipsacales	Caprifoliaceae	<i>Lonicera japonica</i>	Japanese honeysuckle	Non-native	Vine	Rank 1	–
Polypodiales	Blechnaceae	<i>Lorinseria areolata</i>	netted chainfern	Native	Forb/herb	–	–
Myrtales	Onagraceae	<i>Ludwigia</i>	primrose-willow	Unknown	–	–	–
Myrtales	Onagraceae	<i>Ludwigia microcarpa</i>	smallfruit primrose-willow	Native	Forb/herb	–	–
Myrtales	Onagraceae	<i>Ludwigia repens</i>	creeping primrose-willow	Native	Forb/herb	–	–
Lamiales	Lamiaceae	<i>Lycopus angustifolius</i>	taperleaf water horehound	Native	Forb/herb	–	Significantly Rare-Peripheral
Myrtales	Lythraceae	<i>Lythrum lineare</i>	wand lythrum	Native	Forb/herb	–	–
Magnoliales	Magnoliaceae	<i>Magnolia virginiana</i> var. <i>virginiana</i>	sweetbay	Native	Tree, Shrub	–	–
Cyperales	Poaceae	<i>Melica mutica</i>	twoflower melicgrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Microstegium vimineum</i>	Nepalese browntop	Non-native	Graminoid	Rank 1	–
Asterales	Asteraceae	<i>Mikania scandens</i>	climbing hempvine	Native	Vine, Forb/herb	–	–
Rubiales	Rubiaceae	<i>Mitchella repens</i>	partridgeberry	Native	Subshrub, Forb/herb	–	–
Lamiales	Lamiaceae	<i>Monarda punctata</i> var. <i>punctata</i>	spotted beebalm	Native	Subshrub, Forb/herb	–	–

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Table A-1 (continued). Vascular plant species present in 52 vegetation monitoring plots at Cape Hatteras National Seashore, July–August 2019.

Order	Family	Scientific Name	Common Name ¹	Native Status ¹	Growth Form	State Invasive Status ²	North Carolina Rare Plant Status ³
Myricales	Myricaceae	<i>Morella cerifera</i>	wax myrtle	Native	Tree, Subshrub, Shrub	–	–
Myricales	Myricaceae	<i>Morella pensylvanica</i>	northern bayberry	Native	Tree, Shrub	–	–
Cyperales	Poaceae	<i>Muhlenbergia sericea</i>	hairawn muhly	Native	Graminoid	–	–
Rhamnales	Vitaceae	<i>Muscadinia rotundifolia</i> var. <i>rotundifolia</i>	muscadine	Native	Vine	–	–
Rhamnales	Vitaceae	<i>Nekemias arborea</i>	peppervine	Native	Shrub, Vine	–	–
Cornales	Cornaceae	<i>Nyssa biflora</i>	swamp tupelo	Native	Tree	–	–
Myrtales	Onagraceae	<i>Oenothera humifusa</i>	seabeach evening primrose	Native	Subshrub, Forb/herb	–	–
Myrtales	Onagraceae	<i>Oenothera similans</i>	southern beeblossom	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Oplismenus setarius</i>	basketgrass	Native	Graminoid	–	Significantly Rare-Peripheral
Caryophyllales	Cactaceae	<i>Opuntia drummondii</i>	cockspur pricklypear	Native	Subshrub, Shrub	–	–
Polypodiales	Osmundaceae	<i>Osmunda spectabilis</i>	royal fern	Native	Forb/herb	–	–
Polypodiales	Osmundaceae	<i>Osmundastrum cinnamomeum</i>	cinnamon fern	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Panicum</i>	panicgrass	Unknown	–	–	–
Cyperales	Poaceae	<i>Panicum amarum</i>	bitter panicgrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Panicum virgatum</i> var. <i>spissum</i>	switchgrass	Native	Graminoid	–	–
Rhamnales	Vitaceae	<i>Parthenocissus quinquefolia</i>	Virginia creeper	Native	Vine	–	–
Cyperales	Poaceae	<i>Paspalum</i>	crowngrass	Unknown	–	–	–
Cyperales	Poaceae	<i>Paspalum dilatatum</i> ssp. <i>dilatatum</i>	dallisgrass	Non-native	Graminoid	–	–
Cyperales	Poaceae	<i>Paspalum distichum</i>	knotgrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Paspalum notatum</i>	bahiagrass	Non-native	Graminoid	–	–
Cyperales	Poaceae	<i>Paspalum vaginatum</i>	seashore paspalum	Native	Graminoid	–	Significantly Rare-Peripheral
Violales	Passifloraceae	<i>Passiflora incarnata</i>	purple passionflower	Native	Vine, Forb/herb	–	–
Gentianales	Asclepiadaceae	<i>Pattalias palustre</i>	gulf coast swallow-wort	Native	Forb/herb, Vine	–	–
Laurales	Lauraceae	<i>Persea palustris</i>	swamp bay	Native	Shrub, Tree	–	–
Polygonales	Polygonaceae	<i>Persicaria densiflora</i>	denseflower knotweed	Native	Forb/herb	–	–
Polygonales	Polygonaceae	<i>Persicaria hydropiperoides</i>	swamp smartweed	Native	Forb/herb	–	–

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Table A-1 (continued). Vascular plant species present in 52 vegetation monitoring plots at Cape Hatteras National Seashore, July–August 2019.

Order	Family	Scientific Name	Common Name ¹	Native Status ¹	Growth Form	State Invasive Status ²	North Carolina Rare Plant Status ³
Polygonales	Polygonaceae	<i>Persicaria punctata</i>	dotted smartweed	Native	Forb/herb	–	–
Polygonales	Polygonaceae	<i>Persicaria sagittata</i>	arrowleaf tearthumb	Native	Vine, Forb/herb	–	–
Cyperales	Poaceae	<i>Phragmites australis</i>	European common reed	Non-native	Graminoid	Rank 1	–
Lamiales	Verbenaceae	<i>Phyla lanceolata</i>	lanceleaf fogfruit	Native	Forb/herb	–	–
Lamiales	Verbenaceae	<i>Phyla nodiflora</i> var. <i>nodiflora</i>	turkey tangle fogfruit	Native	Forb/herb	–	–
Solanales	Solanaceae	<i>Physalis walteri</i>	Walter's groundcherry	Native	Forb/herb	–	–
Pinales	Pinaceae	<i>Pinus taeda</i>	loblolly pine	Native	Tree	–	–
Asterales	Asteraceae	<i>Pityopsis nervosa</i>	narrowleaf silkgrass	Native	Forb/herb	–	–
Plantaginales	Plantaginaceae	<i>Plantago lanceolata</i>	narrowleaf plantain	Non-native	Forb/herb	–	–
Asterales	Asteraceae	<i>Pluchea baccharis</i>	rosy camphorweed	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Pluchea camphorata</i>	camphor pluchea	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Pluchea foetida</i> var. <i>foetida</i>	stinking camphorweed	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Pluchea odorata</i>	sweetscent	Native	Subshrub, Forb/herb	–	–
Cyperales	Poaceae	<i>Poa pratensis</i> ssp. <i>pratensis</i>	Kentucky bluegrass	Non-native	Graminoid	–	–
Cyperales	Poaceae	<i>Poaceae</i>	Grass Family	Unknown	Graminoid	–	–
Cyperales	Poaceae	<i>Polypogon monspeliensis</i>	annual rabbitsfoot grass	Non-native	Graminoid	–	–
Haloragales	Haloragaceae	<i>Proserpinaca palustris</i>	marsh mermaidweed	Native	Forb/herb	–	–
Rosales	Rosaceae	<i>Prunus caroliniana</i>	Carolina laurelcherry	Native	Shrub, Tree	–	–
Apiales	Apiaceae	<i>Ptilimnium capillaceum</i>	herbwilliam	Native	Forb/herb	–	–
Fagales	Fagaceae	<i>Quercus hemisphaerica</i>	Darlington oak	Native	Tree	–	–
Fagales	Fagaceae	<i>Quercus virginiana</i>	live oak	Native	Tree	–	–
Sapindales	Anacardiaceae	<i>Rhus copallinum</i> var. <i>copallinum</i>	winged sumac	Native	Tree, Shrub	–	–
Cyperales	Cyperaceae	<i>Rhynchospora colorata</i>	starrush whitetop	Native	Graminoid	–	–
Rosales	Rosaceae	<i>Rosa palustris</i>	swamp rose	Native	Subshrub	–	–
Rosales	Rosaceae	<i>Rubus</i>	blackberry	Native	–	–	–
Rosales	Rosaceae	<i>Rubus pensilvanicus</i>	sawtooth blackberry	Native	Subshrub	–	–
Rosales	Rosaceae	<i>Rubus trivialis</i>	southern dewberry	Native	Subshrub, Vine	–	–
Arecales	Arecaceae	<i>Sabal minor</i>	dwarf palmetto	Native	Tree, Shrub	–	–
Gentianales	Gentianaceae	<i>Sabatia stellaris</i>	rose of Plymouth	Native	Forb/herb	–	–

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Table A-1 (continued). Vascular plant species present in 52 vegetation monitoring plots at Cape Hatteras National Seashore, July–August 2019.

Order	Family	Scientific Name	Common Name ¹	Native Status ¹	Growth Form	State Invasive Status ²	North Carolina Rare Plant Status ³
Cyperales	Poaceae	<i>Sacciolepis striata</i>	American cupscale	Native	Graminoid	–	–
Caryophyllales	Chenopodiaceae	<i>Salicornia virginica</i>	Virginia glasswort	Native	Forb/herb, Subshrub	–	–
Salicales	Salicaceae	<i>Salix caroliniana</i>	Carolina willow	Native	Tree	–	–
Apiales	Apiaceae	<i>Sanicula canadensis</i> var. <i>floridana</i>	Canadian blacksnakeroot	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Schizachyrium littorale</i>	shore little bluestem	Native	Graminoid	–	Rare but Relatively Secure
Cyperales	Poaceae	<i>Schizachyrium scoparium</i> var. <i>scoparium</i>	little bluestem	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Schoenoplectus pungens</i> var. <i>pungens</i>	common threesquare	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Schoenoplectus tabernaemontani</i>	softstem bulrush	Native	Graminoid	–	–
Cyperales	Cyperaceae	<i>Scleria</i>	nutrush	Native	–	–	–
Cyperales	Cyperaceae	<i>Scleria flaccida</i>	whip nutrush	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Setaria magna</i>	giant bristlegrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Setaria parviflora</i>	marsh bristlegrass	Native	Graminoid	–	–
Liliales	Smilacaceae	<i>Smilax auriculata</i>	earleaf greenbrier	Native	Shrub, Vine	–	–
Liliales	Smilacaceae	<i>Smilax bona-nox</i>	saw greenbrier	Native	Shrub, Vine	–	–
Liliales	Smilacaceae	<i>Smilax glauca</i>	cat greenbrier	Native	Shrub, Vine	–	–
Liliales	Smilacaceae	<i>Smilax laurifolia</i>	laurel greenbrier	Native	Shrub, Vine	–	–
Liliales	Smilacaceae	<i>Smilax rotundifolia</i>	roundleaf greenbrier	Native	Vine, Shrub	–	–
Liliales	Smilacaceae	<i>Smilax smallii</i>	lanceleaf greenbrier	Native	Shrub, Vine	–	–
Liliales	Smilacaceae	<i>Smilax walteri</i>	coral greenbrier	Native	Shrub, Vine	–	–
Asterales	Asteraceae	<i>Solidago fistulosa</i>	pine barren goldenrod	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Solidago mexicana</i>	seaside goldenrod	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Solidago odora</i>	anisescented goldenrod	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Solidago sempervirens</i>	seaside goldenrod	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Spartina alterniflora</i>	smooth cordgrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Spartina cynosuroides</i>	big cordgrass	Native	Graminoid	–	–
Cyperales	Poaceae	<i>Spartina patens</i>	saltmeadow cordgrass	Native	Graminoid	–	–
Orchidales	Orchidaceae	<i>Spiranthes cernua</i>	nodding lady's tresses	Native	Forb/herb	–	–

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Table A-1 (continued). Vascular plant species present in 52 vegetation monitoring plots at Cape Hatteras National Seashore, July–August 2019.

Order	Family	Scientific Name	Common Name ¹	Native Status ¹	Growth Form	State Invasive Status ²	North Carolina Rare Plant Status ³
Cyperales	Poaceae	<i>Sporobolus indicus</i>	smut grass	Non-native	Graminoid	–	–
Caryophyllales	Caryophyllaceae	<i>Stellaria media</i>	common chickweed	Non-native	Forb/herb	Rank 2	–
Fabales	Fabaceae	<i>Strophostyles helvola</i>	amberique-bean	Native	Vine, Forb/herb	–	–
Cornales	Cornaceae	<i>Swida foemina</i>	stiff dogwood	Native	Tree, Shrub	–	–
Asterales	Asteraceae	<i>Symphyotrichum simmondsii</i>	Simmonds' aster	Native	Forb/herb	–	Rare but Relatively Secure
Asterales	Asteraceae	<i>Symphyotrichum subulatum</i>	eastern annual saltmarsh aster	Native	Forb/herb	–	–
Asterales	Asteraceae	<i>Symphyotrichum tenuifolium</i>	perennial saltmarsh aster	Native	Forb/herb	–	–
Polypodiales	Thelypteridaceae	<i>Thelypteris palustris</i> var. <i>pubescens</i>	eastern marsh fern	Native	Forb/herb	–	–
Sapindales	Anacardiaceae	<i>Toxicodendron radicans</i> var. <i>radicans</i>	eastern poison ivy	Native	Vine	–	–
Theales	Clusiaceae	<i>Triadenum walteri</i>	greater marsh St. Johnswort	Native	Forb/herb	–	–
Lamiales	Lamiaceae	<i>Trichostema nesophilum</i>	bluecurls	Native	Forb/herb	–	Significantly Rare-Limited
Cyperales	Poaceae	<i>Tripsacum dactyloides</i> var. <i>dactyloides</i>	eastern gamagrass	Native	Graminoid	–	–
Typhales	Typhaceae	<i>Typha angustifolia</i>	narrowleaf cattail	Native	Forb/herb	–	–
Typhales	Typhaceae	<i>Typha latifolia</i>	broadleaf cattail	Native	Forb/herb	–	–
Cyperales	Poaceae	<i>Uniola paniculata</i>	seaoats	Native	Graminoid	–	–
Unknown	Unknown	<i>Unknown</i>	unknown	Unknown	Unknown	–	–
Scrophulariales	Lentibulariaceae	<i>Utricularia gibba</i>	humped bladderwort	Native	Forb/herb	–	–
Ericales	Ericaceae	<i>Vaccinium arboreum</i>	farkleberry	Native	Tree, Shrub	–	–
Ericales	Ericaceae	<i>Vaccinium formosum</i>	southern blueberry	Native	Shrub	–	–
Ericales	Ericaceae	<i>Vaccinium fuscatum</i>	black highbush blueberry	Native	Shrub	–	–
Rhamnales	Vitaceae	<i>Vitis aestivalis</i> var. <i>aestivalis</i>	summer grape	Native	Vine	–	–
Rhamnales	Vitaceae	<i>Vitis labrusca</i>	fox grape	Native	Vine	–	–
Liliales	Agavaceae	<i>Yucca aloifolia</i>	aloe yucca	Native	Shrub, Tree	–	Rare but Relatively Secure
Sapindales	Rutaceae	<i>Zanthoxylum clava-herculis</i>	Hercules' club	Native	Tree, Shrub	–	–
Cyperales	Poaceae	<i>Zizania aquatica</i> var. <i>aquatica</i>	annual wildrice	Native	Graminoid	–	Poorly Known in NC

¹ Information obtained from the PLANTS database (USDA 2020)² Information obtained from the North Carolina Native Plant Society (Buchanan 2010); Rank 1=Severe Threat; Rank 2=Significant Threat³ Information obtained from the North Carolina Natural Heritage Program (Robinson 2018)

Appendix B. Species Diversity, Abundance, and Woody Stem Metrics Summarized by Broadly Defined Habitats of Cape Hatteras National Seashore

Table B-1. Constancy and average cover class for all vascular plant species observed in 52 Southeast Coast Network vegetation monitoring plots. Broadly Defined Habitat Codes are as follows: MTW = Maritime Tidal Wetlands (six plots); MNW = Maritime Nontidal Wetlands (17 plots); MOU = Maritime Open Uplands (20 plots); and MUFS = Maritime Upland Forests and Shrublands (nine plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	MTW Constancy	MTW Cover	MNW Constancy	MNW Cover	MOU Coonstancy	MOU Cover	MUFS Constancy	MUFS Cover
<i>Acer rubrum</i>	–	–	6	3	–	–	–	–
<i>Agalinis maritima</i> var. <i>grandiflora</i>	17	1	–	–	–	–	–	–
<i>Alternanthera philoxeroides</i>	–	–	6	2	–	–	–	–
<i>Ambrosia artemisiifolia</i>	–	–	12	1	10	2	–	–
<i>Amelanchier canadensis</i>	–	–	12	5	–	–	11	2
<i>Anchistea virginica</i>	–	–	12	2	–	–	11	2
<i>Andropogon</i>	–	–	–	–	–	–	11	2
<i>Andropogon tenuispathus</i>	33	2	41	2	20	1	11	2
<i>Andropogon ternarius</i>	–	–	6	2	5	1	–	–
<i>Andropogon virginicus</i> var. <i>decipiens</i>	–	–	18	2	15	2	44	2
<i>Andropogon virginicus</i> var. <i>virginicus</i>	–	–	–	–	5	2	11	2
<i>Aronia arbutifolia</i>	–	–	12	2	–	–	–	–
<i>Asclepias incarnata</i> var. <i>pulchra</i>	–	–	6	2	–	–	–	–
<i>Asclepias lanceolata</i>	–	–	12	2	–	–	–	–
<i>Baccharis angustifolia</i>	17	1	–	–	–	–	–	–
<i>Baccharis halimifolia</i>	50	2	59	3	10	2	11	1
<i>Bartonia virginica</i>	–	–	6	1	–	–	11	1
<i>Benthamidia florida</i>	–	–	–	–	–	–	22	4
<i>Berchemia scandens</i>	–	–	12	2	–	–	44	2
<i>Boehmeria cylindrica</i>	–	–	29	4	–	–	–	–
<i>Bolboschoenus robustus</i>	–	–	18	2	–	–	–	–
<i>Borrchia frutescens</i>	67	4	6	2	5	1	--	--
<i>Buchnera floridana</i>	–	–	6	2	–	–	–	–
<i>Cakile</i> [edentula + harperi]	–	–	6	1	60	2	–	–
<i>Calamagrostis breviligulata</i> ssp. <i>breviligulata</i>	–	–	6	2	10	2	–	–
<i>Callicarpa americana</i>	–	–	–	–	–	–	22	1
<i>Carex</i>	–	–	18	3	–	–	–	–
<i>Carex comosa</i>	–	–	12	1	–	–	–	–
<i>Carex floridana</i>	–	–	–	–	–	–	22	2
<i>Carex howei</i>	–	–	12	2	–	–	–	–
<i>Carex longii</i>	17	1	35	2	5	1	11	2
<i>Carex lupulina</i>	–	–	12	2	–	–	–	–
<i>Carex muehlenbergii</i>	–	–	–	–	–	–	11	2
<i>Carex seorsa</i>	–	–	6	3	–	–	–	–
<i>Carpinus caroliniana</i> var. <i>caroliniana</i>	–	–	12	2	–	–	44	6
<i>Cenchrus tribuloides</i>	–	–	6	2	60	2	–	–

Table B-1 (continued). Constancy and average cover class for all vascular plant species observed in 52 Southeast Coast Network vegetation monitoring plots. Broadly Defined Habitat Codes are as follows: MTW = Maritime Tidal Wetlands (six plots); MNW = Maritime Nontidal Wetlands (17 plots); MOU = Maritime Open Uplands (20 plots); and MUFS = Maritime Upland Forests and Shrublands (nine plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	MTW Constancy	MTW Cover	MNW Constancy	MNW Cover	MOU Coconstancy	MOU Cover	MUFS Constancy	MUFS Cover
<i>Centella asiatica</i>	50	3	53	2	–	–	44	2
<i>Chamaecrista fasciculata</i>	–	–	6	1	–	–	–	–
<i>Chasmanthium laxum</i>	–	–	12	2	–	–	89	3
<i>Chasmanthium sessiliflorum</i> var. <i>sessiliflorum</i>	–	–	6	2	–	–	11	1
<i>Cicuta maculata</i> var. <i>maculata</i>	–	–	6	3	–	–	–	–
<i>Cirsium horridulum</i> var. <i>horridulum</i>	–	–	29	2	35	2	33	2
<i>Cladium jamaicense</i>	50	2	18	2	–	–	–	–
<i>Commelina erecta</i> var. <i>angustifolia</i>	–	–	18	2	70	2	11	1
<i>Convolvulus soldanella</i>	–	–	–	–	5	2	–	–
<i>Croton punctatus</i>	–	–	6	1	35	4	–	–
Cyperaceae	–	–	–	–	5	1	–	–
<i>Cyperus</i>	–	–	–	–	5	1	11	1
<i>Cyperus croceus</i>	–	–	6	2	–	–	–	–
<i>Cyperus esculentus</i> var. <i>leptostachyus</i>	–	–	–	–	–	–	11	1
<i>Cyperus filicinus</i>	–	–	6	1	–	–	–	–
<i>Cyperus grayi</i>	–	–	–	–	40	2	–	–
<i>Cyperus odoratus</i> var. <i>odoratus</i>	–	–	6	2	–	–	–	–
<i>Cyperus retrorsus</i>	–	–	6	2	5	1	–	–
<i>Cyperus strigosus</i>	–	–	6	2	–	–	–	–
<i>Danthonia sericea</i>	–	–	–	–	–	–	11	1
<i>Desmodium glabellum</i>	–	–	–	–	–	–	11	1
<i>Dichanthelium</i>	–	–	24	2	5	1	11	2
<i>Dichanthelium aciculare</i>	–	–	6	2	–	–	11	2
<i>Dichanthelium acuminatum</i>	–	–	6	2	–	–	11	1
<i>Dichanthelium boscii</i>	–	–	–	–	–	–	11	2
<i>Dichanthelium caeruleum</i>	–	–	12	2	–	–	–	–
<i>Dichanthelium commutatum</i> var. <i>commutatum</i>	–	–	6	1	35	2	56	2
<i>Dichanthelium dichotomum</i> var. <i>dichotomum</i>	–	–	–	–	–	–	11	2
<i>Dichanthelium laxiflorum</i>	–	–	–	–	–	–	11	2
<i>Dichanthelium meridionale</i>	–	–	6	2	25	2	–	–
<i>Dichanthelium scoparium</i>	–	–	6	1	–	–	–	–
<i>Diodia virginiana</i>	–	–	12	2	–	–	–	–
<i>Diospyros virginiana</i>	–	–	18	5	–	–	89	2
<i>Distichlis spicata</i>	67	2	24	2	–	–	–	–
<i>Eleocharis cellulosa</i>	50	3	–	–	–	–	–	–
<i>Eleocharis fallax</i>	33	5	6	4	–	–	–	–
<i>Eleocharis montevidensis</i>	–	–	6	2	–	–	11	2
<i>Eleocharis rostellata</i>	17	1	18	3	–	–	–	–
<i>Elephantopus tomentosus</i>	–	–	–	–	–	–	22	2
<i>Eleusine indica</i>	–	–	–	–	–	–	11	2

Table B-1 (continued). Constancy and average cover class for all vascular plant species observed in 52 Southeast Coast Network vegetation monitoring plots. Broadly Defined Habitat Codes are as follows: MTW = Maritime Tidal Wetlands (six plots); MNW = Maritime Nontidal Wetlands (17 plots); MOU = Maritime Open Uplands (20 plots); and MUFS = Maritime Upland Forests and Shrublands (nine plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	MTW Constancy	MTW Cover	MNW Constancy	MNW Cover	MOU Coonstancy	MOU Cover	MUFS Constancy	MUFS Cover
<i>Elymus halophilus</i>	–	–	6	1	–	–	–	–
<i>Elymus virginicus</i>	–	–	6	1	10	2	–	–
<i>Eragrostis spectabilis</i>	–	–	6	2	45	2	–	–
<i>Eremochloa ophiuroides</i>	–	–	12	3	20	6	–	–
<i>Erianthus giganteus</i>	–	–	–	–	–	–	11	1
<i>Erigeron pusillus</i>	–	–	35	2	95	2	33	2
<i>Euonymus americanus</i>	–	–	–	–	–	–	11	1
<i>Eupatorium capillifolium</i>	–	–	12	2	–	–	–	–
<i>Eupatorium glaucescens</i>	–	–	–	–	–	–	11	2
<i>Eupatorium hyssopifolium</i>	–	–	–	–	–	–	33	1
<i>Eupatorium leucolepis</i>	–	–	6	1	–	–	–	–
<i>Eupatorium pilosum</i>	–	–	6	1	–	–	–	–
<i>Eupatorium rotundifolium</i>	–	–	6	2	–	–	–	–
<i>Euphorbia [bombensis + polygonifolia]</i>	–	–	12	2	85	2	22	2
<i>Eustachys petraea</i>	–	–	29	2	30	2	33	2
<i>Festuca octoflora</i>	–	–	6	2	15	2	–	–
<i>Festuca rubra</i>	17	1	6	1	–	–	–	–
<i>Festuca sciurea</i>	–	–	–	–	20	3	–	–
<i>Fimbristylis caroliniana</i>	33	2	6	1	–	–	11	2
<i>Fimbristylis castanea</i>	83	2	18	2	10	1	11	1
<i>Gaillardia pulchella</i> var. <i>drummondii</i>	–	–	12	3	45	4	–	–
<i>Galactia volubilis</i>	–	–	6	2	10	2	–	–
<i>Galium aparine</i>	–	–	12	2	–	–	–	–
<i>Galium bermudense</i>	–	–	–	–	–	–	22	2
<i>Galium circaezans</i>	–	–	–	–	–	–	11	1
<i>Galium obtusum</i>	–	–	18	1	–	–	22	2
<i>Galium tinctorium</i>	–	–	24	2	–	–	–	–
<i>Galium uniflorum</i>	–	–	–	–	–	–	22	2
<i>Gamochaeta</i>	–	–	6	1	–	–	–	–
<i>Gamochaeta pensylvanica</i>	–	–	–	–	–	–	11	1
<i>Gamochaeta purpurea</i>	–	–	6	1	20	2	11	1
<i>Gelsemium sempervirens</i>	–	–	–	–	–	–	44	2
<i>Glyceria septentrionalis</i>	–	–	18	3	–	–	–	–
<i>Gonolobus suberosus</i> var. <i>suberosus</i>	–	–	–	–	–	–	11	2
<i>Greeneochloa coarctata</i>	–	–	6	3	–	–	–	–
<i>Heterotheca subaxillaris</i>	–	–	12	2	100	3	–	–
<i>Hexasepalum teres</i>	–	–	12	1	50	2	11	2
<i>Hibiscus moscheutos</i>	33	2	12	1	–	–	–	–
<i>Hieracium gronovii</i>	–	–	–	–	–	–	11	1
<i>Hydrocotyle bonariensis</i>	33	3	35	2	95	2	22	2

Table B-1 (continued). Constancy and average cover class for all vascular plant species observed in 52 Southeast Coast Network vegetation monitoring plots. Broadly Defined Habitat Codes are as follows: MTW = Maritime Tidal Wetlands (six plots); MNW = Maritime Nontidal Wetlands (17 plots); MOU = Maritime Open Uplands (20 plots); and MUFS = Maritime Upland Forests and Shrublands (nine plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	MTW Constancy	MTW Cover	MNW Constancy	MNW Cover	MOU Coonstancy	MOU Cover	MUFS Constancy	MUFS Cover
<i>Hydrocotyle umbellata</i>	33	3	24	2	–	–	–	–
<i>Hydrocotyle verticillata</i>	–	–	6	2	–	–	–	–
<i>Hypericum crux-andreae</i>	–	–	–	–	–	–	11	2
<i>Hypericum gentianoides</i>	–	–	6	1	15	2	–	–
<i>Hypericum hypericoides</i>	–	–	12	2	–	–	33	2
<i>Ilex glabra</i>	–	–	6	7	–	–	–	–
<i>Ilex opaca</i>	–	–	6	2	–	–	78	3
<i>Ilex vomitoria</i>	–	–	59	4	40	3	89	5
<i>Ipomoea pandurata</i>	–	–	6	1	5	1	–	–
<i>Ipomoea sagittata</i>	50	2	41	2	5	2	–	–
<i>Iva frutescens</i>	33	3	12	1	10	1	–	–
<i>Iva imbricata</i>	–	–	6	2	45	3	–	–
<i>Juncus</i>	–	–	–	–	5	1	–	–
<i>Juncus biflorus</i>	–	–	6	2	–	–	–	–
<i>Juncus coriaceus</i>	–	–	12	2	–	–	11	1
<i>Juncus dichotomus</i>	–	–	6	2	15	2	67	2
<i>Juncus effusus</i> ssp. <i>solutus</i>	–	–	12	2	–	–	11	1
<i>Juncus megacephalus</i>	50	2	41	2	5	3	22	2
<i>Juncus roemerianus</i>	50	6	35	5	5	1	–	–
<i>Juncus tenuis</i>	–	–	–	–	5	2	–	–
<i>Juniperus [silicicola + virginiana]</i>	33	2	53	6	65	5	100	6
<i>Kosteletzkya pentacarpos</i>	67	5	35	2	–	–	–	–
<i>Krigia virginica</i>	–	–	6	1	–	–	22	1
<i>Lactuca canadensis</i>	–	–	–	–	10	1	–	–
<i>Lactuca graminifolia</i>	–	–	12	2	–	–	–	–
<i>Leersia oryzoides</i>	–	–	24	2	–	–	–	–
<i>Leersia virginica</i>	–	–	12	2	–	–	–	–
<i>Lepidium virginicum</i>	–	–	6	2	35	1	–	–
<i>Lindernia dubia</i>	–	–	–	–	10	2	–	–
<i>Lonicera japonica</i>	–	–	29	2	–	–	–	–
<i>Lorinseria areolata</i>	–	–	–	–	–	–	11	1
<i>Ludwigia</i>	–	–	6	2	–	–	–	–
<i>Ludwigia microcarpa</i>	–	–	24	2	–	–	22	1
<i>Ludwigia repens</i>	–	–	6	2	–	–	–	–
<i>Lycopus angustifolius</i>	–	–	6	2	–	–	–	–
<i>Lythrum lineare</i>	17	2	–	–	–	–	–	–
<i>Magnolia virginiana</i> var. <i>virginiana</i>	–	–	6	1	–	–	–	–
<i>Melica mutica</i>	–	–	–	–	5	1	–	–
<i>Microstegium vimineum</i>	–	–	6	2	–	–	–	–
<i>Mikania scandens</i>	33	2	65	2	–	–	33	2

Table B-1 (continued). Constancy and average cover class for all vascular plant species observed in 52 Southeast Coast Network vegetation monitoring plots. Broadly Defined Habitat Codes are as follows: MTW = Maritime Tidal Wetlands (six plots); MNW = Maritime Nontidal Wetlands (17 plots); MOU = Maritime Open Uplands (20 plots); and MUFS = Maritime Upland Forests and Shrublands (nine plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	MTW Constancy	MTW Cover	MNW Constancy	MNW Cover	MOU Coonstancy	MOU Cover	MUFS Constancy	MUFS Cover
<i>Mitchella repens</i>	–	–	6	1	–	–	56	2
<i>Monarda punctata</i> var. <i>punctata</i>	–	–	–	–	5	3	–	–
<i>Morella cerifera</i>	50	2	88	6	40	4	89	6
<i>Morella pensylvanica</i>	–	–	–	–	15	5	–	–
<i>Muhlenbergia sericea</i>	–	–	18	2	20	2	11	2
<i>Muscadinia rotundifolia</i> var. <i>rotundifolia</i>	–	–	12	2	5	2	89	3
<i>Nekemias arborea</i>	–	–	29	2	–	–	78	2
<i>Nyssa biflora</i>	–	–	6	1	–	–	–	–
<i>Oenothera humifusa</i>	–	–	18	2	100	2	11	2
<i>Oenothera simulans</i>	–	–	6	1	–	–	–	–
<i>Oplismenus setarius</i>	–	–	6	2	–	–	44	3
<i>Opuntia drummondii</i>	–	–	24	2	85	2	33	2
<i>Osmunda spectabilis</i>	–	–	29	3	–	–	11	1
<i>Osmundastrum cinnamomeum</i>	–	–	12	2	–	–	–	–
<i>Panicum</i>	–	–	–	–	–	–	11	1
<i>Panicum amarum</i>	–	–	18	2	90	2	11	1
<i>Panicum virgatum</i> var. <i>spissum</i>	–	–	6	1	–	–	–	–
<i>Parthenocissus quinquefolia</i>	–	–	59	2	25	2	89	2
<i>Paspalum</i>	–	–	18	2	5	1	11	2
<i>Paspalum dilatatum</i> ssp. <i>dilatatum</i>	–	–	–	–	–	–	11	2
<i>Paspalum distichum</i>	–	–	12	2	5	3	–	–
<i>Paspalum notatum</i>	–	–	–	–	5	2	–	–
<i>Paspalum vaginatum</i>	–	–	12	2	–	–	–	–
<i>Passiflora incarnata</i>	–	–	–	–	–	–	11	2
<i>Pattalias palustre</i>	83	3	24	2	20	2	–	–
<i>Persea palustris</i>	33	1	59	4	10	2	89	4
<i>Persicaria densiflora</i>	–	–	6	2	–	–	–	–
<i>Persicaria hydropiperoides</i>	–	–	24	2	–	–	–	–
<i>Persicaria punctata</i>	–	–	18	3	–	–	–	–
<i>Persicaria sagittata</i>	–	–	18	2	–	–	–	–
<i>Phragmites australis</i>	17	4	18	5	–	–	–	–
<i>Phyla lanceolata</i>	50	2	12	2	–	–	–	–
<i>Phyla nodiflora</i> var. <i>nodiflora</i>	–	–	29	2	–	–	11	2
<i>Physalis walteri</i>	–	–	12	2	70	2	33	2
<i>Pinus taeda</i>	–	–	29	3	–	–	100	6
<i>Pityopsis nervosa</i>	–	–	–	–	–	–	44	2
<i>Plantago lanceolata</i>	–	–	–	–	5	2	–	–
<i>Pluchea baccharis</i>	–	–	–	–	–	–	11	2
<i>Pluchea camphorata</i>	–	–	6	2	–	–	–	–
<i>Pluchea foetida</i> var. <i>foetida</i>	–	–	12	2	–	–	–	–

Table B-1 (continued). Constancy and average cover class for all vascular plant species observed in 52 Southeast Coast Network vegetation monitoring plots. Broadly Defined Habitat Codes are as follows: MTW = Maritime Tidal Wetlands (six plots); MNW = Maritime Nontidal Wetlands (17 plots); MOU = Maritime Open Uplands (20 plots); and MUFS = Maritime Upland Forests and Shrublands (nine plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	MTW Constancy	MTW Cover	MNW Constancy	MNW Cover	MOU Coconstancy	MOU Cover	MUFS Constancy	MUFS Cover
<i>Pluchea odorata</i>	17	1	–	–	–	–	–	–
<i>Poa pratensis</i> ssp. <i>pratensis</i>	–	–	6	1	–	–	–	–
<i>Poaceae</i>	17	1	18	2	5	1	22	2
<i>Polypogon monspeliensis</i>	–	–	12	2	–	–	–	–
<i>Proserpinaca palustris</i>	–	–	6	3	–	–	–	–
<i>Prunus caroliniana</i>	–	–	–	–	10	2	–	–
<i>Ptilimnium capillaceum</i>	50	2	12	1	–	–	–	–
<i>Quercus hemisphaerica</i>	–	–	6	2	–	–	56	6
<i>Quercus virginiana</i>	–	–	12	2	10	2	89	6
<i>Rhus copallinum</i> var. <i>copallinum</i>	–	–	–	–	–	–	11	2
<i>Rhynchospora colorata</i>	17	2	12	4	–	–	33	2
<i>Rosa palustris</i>	–	–	24	2	–	–	–	–
<i>Rubus</i>	–	–	18	2	–	–	22	2
<i>Rubus pensilvanicus</i>	–	–	24	2	–	–	–	–
<i>Rubus trivialis</i>	–	–	47	2	20	2	11	2
<i>Sabal minor</i>	–	–	18	2	–	–	67	2
<i>Sabatia stellaris</i>	67	2	12	2	10	1	–	–
<i>Sacciolepis striata</i>	–	–	18	2	–	–	–	–
<i>Salicornia virginica</i>	17	1	–	–	–	–	–	–
<i>Salix caroliniana</i>	–	–	6	6	–	–	–	–
<i>Sanicula canadensis</i> var. <i>floridana</i>	–	–	–	–	–	–	11	2
<i>Schizachyrium littorale</i>	–	–	24	1	20	2	–	–
<i>Schizachyrium scoparium</i> var. <i>scoparium</i>	–	–	6	1	–	–	33	1
<i>Schoenoplectus pungens</i> var. <i>pungens</i>	67	4	35	6	–	–	–	–
<i>Schoenoplectus tabernaemontani</i>	17	2	12	2	–	–	–	–
<i>Scleria</i>	–	–	6	1	–	–	11	1
<i>Scleria flaccida</i>	–	–	–	–	–	–	22	2
<i>Setaria magna</i>	–	–	6	2	–	–	–	–
<i>Setaria parviflora</i>	67	2	29	2	–	–	–	–
<i>Smilax auriculata</i>	–	–	53	4	60	4	78	2
<i>Smilax bona-nox</i>	–	–	71	2	25	2	89	2
<i>Smilax glauca</i>	–	–	6	1	–	–	11	2
<i>Smilax laurifolia</i>	–	–	12	2	–	–	11	1
<i>Smilax rotundifolia</i>	–	–	18	4	–	–	11	2
<i>Smilax smallii</i>	–	–	–	–	–	–	11	1
<i>Smilax walteri</i>	–	–	24	2	–	–	–	–
<i>Solidago fistulosa</i>	–	–	6	3	–	–	–	–
<i>Solidago mexicana</i>	33	2	47	2	40	2	11	1
<i>Solidago odora</i>	–	–	–	–	5	1	–	–
<i>Solidago sempervirens</i>	50	2	41	2	45	2	22	2

Table B-1 (continued). Constancy and average cover class for all vascular plant species observed in 52 Southeast Coast Network vegetation monitoring plots. Broadly Defined Habitat Codes are as follows: MTW = Maritime Tidal Wetlands (six plots); MNW = Maritime Nontidal Wetlands (17 plots); MOU = Maritime Open Uplands (20 plots); and MUFS = Maritime Upland Forests and Shrublands (nine plots). Cover classes are as follows: 1: 0–0.1%, 2: 0.1–1%, 3: 1–2%, 4: 2–5%, 5: 5–10%, 6: 10–25%, 7: 25–50%, 8: 50–75%, 9: 75–95%, 10: 95–100%.

Species	MTW Constancy	MTW Cover	MNW Constancy	MNW Cover	MOU Coconstancy	MOU Cover	MUFS Constancy	MUFS Cover
<i>Spartina alterniflora</i>	50	4	–	–	–	–	–	–
<i>Spartina cynosuroides</i>	–	–	6	1	–	–	–	–
<i>Spartina patens</i>	100	7	82	6	95	4	56	3
<i>Spiranthes cernua</i>	33	2	–	–	–	–	–	–
<i>Sporobolus indicus</i>	–	–	12	2	5	1	–	–
<i>Stellaria media</i>	–	–	6	3	–	–	–	–
<i>Strophostyles helvola</i>	33	2	6	1	45	2	–	–
<i>Swida foemina</i>	–	–	24	6	–	–	44	1
<i>Symphyotrichum simmondsii</i>	–	–	6	1	–	–	–	–
<i>Symphyotrichum subulatum</i>	17	1	–	–	–	–	–	–
<i>Symphyotrichum tenuifolium</i>	17	1	–	–	–	–	–	–
<i>Thelypteris palustris</i> var. <i>pubescens</i>	–	–	29	4	–	–	–	–
<i>Toxicodendron radicans</i> var. <i>radicans</i>	17	1	71	4	25	3	89	2
<i>Triadenum walteri</i>	–	–	6	1	–	–	–	–
<i>Trichostema nesophilum</i>	–	–	6	1	30	2	22	2
<i>Tripsacum dactyloides</i> var. <i>dactyloides</i>	–	–	18	2	–	–	–	–
<i>Typha angustifolia</i>	33	2	6	8	–	–	–	–
<i>Typha latifolia</i>	–	–	18	4	–	–	–	–
<i>Uniola paniculata</i>	–	–	18	4	100	6	22	3
Unknown	–	–	6	2	–	–	–	–
<i>Utricularia gibba</i>	–	–	6	2	–	–	–	–
<i>Vaccinium arboreum</i>	–	–	–	–	–	–	11	4
<i>Vaccinium formosum</i>	–	–	6	4	–	–	22	2
<i>Vaccinium fuscum</i>	–	–	18	2	–	–	22	2
<i>Vitis aestivalis</i> var. <i>aestivalis</i>	–	–	–	–	–	–	33	4
<i>Vitis labrusca</i>	–	–	6	2	10	2	22	2
<i>Yucca aloifolia</i>	–	–	6	1	–	–	–	–
<i>Zanthoxylum clava-herculis</i>	–	–	–	–	10	2	–	–
<i>Zizania aquatica</i> var. <i>aquatica</i>	–	–	6	3	–	–	–	–

Table B-2. Basal area (BA, m²/ha) and density (Den, count/ha) of woody vascular plant species observed in 52 Southeast Coast Network vegetation monitoring plots. Broadly Defined Habitat Codes are as follows: MTW = Maritime Tidal Wetlands (six plots); MNW = Maritime Nontidal Wetlands (17 plots); MOU = Maritime Open Uplands (20 plots); and MUFS = Maritime Upland Forests and Shrublands (nine plots) [Sap—Sapling; Seed—Seedling].

Species	MTW Tree BA	MTW Tree Den	MTW Sap BA	MTW Sap Den	MTW Seed Den	MNW Tree BA	MNW Tree Den	MNW Sap BA	MNW Sap Den	MNW Seed Den	MOU Tree BA	MOU Tree Den	MOU Sap BA	MOU Sap Den	MOU Seed Den	MUFS Tree BA	MUFS Tree Den	MUFS Sap BA	MUFS Sap Den	MUFS Seed Den
<i>Acer rubrum</i>	–	–	–	–	–	–	–	0.03	83	–	–	–	–	–	–	–	–	–	–	–
<i>Amelanchier canadensis</i>	–	–	–	–	–	–	–	0.04	383	221	–	–	–	–	–	–	–	–	–	–
<i>Baccharis halimifolia</i>	–	–	–	–	625	–	–	0.01	92	441	–	–	–	–	–	–	–	–	–	–
<i>Benthamia florida</i>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.09	6	–	–	139
<i>Berchemia scandens</i>	–	–	–	–	–	–	–	–	–	74	–	–	–	–	–	–	–	0.02	56	1389
<i>Carpinus caroliniana</i> var. <i>caroliniana</i>	–	–	–	–	–	0.01	1	0.04	8	74	–	–	–	–	–	0.67	31	0.11	83	1944
<i>Diospyros virginiana</i>	–	–	–	–	–	0.08	3	–	–	515	–	–	–	–	–	–	–	0.00	14	1389
<i>Gelsemium sempervirens</i>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.01	83	2361
<i>Ilex glabra</i>	–	–	–	–	–	–	–	0.01	492	1103	–	–	–	–	–	–	–	–	–	–
<i>Ilex opaca</i>	–	–	–	–	–	–	–	0.00	8	–	–	–	–	–	–	0.28	11	0.00	14	556
<i>Ilex vomitoria</i>	–	–	–	–	–	–	–	0.21	608	4191	–	–	0.00	18	563	–	–	0.48	694	12500
<i>Iva frutescens</i>	–	–	–	–	625	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
<i>Iva imbricata</i>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	375	–	–	–	–	–
<i>Juniperus [silicicola</i> + <i>virginiana</i>]	–	–	–	–	–	1.22	68	0.73	600	882	0.02	1	0.65	527	688	3.90	175	0.42	236	7917
<i>Lonicera japonica</i>	–	–	–	–	–	–	–	0.00	8	735	–	–	–	–	–	–	–	–	–	–
<i>Morella cerifera</i>	–	–	–	–	–	0.06	4	0.79	1808	11397	–	–	0.03	188	63	–	–	0.25	1528	4583
<i>Morella pensylvanica</i>	–	–	–	–	–	–	–	–	–	–	–	–	0.04	152	1000	–	–	–	–	–
<i>Muscadinia rotundifolia</i> var. <i>rotundifolia</i>	–	–	–	–	–	–	–	0.00	8	–	–	–	–	–	–	–	–	0.02	125	7500
<i>Nekemias arborea</i>	–	–	–	–	–	–	–	0.03	183	2353	–	–	–	–	–	–	–	0.00	42	1111
<i>Parthenocissus quinquefolia</i>	–	–	–	–	–	–	–	0.01	267	1029	–	–	0.00	18	188	–	–	0.02	83	6111
<i>Persea palustris</i>	–	–	–	–	–	0.03	3	0.11	308	2941	–	–	0.00	27	–	0.45	17	0.02	153	11250
<i>Pinus taeda</i>	–	–	–	–	–	–	–	0.03	75	–	–	–	–	–	–	8.94	183	0.19	361	4028
<i>Prunus caroliniana</i>	–	–	–	–	–	–	–	–	–	–	–	–	0.00	9	–	–	–	–	–	–
<i>Quercus hemisphaerica</i>	–	–	–	–	–	–	–	–	–	147	–	–	–	–	–	2.58	58	0.06	14	11806

Table B-2 (continued). Basal area (BA, m²/ha) and density (Den, count/ha) of woody vascular plant species observed in 52 Southeast Coast Network vegetation monitoring plots. Broadly Defined Habitat Codes are as follows: MTW = Maritime Tidal Wetlands (six plots); MNW = Maritime Nontidal Wetlands (17 plots); MOU = Maritime Open Uplands (20 plots); and MUFS = Maritime Upland Forests and Shrublands (nine plots) [Sap—Sapling; Seed—Seedling].

Species	MTW Tree BA	MTW Tree Den	MTW Sap BA	MTW Sap Den	MTW Seed Den	MNW Tree BA	MNW Tree Den	MNW Sap BA	MNW Sap Den	MNW Seed Den	MOU Tree BA	MOU Tree Den	MOU Sap BA	MOU Sap Den	MOU Seed Den	MUFS Tree BA	MUFS Tree Den	MUFS Sap BA	MUFS Sap Den	MUFS Seed Den
<i>Quercus virginiana</i>	–	–	–	–	–	–	–	–	–	294	–	–	–	–	938	5.87	203	0.42	236	23056
<i>Salix caroliniana</i>	–	–	–	–	–	0.24	18	0.00	42	–	–	–	–	–	–	–	–	–	–	–
<i>Smilax auriculata</i>	–	–	–	–	–	–	–	0.02	750	1029	–	–	0.01	482	1313	–	–	–	–	694
<i>Smilax bona-nox</i>	–	–	–	–	–	–	–	0.00	175	1324	–	–	0.00	9	563	–	–	0.00	42	4861
<i>Smilax rotundifolia</i>	–	–	–	–	–	–	–	0.00	225	588	–	–	–	–	–	–	–	–	–	–
<i>Smilax smallii</i>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	139
<i>Smilax walteri</i>	–	–	–	–	–	–	–	0.00	167	74	–	–	–	–	–	–	–	–	–	–
<i>Swida foemina</i>	–	–	–	–	–	0.06	6	0.93	658	–	–	–	–	–	–	–	–	–	–	556
<i>Toxicodendron radicans</i> var. <i>radicans</i>	–	–	–	–	–	–	–	0.03	500	28309	–	–	0.00	36	3750	–	–	0.00	28	19583
<i>Vaccinium arboreum</i>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.05	292	278
<i>Vaccinium formosum</i>	–	–	–	–	–	–	–	0.01	75	74	–	–	–	–	–	–	–	–	–	–
<i>Vaccinium fuscatum</i>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	139
<i>Vitis aestivalis</i> var. <i>aestivalis</i>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.02	42	–
<i>Vitis labrusca</i>	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.00	14	139

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