National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Vegetation Mapping at Cape Hatteras National Seashore

Natural Resource Report NPS/SECN/NRR—2014/710



ON THE COVER
The Cape Hatteras Lighthouse
Photograph by Rachel McManamay

Vegetation Mapping at Cape Hatteras National Seashore

Natural Resource Report NPS/SECN/NRR—2014/710

Rachel H. McManamay[1], Sarah Corbett Heath[2], Lisa Baron[1]

[1]USDI National Park Service
Southeast Coast Inventory & Monitoring Network
135 Phoenix Road
Athens, GA 30605

[2]USDI National Park Service
Southeast Coast Inventory & Monitoring Network
Cumberland Island National Seashore
101 Wheeler Street
Saint Marys, Georgia 31558

October 2014

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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 Report Series is used to disseminate high-priority, current natural resource management information with managerial application. The series targets a general, diverse audience, and may contain NPS policy considerations or address sensitive issues of management applicability.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available in digital format from the Southeast Coast Network website website (http://science.nature.nps.gov.im/units/secn), and the Natural Resource Publications Management website (http://www.nature.nps.gov/publications/nrpm/). To receive this report in a format optimized for screen readers, please email irma@nps.gov**.**

Please cite this publication as:

McManamay, R. H., S. C. Heath, and L. Baron. 2014. Vegetation mapping at Cape Hatteras National Seashore. Natural Resource Data Series NPS/SECN/NRR—2014/710. National Park Service, Fort Collins, Colorado.

NPS 603/126787, October 2014

Contents

Page

Figures v
Tables vii
Appendices vii
Executive Summary ix
Acknowledgments xi
Introduction 1
Cape Lookout National Seashore National Battlefield Vegetation Mapping Project 1
The Vegetation Inventory Program 1
Vegetation Inventory Program Standards 1
National Vegetation Classification Standard 2
Federal Geographic Data Committee Standards 3
Methods 5
Study Area 5
Location 5
History 5
Vegetation 5
Climate and Weather 7
Storm Events During Vegetation Mapping 14
Project Scoping and Planning 18
Project Boundary Extent 18
Field Survey 18
Location and Plot Identifiers 20
Environmental Description 20
Vegetation Description 21
Other Ancillary Information Useful to Classification 21
Vegetation Classification 21
Final Map Classifications 22
Digital Imagery and Interpretation 23

Contents (continued)

Page

Aerial Photography Acquisition and Processing 23
Preliminary Photo-Interpretation 26
Field Reconnaissance 26
Photo-Interpretation and Polygon Attribution 26
Field Verification 27
Accuracy Assessment 27
Sampling Design 29
Field Data Collection 31
Data Analysis 31
Results 33
Vegetation Classification 33
Digital Imagery and Interpretation 33
Vegetation Map 34
Map Layer Presentation 36
Accuracy Assessment 38
User's Accuracy (Errors of Commission) 38
Producers' Accuracy (Errors of Omission) 40
Literature Cited 43

Figures

Page

Figure 1. Location of Cape Hatteras National Seashore in eastern North Carolina.....8

Figure 2. Sea-oats Temperate Herbaceous Alliance occurring in the dune zone at Cape Hatteras National Seashore.....9

Figure 3. The invasive common reed, *Phragmites australis*, has become particularly widespread at Cape Hatteras National Seashore.....10

Figure 4. The Atlantic Coast Interdune Swale is a common shrub community to Cape Hatteras National Seashore.....11

Figure 5. An example of maritime forest found at Cape Hatteras National Seashore. 12

Figure 6. The Atlantic Coast Stiff Dogwood Swale, locally called "sedges," may only occur in Buxton Woods within Cape Hatteras National Seashore.....13

Figure 7. Plot of water level data from Oregon Inlet Marina, NC (Station ID 8652587) from the time the imagery was taken (May 2009) to the time ground truthing was performed (April 2012).....14

Figure 8. Total precipitation and maximum wind gusts during Hurricane Irene (NWS Raleigh, NC 2014). 15

Figure 9. Photographs taken pre and post Hurricane Irene on the coast of NC showing the sediment deposition, overwash, and breach formations.....16

Figure 10. Pictures from pre and post Hurricane Irene on coastal NC showing the breaching and land loss that occurred (Images from USGS 2014).....17

Figure 11. Locations of plots sampled in Cape Hatteras National Seashore used for vegetation classification.....19

Figure 12. Example of a vegetation classification plot for the Cape Hatteras National Seashore Vegetation Mapping Project.....20

Figure 13. Flight lines for the 2009 color infrared stereo aerial photograph coverage of Cape Hatteras National Seashore.....25

Figure 14. Locations of accuracy assessment points sampled in Cape Hatteras National Seashore.....30

Figure 15. Vegetation (NVCS, FGDC 1997) and Land Use (Anderson et al. 1976) map classes for Cape Hatteras National Seashore.....37

Tables

Page

Table 1. Example of National Vegetation Classification (NVCS) hierarchy for terrestrial vegetation (FGDC 1997).....3

Table 2. Vegetation height and cover classes used in the Cape Hatteras National Battlefield Vegetation Mapping Project. 21

Table 3. Map classification codes for wetlands derived from the U.S. Fish and Wildlife Service's Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979). 22

Table 4. Fields used in the attribute table of the vegetation polygon layer of the Cape Hatteras National Seashore Mapping Project. 27

Table 5. Standard sample size allocations for accuracy assessment, based on map class area (Lea and Curtis 2010).....29

Table 6. Final vegetation associations of the NVCS used for vegetation mapping (with their assigned Map Codes) in Cape Hatteras National Seashore 33

Table 7. Map classification codes for non-vegetated areas in Cape Hatteras National Seashore, following Land Use and Land Cover Level II (Anderson et al. 1976).....34

Table 8. Summary statistics for the map classes occurring in Cape Hatteras National Seashore. 35

Appendices

Page

Appendix A: Field Survey Form.....47

Appendix B: Descriptions of Vegetation Types 51

Appendix C: Key to the National Vegetation Classification (NVC) Associations That Occur or Potentially Occur at Cape Hatteras and Cape Lookout National Seashores.....201

Appendix D: Photo-Interpretation Guide to the Vegetated Map Classes of Cape Hatteras National Seashore 207

Appendix E: Field Reconnaissance Form.....237

Appendix F: Accuracy Assessment Form.....241

Appendix G: Accuracy Assessment Contingency Table 245

Executive Summary

The Southeast Coast Network (SECN) worked with the support of the National Park Service (NPS) Vegetation Inventory Program (VIP) to describe and map vegetation at Cape Hatteras National Seashore (CAHA). This mapping effort was accomplished through collaboration with the Southeast regional office of NatureServe (Raleigh/Durham, NC).

The mapping area is 11,749 hectares (ha) encompassing the entire boundary of CAHA and an additional buffered area of adjacent lands. NatureServe ecologists identified plant associations for CAHA and a remote sensing specialist from the SECN completed the vegetation mapping using 1:12,000-scale, color infrared aerial photography and digital orthophotography. NatureServe collected vegetation and environmental data from 40 vegetation classification plots, and the remote sensing specialist assessed 111 observation points. Two Student Conservation Association interns hired by the SECN conducted an accuracy assessment (AA), which entailed sampling 450 additional points. Fieldwork and mapping were completed between 2005 and 2014.

A total of 27 map classes were developed to map the vegetation and general land cover of CAHA and surroundings, including the following: 13 map classes representing natural/semi-natural vegetation at the association level in the National Vegetation Classification System (NVCS), and 14 map classes representing non-vegetated units (e.g., open water bodies, buildings, roads, etc.). Features were interpreted using 1:12,000 scale digital color infrared aerial photography (flown 31 May 2009) through heads-up-digitizing in ArcGIS (Version 10.0, © 2010 Environmental Systems Research Institute, Redlands, California). Polygons were mapped to a 0.5-ha minimum mapping unit (MMU).

A geodatabase containing various feature-class layers and tables show the locations of vegetation types and general land cover (vegetation map), vegetation plot samples, AA sites, project boundary extent, and aerial photographic centers. The feature-class layer for the CAHA vegetation map provides 2, 437 polygons of detailed attribute data covering 11,749 ha, with an average polygon size of 3.6 ha. Of the area mapped, 1,924 polygons (79.0% of all polygons) represent natural/semi-natural vegetation types in the NVCS, encompassing 7,402 ha, 63% of the total map extent.

Summary reports generated from the vegetation map layer indicate that the Atlantic Coast Interdune Swale is the most prominent map class in the vegetated landscape (488 polygons covering 2,050 ha), with Needlerush High Marsh also covering a considerable portion of the park (408 polygons totaling 1,273 ha).

A thematic AA study was conducted on the 13 map classes within the boundary of CAHA representing floristic types within the NVCS. Results present an overall accuracy of 80.1% (Kappa statistic = 69.9%) based on data from 450 AA sites.

Products resulting from the CAHA vegetation mapping project include:

Available in this report:

- Project summary of methods and results
- Illustrated photo-interpretation guide
- Detailed descriptions of vegetation associations
- Samples of field forms

Available elsewhere[1]:

- Geodatabase containing map-polygon attribute, aerial photography flight lines, plot data and monument and project boundaries.
- Ground photography of vegetation plots, observation points, and accuracy assessment points in hard copy and digital formats.
- All field data (plot, observation point, and accuracy assessment point) stored in the Microsoft Access PLOTS database.
- Hard copy vegetation maps.
- Hard copy orthophotographs in DOQQ format and stereo aerial photograph prints.
- Metadata for all digital products.

Geospatial products are in the Universal Transverse Mercator (UTM) projection, Zone 17, using the North American Datum of 1983.

[1] Products and additional information can be found at the following website: http://biology.usgs.gov/npsveg/.

Acknowledgments

Funding for this project was provided by the National Park Service Vegetation Inventory Program. The Southeast regional office of NatureServe (Raleigh/Durham, NC) completed the field survey and other tasks associated with the vegetation classification portion of the mapping project. The Southeast Coast Network completed the vegetation mapping and the Student Conservation Association completed the accuracy assessment. Jennifer Asper, University of Georgia, produced the study site map for this report. Special thanks to the staff of Cape Hatteras National Seashore for their cooperation with this project.

Introduction

Cape Lookout National Seashore National Battlefield Vegetation Mapping Project

Cape Hatteras National Seashore (CAHA) Vegetation Mapping project was organized and coordinated by the Southeast Coast Network (SECN) between 2005 and 2012, with assistance from the Southeast regional office of NatureServe for the vegetation classification portion of the project. The purpose of this project was to inventory and map existing plant associations on approximately 10,206 hectares (25,219 acres) of CAHA and a buffered area surrounding the park. The mapping information is provided in written, tabular, digital, and spatial formats that are useful to resource managers, the SECN, and others. The mapping product will serve as a baseline of vegetation information that will assist park natural- and cultural-resource stewardship. The identification and description of plant communities also provides habitat information important to understanding associated organisms (reptiles, amphibians, mammals, etc.) and providing inference to the location and abundance of species that are characteristic of each community.

The Vegetation Inventory Program

The Vegetation Inventory Program (VIP) is an effort by the National Park Service (NPS) to classify, describe, inventory, and map vegetation communities in more than 280 national park units across the United States. The primary objective of the VIP is to produce high-quality, standardized maps and associated data sets of vegetation and other land cover occurring within parks. Since vegetation species and communities are unique from park to park, the inventory of these resources assists park managers on a wide array of management issues. For more information about the Vegetation Inventory Program, visit http://science.nature.nps.gov/im/inventory/veg/index.cfm.

Vegetation Inventory Program Standards

The NPS and VIP established guidance and standards for all vegetation mapping projects in a series of documents:

Protocols

- National Vegetation Classification System (TNC and ESRI 1994a, NatureServe 2003)
- Field methods and mapping procedures (TNC and ESRI 1994b)
- Statistically rigorous and consistent accuracy assessment procedures (ESRI and TNC 1994, Lea and Curtis 2010)
- Guidelines for using existing vegetation data (TNC 1996)

Standards

- The National Vegetation Classification Standard (FGDC 1997, FGDC 2008, NatureServe 2009)
- Spatial Data Transfer Standard (FGDC 1998b)
- Content Standard for Digital Geospatial Metadata (FGDC 1998a)

- United States National Map Accuracy Standards (USGS 1999)
- Integrated Taxonomic Information System (U.S. Department of Agriculture)
- Program-defined standards for map attribute accuracy and minimum mapping unit

National Vegetation Classification Standard

The National Vegetation Classification Standard (NVCS) is the mapping standard used in SECN vegetation mapping projects. The NVCS, adopted by the Federal Geographic Data Committee (FGDC 1997), evolved from work conducted by The Nature Conservancy, NatureServe, and the Natural Heritage Program network over more than two decades. The NVCS standard supports the development and use of a consistent national vegetation classification throughout the NPS and other organizations. Such a standard facilitates the production of uniform statistics about vegetation resources across the nation and makes cooperation on vegetation management issues across jurisdictional boundaries possible (Grossman et al. 1998). The FGDC Vegetation Subcommittee works to keep the standard relevant and current. Revisions made to the upper levels of the NVCS hierarchy adopted by the Vegetation Subcommittee as Version 2 (FGDC 2008) were not used in this project since the crosswalks for vegetation associations were unavailable at the time this project began.

Vegetation classification systems attempt to recognize and describe repeating assemblages of plants in similar habitats. The NVCS is a hierarchical system that incorporates physiognomic characters and floristic data to define seven levels of terrestrial vegetation classification. The five upper levels (class, subclass, group, subgroup, and formation) are based on physiognomic features. The two lower levels (alliance and association) are distinguished by differences in floristic composition. The physiognomic units have a broad geographic perspective and the floristic units have utility in local and site-specific applications (Grossman et al. 1998). The physiognomic levels of the NVCS are based on physical, structural, and environmental characteristics identifiable from satellite imagery, aerial photography, or ground observations (Table 1). Specific criteria defining these physiognomic units are based on ecologic characteristics that vary among major vegetation groups (FGDC 1997).

The alliance and association levels form the base of the NVCS hierarchy and are determined by the most abundant or diagnostic species comprising the various layers of a homogenous vegetation community. An association is here defined as a plant community type with a consistent species composition, uniform physiognomy, and similar habitat conditions (Flahault and Schroter 1910). Species composition differentiates associations (TNC and ESRI 1994a). An alliance is "a physiognomically uniform group of plant associations sharing one or more dominant or diagnostic species which, as a rule, are found in the uppermost strata of the vegetation" (Reid and Comer 1998). NatureServe coordinates plant association data for the SECN vegetation mapping projects. Associations are added to the NVCS and older concepts are refined as new data become available.

For more information about the NVCS, see the USGS-NPS Vegetation Mapping Program standards (http://biology.usgs.gov/npsveg/standards.html) or Grossman et al. (1998).

Table 1. Example of National Vegetation Classification (NVCS) hierarchy for terrestrial vegetation (FGDC 1997).

Level	Criteria Delineating Level	Example
Class	Structure (height, cover) of dominant vegetation strata.	Forest
Subclass	Growth form characteristics including leaf type (evergreen, deciduous) for woody plants and persistent (perennial, annual) herbaceous species.	Evergreen forest
Group	Leaf morphology (broad leaf, microphyllous, xeromorphic), leaf phenology, and climatic conditions.	Temperate or subpolar needle-leaved evergreen forest
Subgroup	Relative degree of human disturbance.	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest
Formation	Additional physiognomic characteristics, general environmental conditions, relative landscape position, and hydrologic regimes.	Rounded-crowned temperate or subpolar needle-leaved evergreen forest
Alliance	Dominant or diagnostic species of uppermost or dominant stratum.	*Pinus taeda* Forest Alliance
Association	Other dominant or diagnostic species from any stratum.	*Pinus taeda/Liquidambar styraciflua-Acer rubrum var. rubrum/Vaccinium stamineum* Forest

Federal Geographic Data Committee Standards

In addition to vegetation classification, the FGDC sets standards for map spatial accuracy and for metadata employed in NPS vegetation mapping projects. Standards for map products stipulate map scales of 1:24,000 or finer, and minimum polygon size of 0.5 hectare (1.24 ac). Positional accuracy for vegetation maps must meet National Map Accuracy Standards, which specify horizontal errors of less than 10.2 meters (33.5 ft) on the ground for 1:12,000-scale maps.

All digital vegetation products resulting from this project are accompanied by FGDC-compliant metadata. Metadata are “data about the data,” and describe the content, quality, condition, and other characteristics of the spatial dataset. Metadata are critical elements that expedite the interpretation and exchange of information among users.

Methods

Study Area

Location

Just east of the North Carolina mainland are the barrier islands that comprise the Outer Banks. Cape Hatteras National Seashore (CAHA) protects the northernmost-section of this barrier island system and is part of the Outer Banks Group of parks which includes Fort Raleigh National Historic Site (FORA) and Wright Brothers National Memorial (WRBR); however, only CAHA was included for this mapping effort. Pea Island National Wildlife Refuge, located within the Seashore's administrative boundary, is managed by the U.S. Fish and Wildlife Service and was also included in this mapping effort. CAHA is located in Dare and Hyde Counties within the Atlantic Coastal Plain physiographic province (Figure 1).

History

Cape Hatteras stretches north to south across three islands, Bodie Island, Hatteras Island, and Ocracoke Island. North Carolina State Highway 12, a narrow, paved road, and Hatteras Inlet ferry link the islands. In 1937, Congress authorized the creation and establishement of Cape Hatteras National Seashore – America's first national seashore park. However, the park was not actually established until January 1953 when the National Park Service possesses sufficient land to meet legal requirements (Binkley 2007). Today the Seashore covers nearly 70 miles from just south of Nags Head to the village of Ocracoke.

Vegetation

CAHA was established to preserve significant segments of barrier islands along North Carolina's stretch of the Atlantic coast. Barrier islands are narrow, low-lying dynamic landforms which parallel ocean coasts, are separated from the mainland, and are constantly moving and reshaping in response to storms, ocean currents, sea level changes, and wave and wind action. These processes continue to influence the islands today through processes of erosion and accretion to shoreline; overwash across the islands; and the formation, migration, and closure of the inlets. These forces of nature have caused the vegetation communities on the island to be in a near constant state of change (information from http://www.nps.gov/caha/naturescience/index.htm).

In addition to natural processes, human activities on the island have also been significant factors influencing vegetation. Some of these activities include early efforts at mosquito control and waterfowl management, which involved excavation of drainage ditches and construction of water control structures as well as the construction and vegetative stabilization of primary dunes along the length of the Seashore. The artificial stabilization of the dunes and the protective maintenance of North Carolina State Highway 12 have altered natural barrier island processes such as westward migration, overwash, and dune development. Additional anthropogenic stressors include the introduction and expansion of non-native plants, feral hogs (*Sus scrofa*) rooting damage, and over-browsing by white-tailed deer (*Odocoileus virginianus*) (information from http://www.nps.gov/caha/naturescience/index.htm and Byrne et al. 2012.)

Beach and Dunes Vegetation

Vegetative cover on the beach and dunes is variable, depending on the amount of exposure to wave and wind action. Many of the plant species found in these areas are well-adapted to these harsh conditions. On the upper beach, vegetation cover is a sparse (20% cover) monoculture of American searocket (*Cakile edentula ssp. edentula*). Seabeach amaranth (*Amaranthus pumilus*), a federally-listed threatened species, may occur here. Vegetative cover on dune slopes ranges from sparse to dense (30-80% cover) and may include some or all of the following species: seaoats (*Uniola paniculata*) (Figure 2), shore little bluestem (*Schizachyrium littorale*), saltmeadow cordgrass (*Spartina patens)*, largeleaf pennywort (*Hydrocotyle bonariensis*) firewheel (*Gaillardia pulchella*), lanceleaf greenbrier (*Smilax smallii*), and prickly pear cactus (*Opuntia pusilla*) (information taken from http://www.nps.gov/caha/naturescience/plants.htm).

Wetland Vegetation

Large and small ponds, wetlands, and marshes occur throughout the Seashore and have variable vegetation cover. Among the commonly encountered species are: southern cattail (Typha domingensis), inland saltgrass (*Distichlis spicata*), Jamaica swamp sawgrass (*Cladium mariscus)*, marsh fimbry (*Fimbristylis castanea*), largeleaf pennywort, needlegrass rush (*Juncus roemerianus*), saltmeadow cordgrass, sturdy bulrush (Schoenoplectus robustus), marsh bristlegrass (*Setaria parviflora*), seaside goldenrod (*Solidago sempervirens*), perennial saltmarsh aster (*Symphyotrichum tenuifolium*), and eastern annual saltmarsh aster (*Symphyotrichum subulatum*). Large areas of intermittently-flooded brackish flats within the Seashore are infested with common reed (*Phragmites australis*), an exotic invasive plant (Figure 3). The dominance of common reed in many tidal wetlands today often indicates human-induced disturbance, either through direct habitat manipulation or through passive introduction of this species to naturally disturbed sites. Common reed can completely dominate areas, excluding native wetland plant species (information taken from http://www.nps.gov/caha/naturescience/plants.htm).

Shrub Thickets

Many different types of shrub thickets can be found throughout the Seashore, each of which is characterized by having moderate to very dense (50-90% cover) vegetative cover. Each of the different shrub thickets types is dominated by one of the following species: salt-pruned live oak (*Quercus virginiana*), southern red cedar (*Juniperus virginiana var. silicicola*), wax myrtle (*Morella cerifera*) (Figure 4), eastern baccharis (*Baccharis halimifolia*), yaupon (*Ilex vomitoria*), Jesuit's bark (*Iva frutescens*), or bushy seaside tansy (*Borrichia frutescens*). Some patches of shrub thicket may be blanketed in thick vines, such as earleaf greenbrier (*Smilax auriculata*), peppervine (*Ampelopsis arborea*), saw greenbrier (*Smilax bona-nox*), or eastern poison ivy (*Toxicodendron radicans*). Within the Seashore, marshlands are typically bounded by shrub thickets which often also qualify as wetlands as defined by the National Park Service and the US Army Corps of Engineers (information taken from http://www.nps.gov/caha/naturescience/plants.htm).

Forests

Maritime forests (Figure 5) are characterized by having moderate to dense vegetative cover, dominated by live oak or loblolly pine and many of the following species in the tree sub-canopy and shrub layers: black cherry (*Prunus serotina*), red bay (*Persea borbonia*), Darlington oak (*Quercus hemisphaerica*), buckthorn bully (*Sideroxylon lycioides*), blackgum (*Nyssa sylvatica*), American holly (*Ilex opaca*), swamp bay (*Persea palustris*), wax myrtle, yaupon, black highbush blueberry (*Vaccinium fuscatum*), and blue huckleberry (*Gaylussacia frondosa*). Vines commonly found in

patches of maritime forest include Virginia creeper (*Parthenocissus quinquefolia*), saw greenbrier, eastern poison ivy, muscadine (*Vitis rotundifolia*), peppervine (*Ampelopsis arborea*), and climbing hempvine (*Mikania scandens*). The ground surface may be thick with pine needles, leaves, or moderately vegetated with herbaceous species including beaked spikerush (*Eleocharis rostellata*), bushy seaside tansy, blood panicgrass (*Dichanthelium consanguineum*), largeleaf pennywort, needlegrass rush, royal fern (*Osmunda regalis*). On Hatteras Island, Buxton Woods is an excellent example of the naturally-occurring, Atlantic coast maritime evergreen forest vegetation community. Interspersed within the maritime evergreen forest are pockets of wetland swales locally called "sedges" which are thought to only occur at Buxton Woods. These sedges are dominated by stiff dogwood (*Cornus foemina)* with dense thickets of Alabama supplejack (*Berchemia scandens*) (Figure 6). Elsewhere in the Seashore, plantations of pines (loblolly pine, slash pine [*Pinus elliottii*], or maritime pine [*Pinus pinaster*]) were established in the early to mid-1900s to reduce erosion and migration of beach sands (information taken from http://www.nps.gov/caha/naturescience/plants.htm).

Climate and Weather

Summer months at CAHA are hot and humid, though can be moderated somewhat by ocean breezes. The mean monthly maximum temperature in July ranges 29.1–31.0º C (84.4–86.0º F; 1961-1990). Winter months at CAHA are typically mild with only brief cold spells. The mean monthly minimum temperate in January ranges 0.1–2.0º C (32.2–35.6º F; 1961-1990). Precipitation mostly comes in the form of rain from storm fronts in winter and spring months, and from thunderstorms, tropical storms, and hurricanes in the summer and fall months. CAHA receives an average precipitation amount that ranges 1,200-1,600 millimeters/year (47.2 – 63.0 in/year; 1961-1990; Davey et al. 2007).

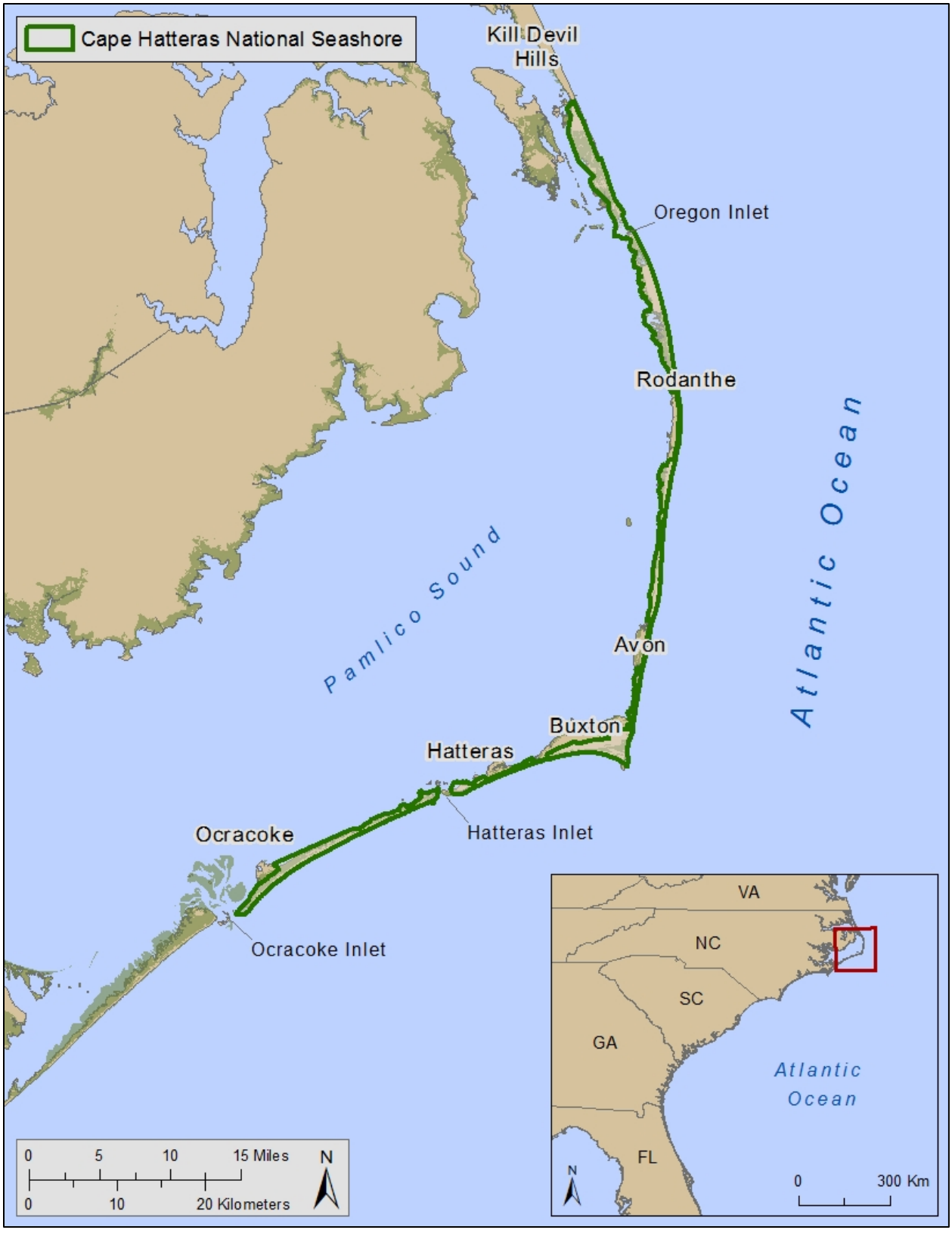


Figure 1. Location of Cape Hatteras National Seashore in eastern North Carolina.



Figure 2. Sea-oats Temperate Herbaceous Alliance occurring in the dune zone at Cape Hatteras National Seashore.



Figure 3. The invasive common reed, *Phragmites australis*, has become particularly widespread at Cape Hatteras National Seashore.



Figure 4. The Atlantic Coast Interdune Swale is a common shrub community to Cape Hatteras National Seashore.



Figure 5. An example of maritime forest found at Cape Hatteras National Seashore.



Figure 6. The Atlantic Coast Stiff Dogwood Swale, locally called “sedges,” may only occur in Buxton Woods within Cape Hatteras National Seashore.

Storm Events During Vegetation Mapping

During the time period from when the photography was taken (May 2009) and when the ground truthing was conducted (April 2012), there were two events where the water level data was abnormal. Using the water level data from the Oregon Inlet Marina (station ID 8652587, Figure 7), the two events are shown during August 28th, 2011 and February 5-28th, 2012.

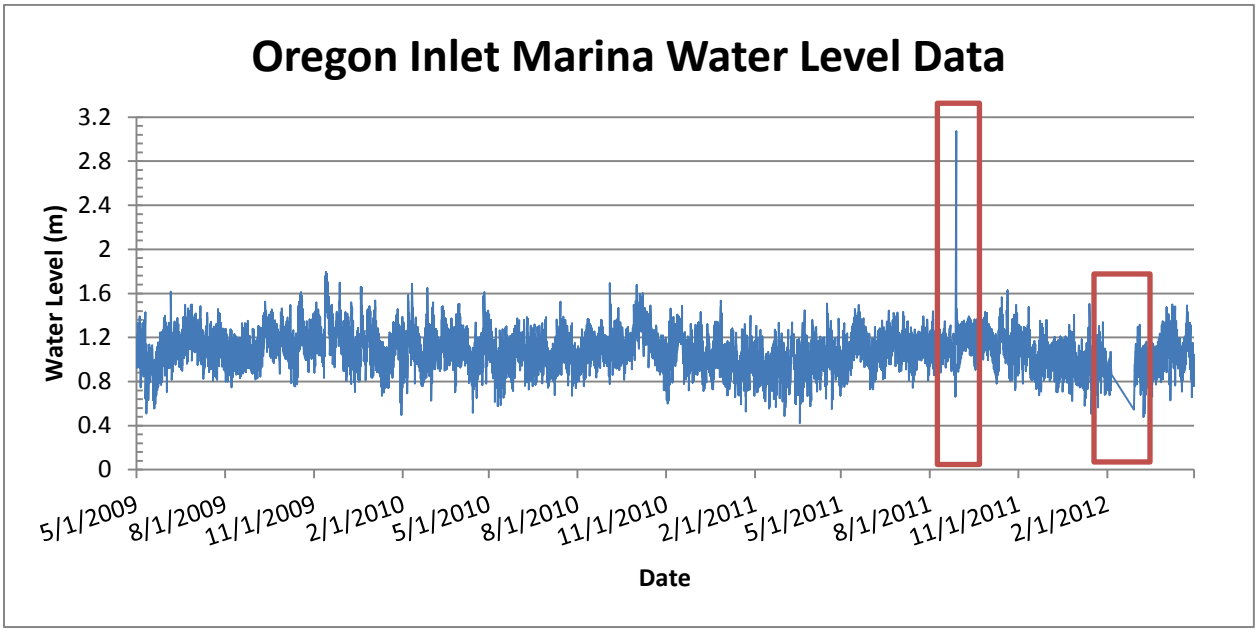


Figure 7. Plot of water level data from Oregon Inlet Marina, NC (Station ID 8652587) from the time the imagery was taken (May 2009) to the time ground truthing was performed (April 2012). The red boxes represent two events in the water level data, which includes Hurricane Irene (August 28th, 2011) and a winter storm (February 5-28th, 2012).

Hurricane Irene impacted the North Carolina coast on August 28th, 2011 and brought 4-12 inches of rain and 70+ mph winds to the CAHA study area (Figure 8). A winter storm brought low temperatures during February 5-28th, 2012, which resulted in a lack of water level data. The winter storm mainly brought snow to Northwest Georgia, but the effects of Hurricane Irene in the CAHA study area may have potentially impacted the ground truthing that occurred in April 2012.

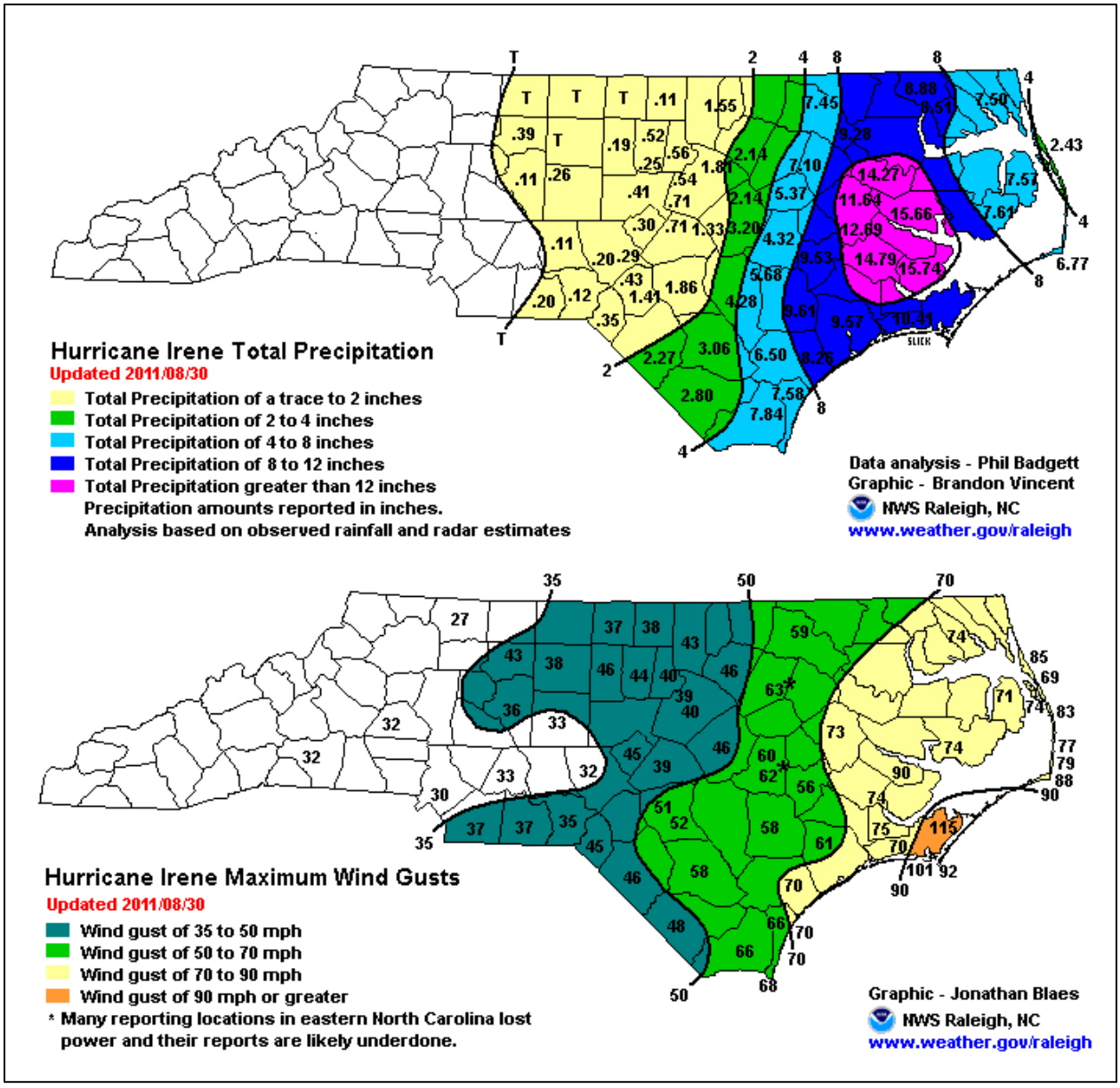


Figure 8. Total precipitation and maximum wind gusts during Hurricane Irene (NWS Raleigh, NC 2014).

Previous research has shown that storm surge can redistribute sediments in coastal wetlands through deposition, erosion, compaction, and change in the vegetated substrate (Morgan et al. 1958; Cahoon et al. 1995; Guntenspergen et al. 1995; Nyman et al. 1995; Risi et al. 1995; Cahoon 2006). Additionally, storm surge can tear and fold marshes, laterally moving the marsh (Cahoon 2006), which would convert an area remotely identified as marsh into open water. Land loss due to hurricane impacts along the coast of Louisiana has been analyzed and discriminated as persistent or temporary, where the majority of the land lost was persistent after 4 years (Palaseanu-Lovejoy, et al. 2013).

Other potential impacts of Hurricane Irene to the ground truhing are overwash and the creation of channels, i.e. breaching. In terms of vegetation characterization, these processes would influence the

ground trothing. For example, an area that was once vegetated may be covered by sand (Figure 9). Additionally, breaching will convert once-vegetated or barren areas to water (Figure 10).



Figure 9. Photographs taken pre and post Hurricane Irene on the coast of NC showing the sediment deposition, overwash, and breach formations. (Images are from USGS 2014)



Figure 10. Pictures from pre and post Hurricane Irene on coastal NC showing the breaching and land loss that occurred (Images from USGS 2014).

Project Scoping and Planning

In 2005, the SECN proposed to develop vegetation classification and maps for 16 parks: Cape Hatteras National Seashore, Cape Lookout National Seashore, Moores Creek National Battlefield, Fort Sumter National Monument, Fort Pulaski National Monument, Fort Frederica National Monument, Cumberland Island National Seashore, Fort Matanzas National Monument, Timucuan Ecological and Historic Preserve, Fort Caroline National Monument, Castillo de San Marcos National Monument, Canaveral National Seashore, Ocmulgee National Monument, Horseshoe Bend National Military Park, Kennesaw Mountain National Battlefield Park, and Chattahoochee River National Recreation Area. The SECN teamed with the Southeast regional office of NatureServe to complete this project. NatureServe's role was to collect field data and develop the local association descriptions and the field key to map classes for each of the parks. The SECN agreed to complete the photographic interpretation/image analysis, digital map and database development, accuracy assessment, metadata, and final reports in-house.

Project Boundary Extent

The SECN determined that the CAHA vegetation mapping boundary extent should include the entire area within the park plus an additional buffer surrounding the park boundary of 50 meters (164 ft). Therefore, the total map extent is 11,749 ha, with 10,186 ha occurring within park boundaries and the remaining 1,536 ha occurring outside of park boundaries.

Field Survey

Prior to field work, NatureServe compiled a list of preliminary vegetation associations and alliances likely to occur in CAHA. Published floristic information, the plant species list of CAHA, and expert local knowledge, including NPS staff at CAHA and North Carolina Natural Heritage Program ecologists, were used to refine the list. The preliminary list of associations was useful for planning, estimating the amount of field work necessary, and for assigning provisional names to vegetation plots and observation points.

Plots were placed non-randomly in such a way as to sample as many of the vegetation associations as possible given the minimum number of plots for the project (C. Nordman, pers. comm., 21 Feb. 2011). Plots were deliberately placed in certain areas in order to capture the diversity of vegetation communities at the park. Plot size was variable (e.g., 10 m × 30 m, 15 m × 20 m, 20 m × 20 m, 20 m × 40 m, 20 m × 50 m) and decided at the time of sampling based on which dimension would most adequately characterize the vegetation sampled in each plot. Forty plots were sampled in CAHA in October 2005 and June 2006 (Figure 11).

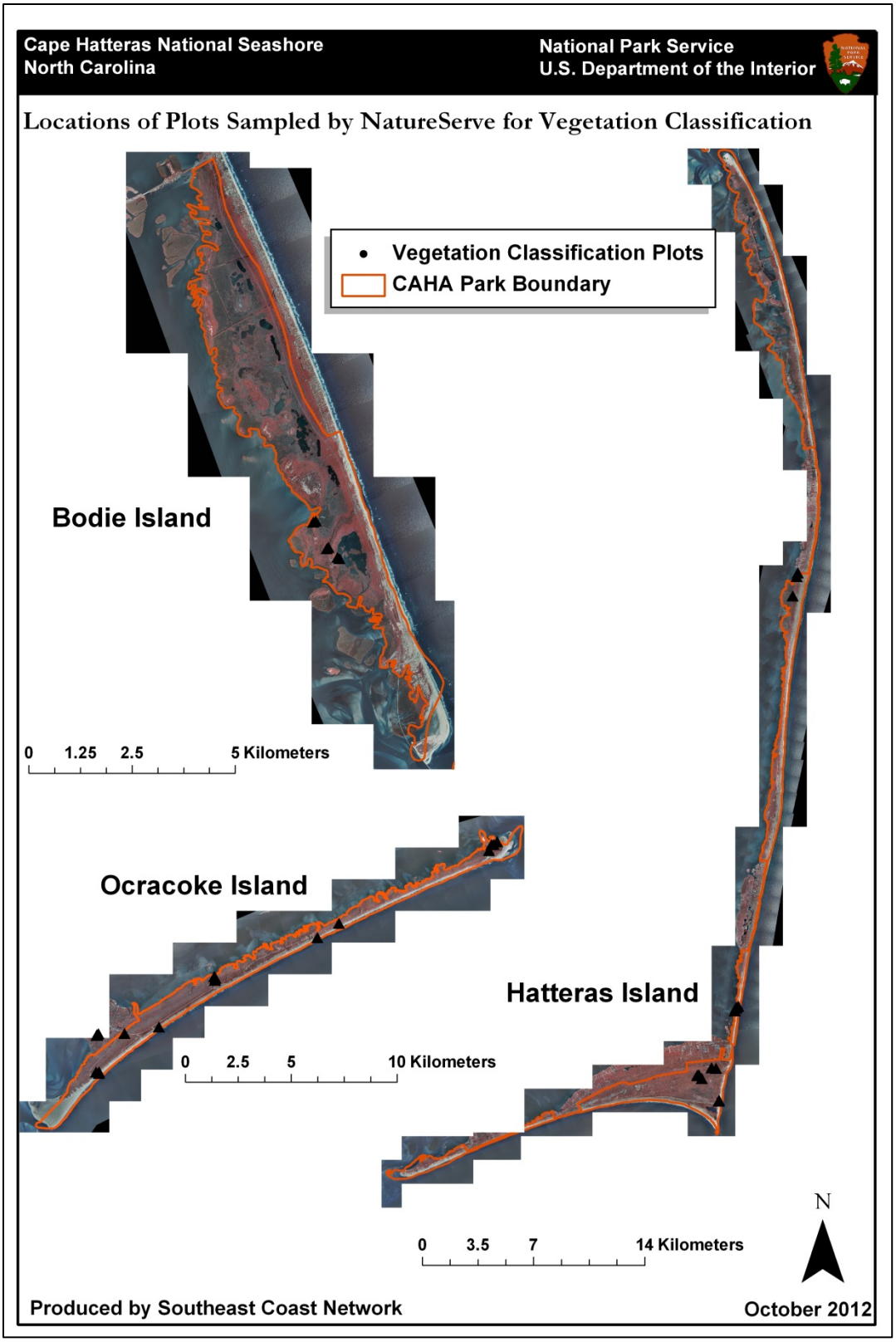


Figure 11. Locations of plots sampled in Cape Hatteras National Seashore used for vegetation classification.

Within each plot, field staff estimated and recorded an array of vegetation and environmental data using the field form featured in Appendix A. The following four categories of data were collected for vegetation plots: *Location and Plot Identifiers, Environmental Description, Vegetation Description,* and *Other Ancillary Information Useful to Classification*.

Location and Plot Identifiers

The locations of the vegetation plots were not permanently marked. The bounds of each plot were marked temporarily using measuring tapes (Figure 12). The Universal Transverse Mercator (UTM) coordinates at the center of each lot were recorded (Zone 18, NAD83) on Garmin® hand-held GPS receivers.



Figure 12. Example of a vegetation classification plot for the Cape Hatteras National Seashore Vegetation Mapping Project.

Environmental Description

The physical characteristics of each plot were documented in both categorical and narrative fields. These characteristics included physical site features (elevation, slope, aspect, topography), hydrology, geology, and soils. Description of the ground surface included an estimate of the cover of rocks, sand, litter, bare soil, biological soil crust, moss, and lichen. A narrative field was provided for

a general description of the plot setting and the influence of disturbance and hydrology on the vegetation.

Vegetation Description

Every vascular plant was assigned to one of eight physiognomic strata. Within each stratum, the investigator recorded the height class for the most abundant species (Table 2). Percent abundance, based on a cover class percentage, for each species present in the plot was also recorded (Table 2). Field crews also recorded percent canopy cover by species.

Table 2. Vegetation height and cover classes used in the Cape Hatteras National Battlefield Vegetation Mapping Project.

Code	Height Scale (m)	Cover Class %
1	< 0.5	Trace
2	0.5 - 1.0	0.1 - 1
3	1.0 - 2.0	1.0 - 2.0
4	2.0 - 5.0	2.0 - 5.0
5	5.0 - 10.0	5.0 -10.0
6	10.0- 15.0	10.0-25.0
7	15.0 - 20.0	25.0 -50.0
8	20.0 - 35.0	50.0 - 75.0
9	35.0 - 50.0	75.0 -95.0
10	> 50.0	> 95

Other Ancillary Information Useful to Classification

Field crews optionally recorded how well the plot represented the vegetation of the surrounding area, site disturbance history, and the overall character of the vegetation features of each plot.

Vegetation Classification

Plot data were manually entered into the NatureServe PLOTS Database Version 3.0, a Microsoft Access database designed for the NPS VIP (NatureServe 2010). The PLOTS database was designed specifically for the NPS vegetation and mapping program so that the electronic data entry fields mirror the standard field form. Data entry was facilitated by assigning each plant taxon a unique, standardized code and name based on the PLANTS database developed by the Natural Resources Conservation Service in cooperation with the Biota of North America Program (USDA and NRCS 2009). Data were thoroughly proofed after entry to minimize errors.

Cluster analysis techniques that have been traditionally used in other vegetation mapping projects to generate vegetation classifications were not used for CAHA. Instead, plots were assigned to an existing vegetation association based on a cursory overview of their best fit according to species composition (R.White, pers. comm., 25 March 2011). The vegetation associations and descriptions can be found on the NatureServe Explorer (see http://www.natureserve.org/explorer/index.htm; NatureServe 2009).

Final Map Classifications

Once the associations were finalized, a dichotomous key, that was originally developed by NatureServe and later revised by the SECN (Appendix C), was finalized. The full NVCS hierarchical classification and global descriptions are available in Appendix B. CAHA specific vegetation (i.e., local) descriptions were written based on CAHA plot data. In addition, the final associations were linked to map classes for use in the photo-interpretation and mapping portions of the project. We assigned a map class code merely for ease of assigning information to polygons and for display purposes for the photo-interpreter.

For non-vegetated features (e.g., open water bodies, structures, etc.), we derived map classes from Level II of the Land Use and Land Cover Classification System (Anderson et al. 1976). The 'Commercial and Services' category was used to characterize areas of the park containing park buildings and facilities. The 'Residential' category was used for private residences outside of park boundaries within the environs of the project mapping boundary. The 'Transportation, Communications, and Utilities' category was used to characterize roads within the mapping boundaries. The "Cropland and Pasture" category was used for the pony pen area on Ocracoke Island.

We further classified vegetated wetlands (natural/semi-natural vegetation) to the System Level of the U.S. Fish and Wildlife Service's Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979; Table 3).

Table 3. Map classification codes for wetlands derived from the U.S. Fish and Wildlife Service's Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979).

Map Class Code from U.S. Fish and Wildlife Wetland Classification	General Explanation of Wetland Systems
Upland	Non-Wetlands
Marine	Open ocean overlying the continental shelf and its associated high energy coastline.
Estuarine	Deepwater tidal habitats and adjacent tidal wetlands in which ocean water is at least occasionally diluted by freshwater runoff from the land.
Riverine	Wetlands and deepwater habitats contained within channels, except where wetlands are dominated by vegetation or where salinity exceeds 0.5%.
Lacustrine	Wetlands and deep water habitats situated in a topographic depression or dammed river channel, lacking vegetation with greater than 30% aerial coverage, total area exceeds 8 ha.
Palustrine	All non-tidal wetlands dominated by vegetation and all such wetlands that occur in tidal areas where salinity is below 0.5%.

Digital Imagery and Interpretation

Aerial Photography Acquisition and Processing

The SECN contracted with Aero-Metric Inc., through the USGS Rolla, Missouri office to provide color infrared aerial photographs. Color infrared (CIR) imagery was chosen because healthy green vegetation is a very strong reflector of infrared radiation and appears bright red in color infrared imagery, which helps tremendously in vegetation mapping efforts. This set of photography covered the full project boundary extent plus a buffer surrounding the boundary of 500 meters. The flight path and centers of the aerial photo mission were planned with 60% forward-lap and 30% side-lap in order to assure stereo viewing (Figure 13). Airborne GPS data were provided by Aero-Metric, Inc, as were ground-check point data. The project was referenced to the North American Datum of 1983/2007 (NAD83/07), Universal Transverse Mercator Zone 17 horizontally and to the North American Vertical Datum of 1988 vertically. The aerial photographs were taken on 31 May 2009 at a scale of 1:12,000. The calibration focal length for the photos was 152.823 mm. Contact prints of the CIR imagery were created for use in the field, and diapositives of the CIR set were created for photo-interpretation. Scanned images (13 micron) were processed to 0.3 meter (1.0 ft) resolution and provided in a digital orthophotograph mosaic. The scanned imagery was rectified through an aerotriangulation process. The scanned images, Airborne Global Positioning System (ABGPS) data, ground-check point data, and camera calibration data were used as inputs to the Zeiss/Intergraph ImageStationAutomatic Triangulation (ISAT) softcopy program. ISAT correlated image points are aerotriangulated in a block of images to create the exposure station exterior orientations. Three ground-check points were manually measured on the imagery. All of these points had vertical and horizontal coordinates. Statistics associated with the aerotriangulation bundle adjustment are as follows (Note: these statistics are for both Cape Hatteras National Seashore and Cape Lookout National Seashore, since the imagery was flown together for both of these parks):

Statistics pertaining to the analytical aerotriangulation bundle adjustment are as follows:

1) 500 photographs (206 photos were aerotriangulated and 294 photos were held with original IMU angles due to water models)
2) 7734 image points
3) 10 Horizontal and Vertical ground checks points
4) 6.3 microns image sigma
5) 8532 degrees of freedom
6) Root mean square error of residuals for 10 ground-check points:
    a) 0.156 meters for horizontal-control eastings
    b) 0.115 meters for horizontal-control northings
    c) 0.225 meters for vertical control

7) Root mean square error of residuals for 419 ABPGS exposure station control points:

   a) 0.012 meters for horizontal-control eastings

   b) 0.012 meters for horizontal-control northings

   c) 0.161 meters for vertical control.

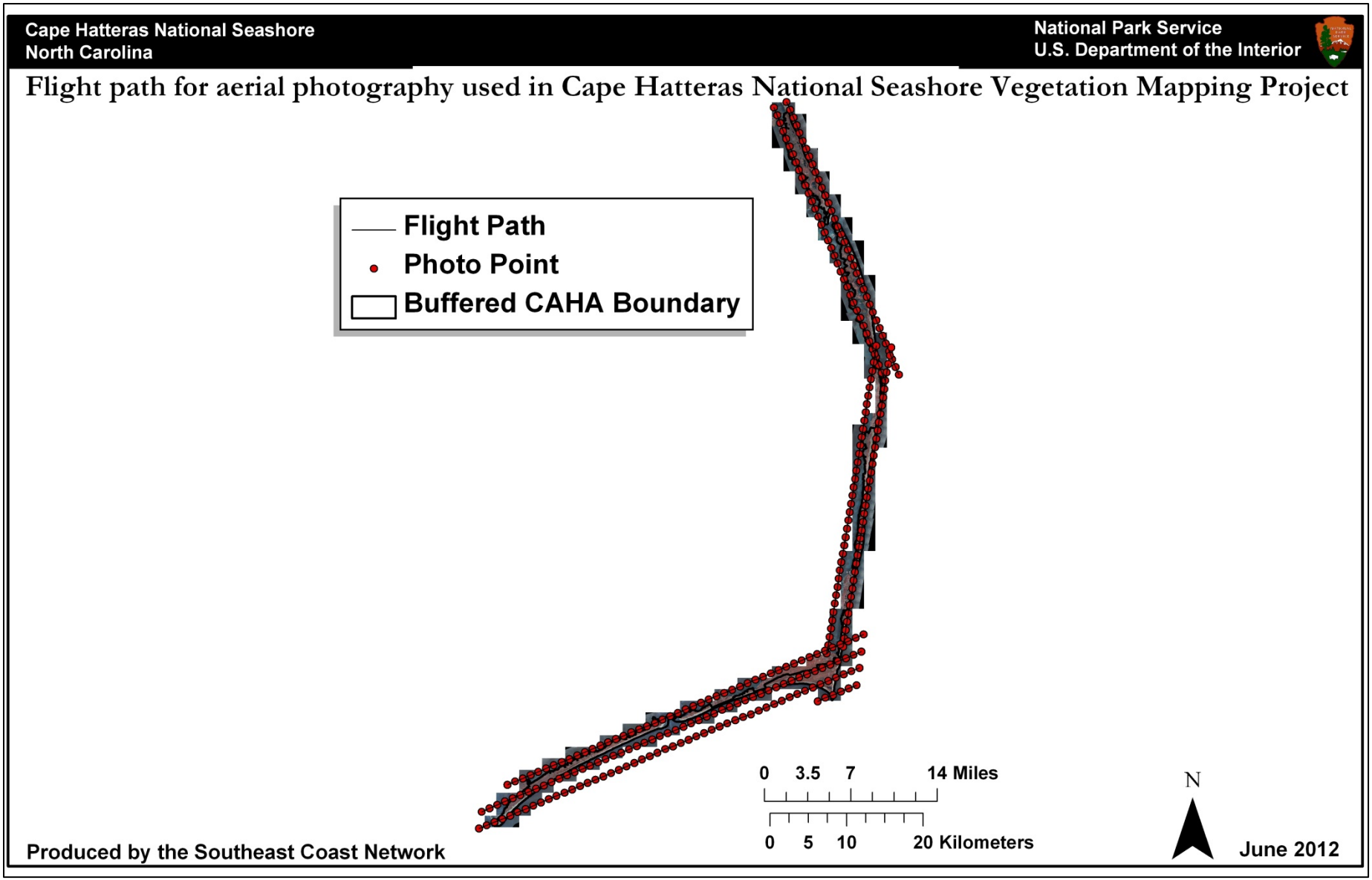


Figure 13. Flight lines for the 2009 color infrared stereo aerial photograph coverage of Cape Hatteras National Seashore.

Preliminary Photo-Interpretation

Prior to field reconnaissance, it is advantageous for the individual(s) interpreting the imagery to become familiar with the project imagery as well as the vegetation types to be mapped. The benefit of this early mapping step is that it allows the interpreters to identify particular areas of interest to visit during the field reconnaissance step. For this preliminary mapping, the SECN remote sensing specialist delineated vegetation polygons on the digital orthophoto mosaics to at least the Formation-level of the NVCS. In addition to vegetation, other features were mapped as well, such as non-vegetated surfaces that were classified according to the Anderson Land Use Level II mapping regime (Anderson et al. 1976). Polygons were digitized on-screen using Arc GIS (Version 9.3, © 2008 Environmental Systems Research Institute, Redlands, California).

Field Reconnaissance

The purpose of this step is to train the photo-interpreter(s) on the correlation of photo-signatures with vegetation associations. A photo signature is a set of diagnostic characteristics present on the imagery, such as color, tone, shape, size, etc. that represents a particular vegetation association on the imagery (Philipson 1997). During field reconnaissance it is important to explore a variety of locations that represent various images, since color infrared (CIR) imagery is typically not consistent between photo sets. Even slight differences in sun angle, light intensity, shadow, and even the particular film batch and printing process can affect vegetation's appearance on imagery (Hershey and Befort 1995). The ability of the imagery interpreter(s) to identify diagnostic characteristics on the imagery that can be tied directly to a vegetation association is a key component to successful, consistent, and accurate mapping. For some vegetation types, a set of diagnostic characteristics may not be visible on the imagery (i.e., the understory species may be the ones that are diagnostic). In such cases, the imagery interpreter(s) may be able to rely on an informed understanding of the ecological and environmental settings of the particular vegetation types (e.g., the environmental setting where an association is likely to occur) in order to make a mapping decision.

A field reconnaissance trip was taken to CAHA in October, 2010. During this trip, the SECN remote sensing specialist spent time investigating ground conditions with copies of the aerial photographs in hand. Notes were taken directly on the copies of the aerial imagery as observations were made. The remote sensing specialist used a Garmin® Rino GPS unit to navigate to a set of predetermined points of interest within the vegetation polygons mapped during the preliminary mapping step. These points of interest were chosen specifically to aid in the identification of vegetation photo-signatures. Upon reaching each point, vegetation at that point was keyed to its association by using the key developed by NatureServe (NatureServe 2008). Difficulties in determining association, if any, were documented on the field sheet (Appendix E). Dominant species found in each vegetation strata were documented. Ground photographs of each point were taken.

Photo-Interpretation and Polygon Attribution

Based on the information gathered from the field reconnaissance trip, the SECN remote sensing specialist was able to develop a photo-interpretation guide that aided the delineation of vegetation classes (see Appendix D). Standard photo-signature characteristics were applied during the photo-interpretation process, including texture, color, pattern, and position in the landscape (Philipson 1997). In addition to photo-signature characteristics, understanding the environmental distribution of

the vegetation types helped the remote sensing specialist not only identify types, but also to properly place polygon boundaries. Polygons were interpreted and digitized on-screen using Arc GIS (Version 9.3, © 2008 Environmental Systems Research Institute, Redlands, California). Features were mapped to a minimum mapping unit (MMU) of 0.5 ha, which is the NPS VIP standard. Exceptions for mapping below the MMU were allowed for map-class units with vegetation unique to the immediate surroundings. For each polygon, the appropriate map-class code along with its NVCS code, alliance, association, and association common name were entered into the fields of the associated attribute table (Table 4).

Table 4. Fields used in the attribute table of the vegetation polygon layer of the Cape Hatteras National Seashore Mapping Project.

Field in Attribute Table	Description	Polygon Types Field Applies to
Cultural Type	NVCS Cultural Vegetation Type	Cultural Vegetation
Alliance	NVCS Alliance scientific name	Natural/Semi-natural vegetation
Association	NVCS Association scientific name	Natural/Semi-natural vegetation
Common_Name	NVCS Association Common Name	Natural/Semi-natural vegetation
LUC_II	Land Cover and Land Use Level II Codes (Anderson et al. 1976)	Natural/Semi-natural vegetation, Cultural Vegetation, and Non-Vegetated Areas
ELCODE	NVCS Element Code	Natural/Semi-natural vegetation
Map Code	Abbreviated code used by photo-interpreter	Natural/Semi-natural vegetation, Cultural Vegetation, and Non-Vegetated Areas
Wetland	Type of wetland	Natural/Semi-natural vegetation
Acres	Size of polygon in acres	Natural/Semi-natural vegetation, Cultural Vegetation, and Non-Vegetated Areas

Field Verification

A second trip was taken to CAHA in April 2012 for field verification. Field verification allows the photo-interpreter to gauge how accurately the photo-signatures developed during the field reconnaissance step are with respect to consistently mapping vegetation associations on the ground. Specific issues with problem classes can be resolved during this step prior to submitting the map for accuracy assessment.

Methodology for the field verification is nearly identical to the field reconnaissance step. The remote sensing specialist navigated via GPS to a predetermined set of points. Vegetation at that point was keyed to its association by using the vegetation key developed by NatureServe (NatureServe 2008). Difficulties in determining association, if any, were documented on the field sheet.

Accuracy Assessment

The main goal of an AA is to measure the probability that a particular location on the map created from the interpreted imagery has been assigned to its correct vegetation class on the ground. A vegetation map is an abstract model of the distribution of vegetation on the ground that is made

possible by making some generalizations. These generalizations lead to errors in the map product. These map errors must be quantified so that the map user and the map producer understand the limitations of the map. A formalized accuracy assessment is a way to quantify these errors. In the AA there is "producers' accuracy," which is the probability that an AA point has been mapped correctly (also known as error of omission), and there is "users' accuracy," which is the probability that the map actually represents what was found on the ground (also known as error of commission). Both the producers' accuracy and users' accuracy can be obtained from the same set of data by using different analyses. Overall accuracy of the map is obtained by determining the fraction of accuracy assessment observations within all map classes that were mapped correctly. The Kappa Index is another measure of overall accuracy, which takes into account the probability that mapped polygons will be correct due to random chance.

There are a number of factors that contribute to error on a vegetation map and some of these are listed below. It is important for the field investigator(s) conducting the AA to be aware of these situations and to take actions to minimize error when at all possible.

- Locational error (when it is not possible to acquire reliable UTM coordinates, the AA point data collected may look like it is in another polygon, or if the polygons are small, narrow and the GPS receiver is not working well, it may be difficult to know which polygon is supposed to be sampled).
- Field key is difficult to use, leading the investigator to assign the point to the wrong association.
- Field key does not include all the plant associations in the park, also leading to confusion in which association to assign a point.
- Field data error; either by misidentifying diagnostic species, or by not reading the key carefully, resulting in a bad field call when the map attribute is accurate.
- AA point falls within an ecotone, which is impossible to classify but still has to be mapped to something.
- Relationship between plant associations and map units (modeling) are flawed.
- The polygon is heterogeneous, including patches of varying vegetation that are too small to map individually. The AA point may fall in a part of the polygon with a different community than observed by the photo-interpreter in the bigger picture.

The formal accuracy assessment consists of several parts. First, a sampling design must be developed that follows methodology which is scientifically sound as well ideally practical and cost effective. The sampling design should cover all vegetation types mapped across the park. Sample sites must be visited in order to determine the vegetation type actually present at that particular ground location. The results of the sampling are used to create a contingency table (confusion matrix) that is used to calculate the per-class and overall accuracy of the map.

Sampling Design

We used a stratified random sampling approach to select AA sites in CAHA. We included all map classes representing natural/semi-natural vegetation types as defined in the NVCS in sampling selection (FGDC 1997). Cultural vegetation (e.g., warm season lawn) and non-vegetated (e.g., Residential, etc.) polygons were excluded from the AA. Points for the AA were restricted to within park boundaries (i.e., no points were located in the buffered region outside of CAHA boundaries).

We determined the sample size needed for each map class by following guidelines outlined in Thematic Accuracy Assessment Procedures (Lea and Curtis 2010; Table 5).

Table 5. Standard sample size allocations for accuracy assessment, based on map class area (Lea and Curtis 2010).

Map Class Total Area (ha)	Number Of Observations per Map Class
>50	30
8.33 to 50	0.6 per hectare
<8.33	5

To account for positional error due to site location (GPS error), vegetation polygons were buffered internally by 10 meters prior to generation of the AA points. The AA points were generated randomly in ArcGIS using the Create Random Points tool in ArcToolbox (Version 9.3, © 2008 Environmental Systems Research Institute, Redlands, California). The total number of observations for the AA of CAHA was 450 (Figure 14).

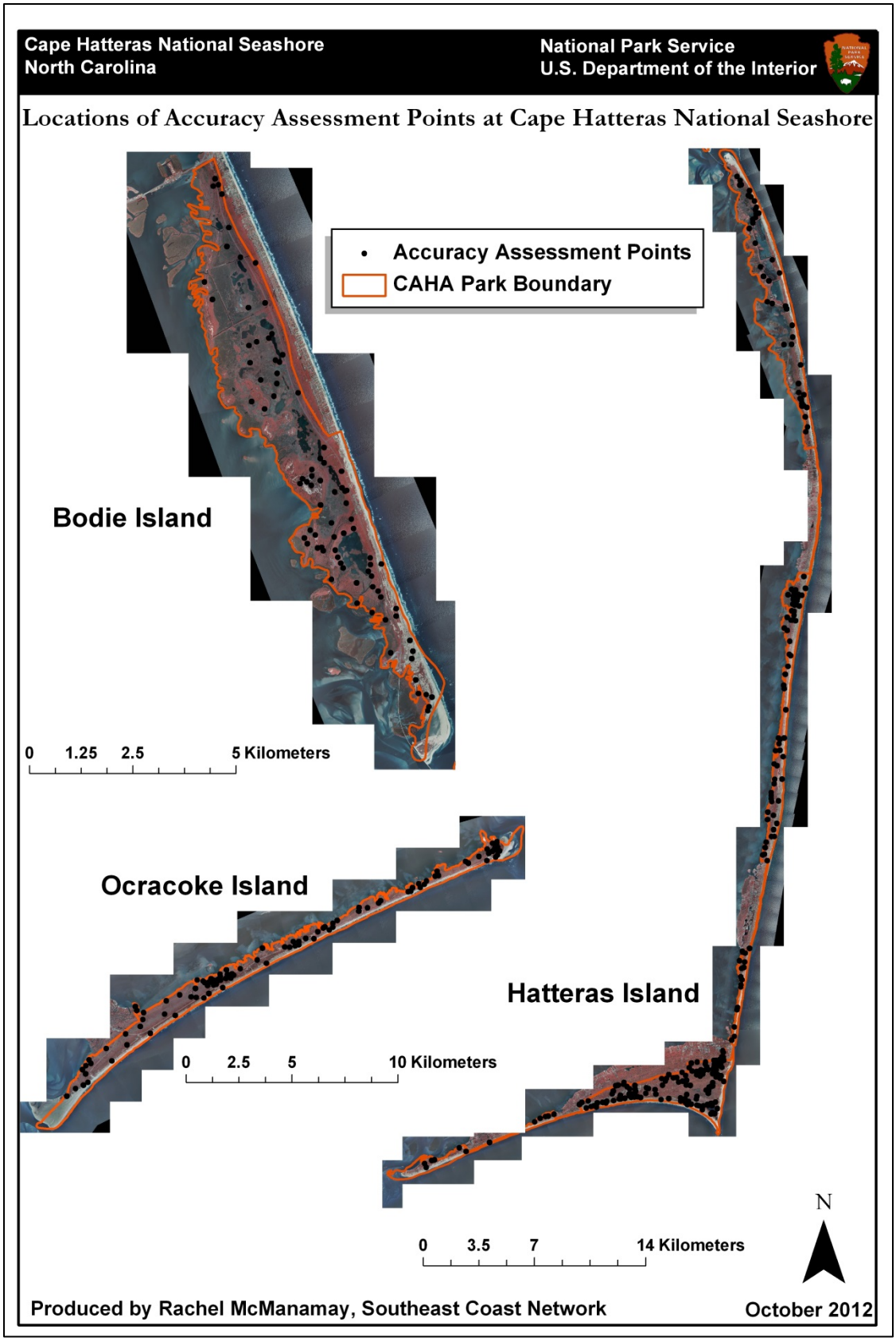


Figure 14. Locations of accuracy assessment points sampled in Cape Hatteras National Seashore.

Field Data Collection

Accuracy assessment point data were collected at CAHA during the summer (June-August) of 2012. A field crew from the SECN loaded the AA points into a GPS receiver in order to navigate to the points in the field. In addition to the GPS receivers, the field crew used copies of the orthophotographs overlaid with the AA points (not including any of the lines from the mapped vegetation polygons) as an additional navigation aid. Upon reaching an AA point, the field crew assessed the site within an area of equal size to the minimum ha radius of the observation area following methodology outlined by Lea and Curtis (2010). The field crew collected environmental data, such as hydrology and topography, where meaningful for each AA plot. Vegetation data collected included leaf phenology, leaf type of the dominant stratum, physiognomic class, and vegetation composition in each stratum (see Appendix F for example of AA form). A space was provided for the field crew to make general comments about the classification made for each plot, noting any problems that were encountered (if any). Photographs in each cardinal direction, as well as of the canopy, were taken at each site to provide a visual documentation of each AA site.

Data Analysis

The AA point data were manually entered into the NPS PLOTS Database Version 3.2 (The Nature Conservancy 2010). PLOTS Version 3.2 is a relational database designed to store vegetation inventory field data for taxonomy and accuracy assessment and the data were subjected to a thorough quality assessment/quality check prior to analysis. The analysis of the map accuracy included the following steps:

- Initial comparative analysis of the field and map data.
- Review of all disagreements and correcting for false errors as necessary.
- Final comparative analysis of the field and map data.
- Individual map-class analysis.
- Final output of results into a contingency matrix.
- Final output of the analyses and results into a spatial database for use in GIS.

Initial Comparative Analysis

We used the Intersect Tool in Arc Toolbox (ArcGIS Version 9.3, © 2008 Environmental Systems Research Institute, Redlands, California) to combine the AA point layer and the map vegetation polygon layer. The resulting layer from the intersection allowed us to compare each AA field-site call (vegetation type) to the corresponding map-polygon call (map class representing vegetation type). We used Microsoft Excel 2007 (Microsoft Corporation) to compare and tabulate the field-site call to the map-polygon call.

Review of Disagreements

All mismatches (disagreements) were subsequently reviewed for false errors. A false error is defined as a mismatch between the AA field-site call and the map-polygon call if caused by an accuracy error

in the GPS field coordinates, a missing or misapplied field call, or a field-site assessment of an area smaller than the MMU. We reviewed the AA sites within the context of their corresponding polygons in ArcGIS. We also reviewed the field data sheet to gain a fuller context of the ground data. From this process, we determined whether an initial disagreement was either a true error or indeed a match.

Final Comparison

None of the mismatches were determined to be a result of a false error. Therefore, we used all 54 of the 54 AA field sites for the final comparative analysis of the vegetation map layer.

Individual Map-class Analysis

We looked at the accuracy for each map class on an individual basis to determine if accuracy requirements of the NPS VIP were met. Based on these individual map class results, we determined whether or not it would be necessary to merge the map classes to gain higher accuracy or to leave the map classes as they were, even if it resulted in lower accuracy.

Final Output

We generated two outputs for the AA results: a sample contingency table and a population contingency table. The sample contingency table provides an initial summary of the AA data by displaying counts of observations, with sample data values (vegetation map classes) as rows and reference data values (vegetation types as identified on the ground) as columns. The values in the shaded cells along the diagonal represent counts for correctly classified observations, where the reference data (column) matches the mapped vegetation type (row; see Appendix G). User's accuracy was calculated by dividing the number of samples that agreed with their corresponding map class by the total number of samples in that class. Producer's accuracy was calculated by dividing the number of samples that agreed with their corresponding map class by the total number of samples whose field call belonged to that category.

Previous NPS VIP guidance (TNC and ESRI 1994) suggested calculating users', producers', and overall accuracies from the sample contingency table of observation counts. However, this practice did not account for the unequal probability sampling imposed by the stratification by map classes. While appropriate for users' accuracies, it will give inaccurate results for producers' accuracies and overall accuracy. Therefore, measures of accuracy for the AA are now defined by the population contingency table. Similar to the sample contingency table, rows in the population contingency table are defined by the sample data values, and the columns are defined by the reference data values. Unlike the sample contingency table, the values in each cell are the proportion of the target area in the corresponding true and mapped vegetation classes, rather than the raw counts of observations. The population and sample contingency tables are reported together as a summary of between-class error relationships and class accuracy statistics (Lea and Curtis 2010; see Appendix G).

AA Spatial Database

For use in GIS, we produced a feature-class layer of the AA site locations, along with supporting tables, and incorporated them into the CAHA vegetation mapping project geodatabase.

Results

Vegetation Classification

The final classification for CAHA (including some combinations of associations that the SECN made to improve overall accuracy) resulted in 13 map classes; see Appendix B for full association descriptions).

Digital Imagery and Interpretation

For CAHA, 13 map units were developed and matched to corresponding plant associations in the NVCS (Table 6). Eleven map classes representing non-vegetated units (e.g., open water bodies, buildings, roads, etc.) were identified (Table 7).

Ancillary data sources such as a digital raster graphic (DRG) and historical aerial photographs provided additional insight into ground conditions. Historical and current land management practices in the park provided details pertinent to classification issues.

Table 6. Final vegetation associations of the NVCS used for vegetation mapping (with their assigned Map Codes) in Cape Hatteras National Seashore.* Indicates that one or more associations were combined to create the map class.

Association Common Name	NVCS Code(s)	Map Code(s)
Forest		
Live Oak - (Cabbage Palmetto) Forest Alliance / Live Oak / Yaupon Shrubland*	A.55 / CEGL003833	FOR1/2/ SHRUB1
Maritime Red Bay Shrub Swamp / Atlantic Coast Stiff Dogwood Dune Swale*	CEGL004635 CEGL007384	FOR3/7
Slash Pine Plantation / Mid-Atlantic Coastal Loblolly Pine Forest*	CEGL004635 CEGL007384	FOR4/8
Coastal Loblolly Pine Wetland Forest	CEGL006137	FOR6
Shrubland		
Atlantic Coast Interdune Swale	CEGL003839	SHRUB2
Groundsel-tree - Maritime Marsh-elder Tidal Shrubland Alliance / Seaside Oxeye Tidal Shrub Flat*	A.1023 CEGL003924	SHRUB4/5/6
Herbaceous		
Centipede Grass Planted Herbaceous Vegetation / Sea-oats Temperate Herbaceous Alliance / Overwash Dune Grassland*	CEGL004204 A.1199 CEGL004097	HERB1/ HERB2/3/ HERB5
Southern Hairgrass - Saltmeadow Cordgrass - Dune Fingergrass Herbaceous Vegetation	CEGL004051	HERB4
Mid-Atlantic High Salt Marsh / Chestnut Fimbry - Common Threesquare Seasonally Flooded Herbaceous Vegetation / Southern Cattail - Giant Foxtail Herbaceous Vegetation*	CEGL004197 CEGL003790 CEGL004138	HERB12/ HERB6/ HERB7
Sawgrass Tidal Herbaceous Vegetation	CEGL004178	HERB8
Needlerush High Marsh	CEGL004186	HERB9
Reed Tidal Marsh	CEGL004191	HERB10
Southern Atlantic Coast Saltmarsh	CEGL004191	HERB11

Table 7. Map classification codes for non-vegetated areas in Cape Hatteras National Seashore, following Land Use and Land Cover Level II (Anderson et al. 1976).

Map Class Code	Anderson Land Use and Land Cover Level II (1976)
11	Residential
12	Commercial and Services
14	Transportation, Communication, and Utilities
21	Cropland and Pasture
50	Water
51	Streams and Canals
54	Bays and Estuaries
55	Open Marine
72	Beaches
73	Sandy Areas other than Beaches
74	Bare Exposed Rock

Vegetation Map

Table 8 provides a summary report of the spatial data layer (map) of CAHA and summarizes frequency, mean area (in ha), and the sum of areas (in ha) for each map class.

Collectively, the CAHA spatial database layer is composed of 2,437 polygons covering 11,749 ha, with an average polygon size of 8.5 ha. Map classes representing natural/semi-natural types in the NVCS apply to 1,924 polygons (79.0% of all polygons) covering 7,401.6 ha (63.0 % of entire area) with an average polygon size of 3.6 ha. Of these natural/semi-natural types, the Atlantic Coast Interdune Swale dominates, both in frequency of polygons (488), and in size (2,050 ha). Needlerush High Marsh is also a widespread association with 408 polygons covering 1,279.9 ha.

Non-vegetated areas (including developed areas and water) consist of 513 polygons (21.1% of all polygons) and cover 4,347.9 ha (37.0% of the entire area). Developed areas in the park include the NPS Visitor Center and maintenance buildings, roads, private residences, and commercial buildings.

Wetlands consist of 1881 polygons (77.1% of all polygons) and cover 8,148 ha (69.3% of entire area). Wetland areas consist non-vegetated areas such as the ocean, sound, and ponds in addition to vegetated polygons.Vegetation associations in the NVCS that are considered wetlands according to the U.S. Fish and Wildlife Service include the following: Maritime Red Bay Shrub Swamp, Coastal Loblolly Pine Wetland Forest, Atlantic Coast Stiff Dogwood Dune Swale, Atlantic Coast Interdune Swale, Groundsel-tree – Maritime Marsh Elder Tidal Shrubland Alliance, Seaside Oxeye Tidal Shrub Flat, Chestnut Fimbry – Common Threesquare Seasonally Flooded Herbaceous Vegetation, Southern Cattail – Giant Foxtail Herbaceous Vegetation, Tidal Sawgrass Marsh, Needlerush High Marsh, Reed Tidal Marsh, Southern Atlantic Coast Salt Marsh, and Mid-Atlantic High Salt Marsh.

Considerably more analyses and deductions can be attained from even these simple summary reports. For example, a query could be done to determine the average distance a certain vegetation association occurs from a road or another developed area. Additionally, more complex reports could be derived by introducing additional spatial data layers (e.g., amphibian distributions, invasive species, etc.) Such analyses provide greater insight into vegetation and its ecology.

Table 8. Summary statistics for the map classes occurring in Cape Hatteras National Seashore.

Map Class	Park Boundary and Buffer			Within-Park Boundary Only		
	Frequency (# Polygons)	Mean (ha)	Sum (ha)	Frequency (# Polygons)	Mean (ha)	Sum (ha)
Natural Vegetation						
Live Oak - (Cabbage Palmetto) Forest Alliance / Live Oak / Yaupon Shrubland	67	9.33	625.5	67	8.76	587.4
Maritime Red Bay Shrub Swamp / Atlantic Coast Stiff Dogwood Dune Swale	31	4.5	139.0	30	4.5	133.6
Slash Pine Plantation / Mid-Atlantic Coastal Loblolly Pine Forest	41	8.0	327.9	41	7.8	319.6
Coastal Loblolly Pine Wetland Forest	1	1.67	1.67	1	1.67	1.67
Atlantic Coast Interdune Swale	488	4.2	2,050.0	488	4.1	1,991.7
Groundsel-tree - Maritime Marsh-elder Tidal Shrubland Alliance / Seaside Oxeye Tidal Shrub Flat	120	0.84	100.8	116	0.81	94.2
Centipede Grass Planted Herbaceous Vegetation / Sea-oats Temperate Herbaceous Alliance / Overwash Dune Grassland	220	6.54	1,438.7	218	6.50	1322.9
Southern Hairgrass - Saltmeadow Cordgrass - Dune Fingergrass Herbaceous Vegetation	38	0.33	12.6	38	0.32	12.2
Mid-Atlantic High Salt Marsh / Chestnut Fimbry - Common Threesquare Seasonally Flooded Herbaceous Vegetation / Southern Cattail - Giant Foxtail Herbaceous Vegetation	354	3.25	1,139.4	350	3.20	1,106.0
Sawgrass Tidal Herbaceous Vegetation	10	1.28	12.8	10	1.28	12.8
Needlerush High Marsh	408	3.10	1,272.9	401	3.10	1,237.1
Reed Tidal Marsh	33	1.25	41.2	33	1.24	41.0
Southern Atlantic Coast Saltmarsh	113	2.12	239.1	106	2.25	238.2
Natural Vegetation subtotal:	**1,924**	**3.6**	**7,401.6**	**1,899**	**3.5**	**7,098.4**
Non-Vegetated Areas						
Residential	28	1.86	52.1	16	1.25	20.0
Commercial and Services	46	2.68	123.1	41	2.90	117.8
Transportation, Communications, and Utilities	14	14.6	199.5	14	14.1	196.7
Other Urban or Built-Up Land	3	10.7	30.8	3	9.8	28.4
Cropland and Pasture	1	5.92	5.92	1	5.92	5.92
Other Agricultural Land	1	0.81	0.81	1	0.81	0.81
Water	192	2.82	541.9	190	2.84	541.1
Streams and Canals	5	1.98	9.9	5	1.86	9.3
Bays and Estuaries	80	17.4	1,363.4	71	11.6	822.5
Open Marine	12	95.5	1,145.5	11	54.6	604.5
Beaches	23	27.4	630.5	21	24.3	511.1
Sandy Areas other than Beaches	101	2.34	236.9	101	2.20	222.4
Bare Exposed Rock	3	0.64	1.94	3	0.64	1.94
Transitional Areas	4	1.39	5.59	4	1.39	5.59
Non-Vegetated Areas subtotal:	**513**	**13.3**	**4,347.9**	**482**	**9.6**	**3,088.0**
Grand Total:	**2,437**	**8.5**	**11,749.4**	**2,381**	**9.0**	**10,186.4**

Map Layer Presentation

Figure 15 presents the map layer produced for the CAHA vegetation mapping project. The map is shown at its finest level, i.e., vegetation classes are shown at the association level and are labeled by the association common name. The boundary for CAHA and the mapping boundary for the project are both included.

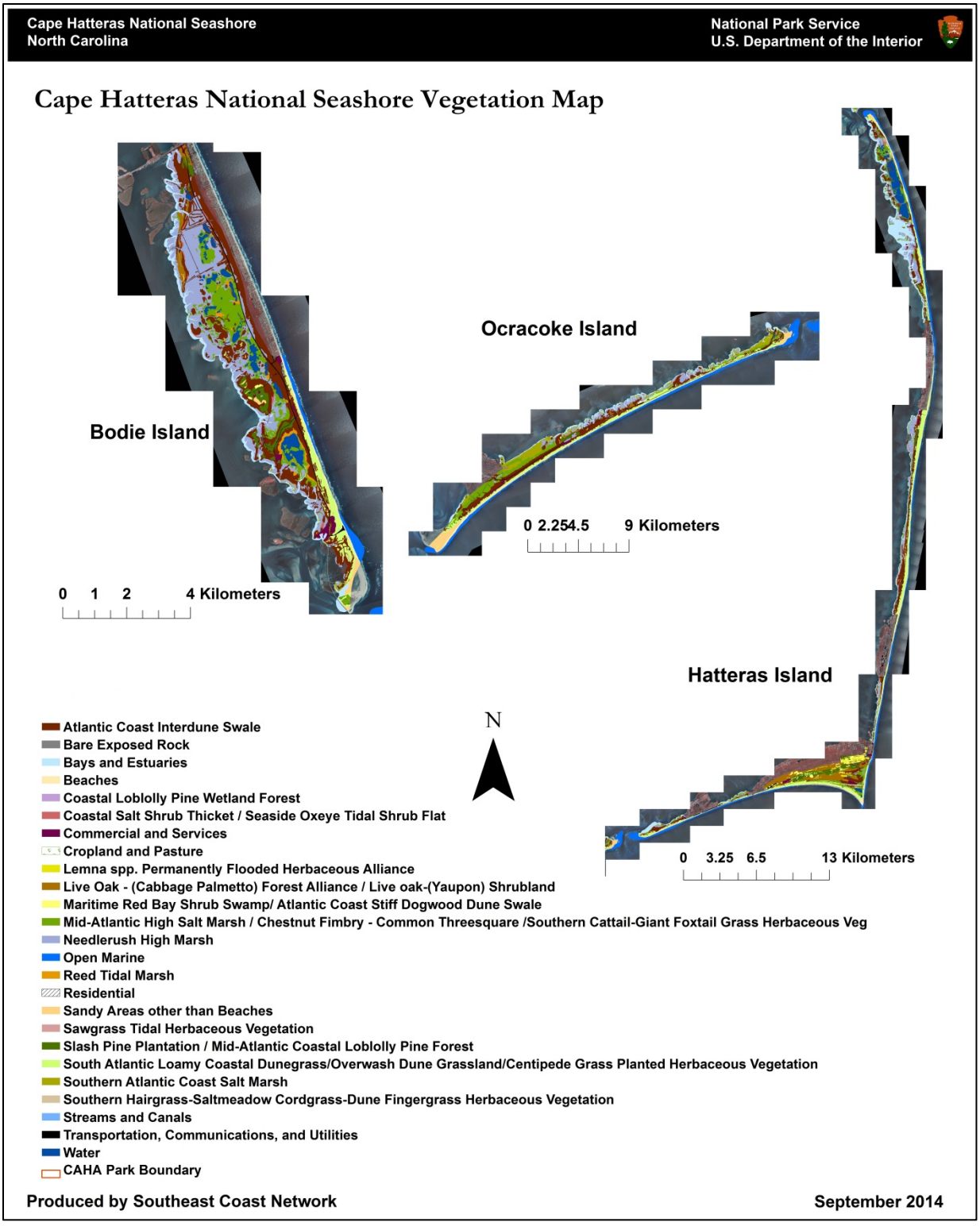


Figure 15. Vegetation (NVCS, FGDC 1997) and Land Use (Anderson et al. 1976) map classes for Cape Hatteras National Seashore.

Accuracy Assessment

Overall accuracy is 80.1% (90% confidence interval [CI]: 76.2 – 84.0%) for primary map classes representing natural/semi-natural vegetation floristic types in the NVCS. A kappa adjustment for chance agreements resulted in a final overall accuracy of 69.9% (90% CI: 65.9 – 73.8%). The sample and population contingency matrices for AA results are provided in Appendix G: Accuracy Assessment Contingency Tables. The population contingency matrix shows the accuracy of each map class (along with 90% CIs), with the user's accuracy reflecting errors of inclusion (commission errors) and the producer's accuracy reflecting errors of exclusion (omission errors) present in the mapping. The width of each CI is affected by the sample size used to derive the point estimate.

Our overall AA met the accuracy requirement of 80% established by the NPS VIP. Some individual classes, however, did not meet the 80% accuracy requirement. The following are individual map classes that did not meet the required accuracy along with a discussion detailing possible sources of error, where applicable.

User's Accuracy (Errors of Commission)

Atlantic Coast Stiff Dogwood Dune Swale / Maritime Red Bay Shrub Swamp: The User's Accuracy for this combined class was 59%. Of the 32 total points sampled for this combined class, 13 were determined on the ground to be Live Oak – (Cabbage Palmetto) Forest Alliance / Live Oak – (Yaupon) Shrubland. We determined that the main source of mapping errors between these two classes came from points sampled in the Buxton Woods area of Cape Hatteras. This region of Cape Hatteras is interspersed with alternating depressions, often called sedges, and higher ground. The sedges are areas vegetated with Atlantic Coast Stiff Dogwood Dune Swale / Maritime Red Bay Shrub Swamp; whereas the upland areas are often vegetated by Live Oak – (Cabbage Palmetto) Forest Alliance / Live Oak – (Yaupon) Shrubland. Sometimes it was difficult on the imagery to decipher where the lowland "pockets" of vegetation occurred. Therefore, we attribute much of this area to challenges induced by challenging topography and often close overlap of these two alternating vegetation classes.

Live Oak – (Cabbage Palmetto) Forest Alliance / Live Oak – (Yaupon) Shrubland: The User's Accuracy for this combined class was 42%. Of the total 60 points that were sampled, 7 were keyed as Atlantic Coast Interdune Swale, 5 were keyed as Atlantic Coast Stiff Dogwood Dune Swale / Maritime Red Bay Shrub Swamp, 21 were keyed as Mid-Atlantic Coastal Loblolly Pine Forest / Slash Pine Plantation, and two were keyed as Coastal Loblolly Pine Wetland Forest. The majority of the error (21 points) came from the confusion between this class and the Atlantic Coastal Loblolly Pine Forest / Slash Pine Plantation. We attribute this error to the fact that the Live Oak – (Cabbage Palmetto) Forest Alliance often includes loblolly pine as a common species in its canopy. Since both of these classes contain Loblolly Pine, it can be difficult in both the photo-interpretation step and the accuracy assessment step to judge how dominant loblolly pine is versus the live oak and/or other canopy species.

Maritime Marsh Elder Tidal Shrub Alliance / Seaside Oxeye Tidal Shrub Flat: The User's Accuracy for this combined class was 65%. Of the total 26 points sampled, 4 were keyed as Atlantic Coast Stiff

Dogwood Dune Swale / Maritime Red Bay Shrub Swamp, 2 were keyed as Mid-Atlantic High Salt Marsh / Chestnut Fimbry-Common Threesquare Seasonally Flooded Alliance / Southern Cattail – Giant Foxtail Herbaceous Vegetation, and three keyed as Needlerush High Marsh. Confusions between these classes are not altogether surprising, since they are wetland associations with similar species compositions, with the exception perhaps of the Atlantic Coast Stiff Dogwood Dune Swale / Maritime Red Bay Shrub Swamp. The confusion in the later case is likely due to a similarity in photo-signatures between these two wetland shrub classes.

Mid-Atlantic Coastal Loblolly Pine Forest / Slash Pine Plantation: The User's Accuracy for this combined class was 77%. Of the total 35 points sampled, 3 were keyed as Atlantic Coast Interdune Swale, one was keyed as Atlantic Coast Stiff Dogwood Dune Swale / Maritime Red Bay Shrub Swamp, two were keyed as Live Oak – (Cabbage Palmetto) Forest Alliance / Live Oak – (Yaupon) Shrubland, and two were keyed as Coastal Loblolly Pine Wetland Forest. These errors likely came about due to confusion in dominance of loblolly and/or the ability to decipher whether or not loblolly was canopy or shrub dominant.

Southern Atlantic Coast Salt Marsh: The User's Accuracy for this class was 77%. Of the 30 points sampled, 2 were keyed as Mid-Atlantic High Salt Marsh / Chestnut Fimbry – Common Threesquare Seasonally Flooded Herbaceous Vegetation / Southern Cattail – Giant Foxtail Herbaceous Vegetation, 2 were keyed as Maritime Marsh Elder Tidal Shrub Alliance / Seaside Oxeye Tidal Shrub Flat, and three were keyed as Needlerush High Marsh. The similarities between these classes are that they are all found in either the tidal and/or tidal fringe areas at CAHA and share at least some similar species.

Southern Hairgrass – Saltmeadow Cordgrass – Dune Fingergrass Herbaceous Vegetation: The User's Accuracy for this class was 50%. Of the 30 points sampled, 2 were keyed as Atlantic Coast Interdune Swale, 9 were keyed as Mid-Atlantic High Salt Marsh / Chestnut Fimbry – Common Threesquare Seasonally Flooded Herbaceous Vegetation / Southern Cattail – Giant Foxtail Herbaceous Vegetation, 3 were keyed as Overwash Dune Grassland / Sea-oats Temperate Herbaceous Alliance / Centipede Grass Planted Herbaceous Vegetation, and one was keyed as Reed Tidal Marsh. The Southern Hairgrass – Saltmeadow Cordgrass – Dune Fingergrass Herbacous Vegetation is a difficult association to map because it typically occurs in small areas and can be confused with other herbaceous classes, as seen here. The majority of the mapping error (9 points) came from confusion with the Mid-Atlantic High Salt Marsh / Chestnut Fimbry – Common Threesquare Seasonally Flooded Herbaceous Vegetation / Southern Cattail – Giant Foxtail Herbaceous Vegetation, which is a combined class that contains herbaceous associatons occurring in wetland areas on the island. Though Southern Hairgrass is not defined as a wetland class, it does typically occur in swales that are intermittently flooded or seasonally saturated.

Tidal Sawgrass Marsh: The User's Accuracy for this class was 40%. Of the five points sampled, 1 was keyed as Mid-Atlantic High Salt Marsh / Chestnut Fimbry – Common Threesquare Seasonally Flooded Herbaceous Vegetation / Southern Cattail – Giant Foxtail Herbaceous Vegetation, 1 was keyed as Maritime Marsh Elder Tidal Shrub Alliance / Seaside Oxeye Tidal Shrub Flat, and one was keyed as Overwash Dune Grassland / Sea-oats Temperate Herbaceous Alliance / Centipede Grass

Planted Herbaceous Vegetation. Tidal Sawgrass Marsh is one of the more restricted associations in the park, and can be difficult to map, as it can occur in pockets within other tidal communities.

Coastal Pine Wetland Forest: No area within the park was mapped to this association, but during the Accuracy Assessment, two plots were keyed as Coastal Pine Wetland Forest. Therefore, the User's Accuracy is 0%.

Producers' Accuracy (Errors of Omission)

Atlantic Coast Interdune Swale: The Producer's Accuracy for this class was 58%. Omissions include 2 points mapped as Mid-Atlantic High Salt Marsh / Chestnut Fimbry – Common Threesquare Seasonally Flooded Herbaceous Vegetation / Southern Cattail – Giant Foxtail Herbaceous Vegetation, 7 points mapped as Live Oak – (Cabbage Palmetto) Forest Alliance / Live Oak – (Yaupon) Shrubland, 7 points mapped as Maritime Marsh Elder Tidal Shrubland Alliance / Seaside Oxeye Tidal Shrub Flat, and four mapped as Overwash Dune Grassland / Sea-oats Temperate Herbaceous Alliance / Centipede Grass Planted Herbaceous Vegetation.

Atlantic Coast Stiff Dogwood Dune Swale / Maritime Red Bay Shrub Swamp: The Producer's Accuracy for this combined class is 66%. Omissions include 5 points mapped as Live Oak – (Cabbage Palmetto) Forest Alliance / Live Oak – (Yaupon) Shrubland, 4 points mapped as Maritime Marsh Elder Tidal Shrubland Alliance / Seaside Oxeye Tidal Shrub Flat, and one mapped as Mid-Atlantic Coastal Loblolly Pine Forest / Slash Pine Plantation.

Mid-Atlantic High Salt Marsh / Chestnut Fimbry – Common Threesquare Seasonally Flooded Herbaceous Vegetation / Southern Cattail – Giant Foxtail Herbaceous Vegetation: The Producer's Accuracy for this combined class is 74%. Omissions include 2 points mapped as Reed Tidal Marsh, 2 points mapped as Southern Atlantic Coast Salt Marsh, 9 points mapped as Southern Hairgrass – Saltmeadow Cordgrass – Dune Fingergrass Herbaceous Vegetation, and one point mapped as Tidal Sawgrass Marsh.

Live Oak – (Cabbage Palmetto) Forest Alliance / Live Oak – (Yaupon) Shrubland: The Producer's Accuracy for this combined class is 61%. Omissions include 1 point mapped as Atlantic Coast Interdune Swale, 13 points mapped as Atlantic Coast Stiff Dogwood Dune Swale / Maritime Red Bay Shrub Swamp, and two points mapped as Maritime Marsh Elder Tidal Shrubland Alliance / Seaside Oxeye Tidal Shrub Flat. The majority of producer's error was derived from the omission of points in the Atlantic Coast Stiff Dogwood Swale / Maritime Red Bay Shrub Swamp. As discussed in the section on User's Accuracy, the main source of mapping errors between these two classes came from points sampled in the Buxton Woods area of Cape Hatteras. This region of Cape Hatteras is interspersed with alternating depressions, often called sedges, and higher ground. The sedges are areas vegetated with Atlantic Coast Stiff Dogwood Dune Swale / Maritime Red Bay Shrub Swamp; whereas the upland areas are often vegetated by Live Oak – (Cabbage Palmetto) Forest Alliance / Live Oak – (Yaupon) Shrubland. Sometimes it was difficult on the imagery to decipher where the lowland "pockets" of vegetation occurred. Therefore, we attribute much of this area to challenges

induced by challenging topography and often close overlap of these two alternating vegetation classes.

Maritime Marsh Elder Tidal Shrub Alliance / Seaside Oxeye Tidal Shrub Flat: The Producer's Accuracy for this combined class is 74%. Omissions include 3 points mapped as Atlantic Coast Interdune Swale, 2 points mapped as Southern Atlantic Coast Salt Marsh, and one point mapped as Tidal Sawgrass Marsh.

Mid-Atlantic Coastal Loblolly Pine Forest / Slash Pine Plantation: The Producer's Accuracy for this combined class is 55%. Omissions include 1 point mapped as Atlantic Coast Interdune Swale and 21 mapped as Live Oak – (Cabbage Palmetto) Forest Alliance / Live Oak – (Yaupon) Shrubland, which was the main source of mapping error. As discussed in the User's Accuracy section, the Live Oak – (Cabbage Palmetto) Forest Alliance often includes loblolly pine as a common species in its canopy. Since both of these classes contain Loblolly Pine, it can be difficult in both the photo-interpretation step and the accuracy assessment step to judge how dominant loblolly pine is versus the live oak and/or other canopy species.

Reed Tidal Marsh: The Producer's Accuracy for this class is 73%. Omissions include 6 points mapped as Mid-Atlantic High Salt Marsh / Chestnut Fimbry – Common Threesquare Seasonally Flooded Herbaceous Vegetation / Southern Cattail – Giant Foxtail Herbaceous Vegetation and one point mapped as Southern Hairgrass – Saltmeadow Cordgrass – Dune Fingergrass Herbaceous Vegetation. The main source of omission in the Mid-Atlantic High Salt Marsh class is likely due to the similarity in photo-signatures between these two classes.

Tidal Sawgrass Marsh: The Producer's Accuracy for this class is 50%. Omissions include 1 point mapped as Overwash Dune Grassland / Sea-oats Temperate Herbaceous Alliance / Centipede Grass Planted Herbaceous Alliance, and one point mapped as Reed Tidal Marsh. The relatively low accuracy for this class is mainly attributed to a small sample size (4 points total) with two of these points being omissions.

Coastal Loblolly Pine Wetland Forest: The Producer's Accuracy for this class was 0%. No area was mapped to this class, but four points were determined in the accuracy assessment to be Coastal Loblolly Pine Wetland Forest. Of those four points, two were mapped as Live Oak – (Cabbage Palmetto) Forest Alliance / Live Oak – (Yaupon) Shrubland, and two were mapped as Coastal Loblolly Pine Forest / Slash Pine Plantation.

Literature Cited

Anderson, J. R., E. E. Hardy, J. T. Roach, and R. E. Witmer. 1976. A land use and land cover classification system for use with remote sensor data. Geological Survey Professional Paper 964. United States Government Printing Office. Washington, DC. 28 pp.

Binkley, Cameron. 2007. The Creation and Establishement of Cape Hatteras National Seashore: the Great Depression through Mission 66. Available from http://www.nps.gov/history/history/online_books/caha/caha_ah.pdf. Accessed June 6, 2012.

Byrne, M. W., S. L. Corbett, and J. C. DeVivo. 2012. Vegetation community monitoring at Cape Hatteras National Seashore, 2010. Natural Resource Data Series NPS/SECN/NRDS—2012/257. National Park Service, Fort Collins, Colorado.

Cahoon, D. R. 2006. A review of Major Storm Impacts on Coastal Wetland Elevations. Estuaries and Coasts 29:889-898.

Cahoon, D. R., D. J. Reed, J. W. Day Jr., G. D. Steyer, R. M. Boumans, J. C. Lynch, D. McNally, and N. Latif. 1995. The influence of Hurricane Andrew on sediment distribution in Louisiana coastal marshes. Journal of Coastal Research SI 21:280-294

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U. S. Department of the Interior. Fish and Wildlife Service. Washington, DC. Jamestown, ND: Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/1998/classwet/classwet.htm. (Version 04DEC98).

Davey, C.A., K.T. Redmond, and D.B. Simeral. 2007. Weather and Climate Inventory, National Park Service, Southeast Coast Network. Natural Resource Technical Report NPS/SECN/NRTR—2007/010. National Park Service, Fort Collins, CO.

Environmental Systems Research Institute (ESRI), Inc. 2008. Arc GIS 9.3. Environmental Systems Research Institute, Inc. Redlands, CA.

Environmental Systems Research Institute (ESRI), National Center for Geographic Information and Analysis, and The Nature Conservancy (TNC). 1994. Final Draft for Field Methods for Vegetation Mapping procedures. USGS/NPS Vegetation Mapping Program. Prepared for the United States Department of the Interior, Biological Resources Division and National Park Service.

Federal Geographic Data Committee (FGDC). 1997. Vegetation classification standard [online]. Available from: http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/vegclass.pdf.

Federal Geographic Data Committee (FGDC). 1998a. Spatial data transfer standard, FGDC-STC-002 (modified version ANSI NCITS 20:19998). Web address: http://www.fgdc.gov/standards/projects/FGDC-standards-projects/SDTS.

Federal Geographic Data Committee (FGDC). 1998b. Content standard for digital geospatial metadata, FGDC-STD-001-1998. Web address: http://www.fgdc.gov/standards/projects/FGDC-standards-projects/metadata/base-metadata.

Federal Geographic Data Committee-Vegetation Subcommittee. 2008. National Vegetation Classification Standard (Version 2). FGDC-STD-005-2008. Available online: http://www.fgdc.gov/standards/project/FGDC-standards-projects/vegetation.

Flahault, C., and C. Schroter. 1910. Rapport sur la nomenclature phytogeopraphique. Proceedings of the Third International Botanical Congress, Brussels 1:131-164.

Grossman, D. H., D. Faber-Langendoen, A.S. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K.D. Patterson, M. Pyne, M. Reid, and L. Sneddon. 1998. International Classification of Ecological Communities: Terrestrial Vegetation of the United States. Volume I. The National Classification System: Development, Status, and Applications. The Nature Conservancy, Arlington, VA.

Guntenspergen, G. R., D. R. Cahoon, J. B. Grace, G. D. Steyer, S. Fournet, M. A. Townson, and A. L. Foote. 1995. Disturbance and recover of the Louisiana coastal marsh landscape from the impacts of Hurricane Andrew. Journal of Coastal Research SI 21:324-251

Hershey, R. R., and W. A. Befort. 1995. Aerial photo guide to New England forest cover types. General Technical Report NE-195. U.S. Forest Service, Radnor, Pennsylvania, USA.

Lea, C. and A.C. Curtis. 2010. Thematic accuracy assessment procedures: National Park Service Vegetation Inventory, version 2.0. Natural Resources Report NPS/2010/NRR-2010/204. National Park Service, Fort Collins, Colorado.

Morgan, J. P., L. G. Nichols, and M. Wright. 1958. Morphological effects of Hurricane Audrey on the Louisiana coast. Technical Report Number 10, Coastal Studies Institute, Louisiana State University, Baton Rouge, Louisiana.

NatureServe. 2003. International Ecological Classification Standard: International Vegetation Classification. Natural Heritage Central Databases, NatureServe, Arlington, VA.

NatureServe. 2009. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, VA, USA. [Available: http://www.natureserve.org/explorer].

NatureServe. 2010. NPS PLOTS Database Version 3.2. NatureServe, Arlington, Virginia, USA.

Nordman, C. 2011. Personal communication. February 21, 2011. Southeast regional office of NatureServe, Raleigh/Durham, North Carolina.

National Weather Service (NWS) Raleigh, NC. 2014. Maximum wind gusts and rainfall from Hurricane Irene. http://www4.ncsu.edu/~nwsfo/storage/cases/maps/20110827.irene.gif. August 2014

Nyman, J. A., C. R. Crozier, and R. D. Delaine. 1995. Roles and patterns of hurricane sedimentation in an estuarine marsh landscape. Estuarine Coastal and Shelf Science 40:665-679

Palaseanu-Lovejoy, M., C. Kranenburg, J. A. Barras, J. C. Brock. 2013. Land loss due to recent hurricanes in coastal Louisiana, U.S.A. Journal of Coastal Research SI 63:97-109.

Philipson, W. 1997. Manual of Photographic Interpretation, Second Edition. American Society for Photogrammetry and Remote Sensing. Bethesda, MD.

Reid, M. and P. Comer. 1998. Vegetation Alliance Descriptions of the Western U.S. Available at http://www.gap.uidaho.edu/bulletins/7/VADWUS.htm.

Risi, J. A., H. R. Wanless, L. P. Tedesco, and S. Gelsanliter. 1995. Catastrophic sedimentation from Hurricane Andrew along southwest Florida coast. Journal of Coastal Research SI 21:83-102

The Nature Conservancy. 1996. Final Draft, Methodology for Assessing the Utility of Existing Data for Vegetation Mapping. Prepared for Prepared for USDI-National Biological Survey and NPS. Arlington, VA.

The Nature Conservancy (TNC) and Environmental Systems Research Institute (ESRI). 1994a. NBS/NPS Vegetation Mapping Program: Final Draft, Standardized National Vegetation Classification System. Prepared for USDI-National Biological Survey and NPS. Arlington, VA.

The Nature Conservancy (TNC) and Environmental Systems Research Institute (ESRI). 1994b. NBS/NPS Vegetation Mapping Program: Final Draft, Field Methods for Vegetation Mapping. Prepared for USDI – National Biological Survey and National Park Service. Arlington, Virginia.

The Nature Conservancy and Environmental Systems Research Institute. 1994. Final Draft Methodology for Assessing the Utility of Existing Data for Vegetation Mapping. NBS/NPS Vegetation Mapping Program. Prepared for the United States Department of Interior, Biological Sciences Resource Division and National Park Service.

USDA-NRCS. 2009. The PLANTS Database (http://plants.usda.gov, 19 April 2011). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

U.S. Geological Survey (USGS). 1999. Map accuracy standards. Fact sheet FS-171-99 (November 1999). Web address: http://egsc.ugs.gov/isb/pubs/factsheets/fs17199.html.

U.S. Geological Survey (USGS). 2014. Costal change hazards: hurricanes and extreme storms. http://coastal.er.usgs.gov/hurricanes/irene/photo-comparisons/. August 2014.

White, R. Personal communication. March 25, 2011. Southeast regional office of NatureServe, Raleigh/Durham, North Carolina.

Appendix A: Field Survey Form

PLOTS # CAHA001

NPS SE COAST PROJECT: Plot Sampling Form Page 1 of 3

County: Dare Park: (CAHA) CALO - MOCR Plot Code: CAHA.1 State: NC Location org: NPS

Provisional community name

Classified community name Viola paniculata Herbaceous Vegetation

Classifier CWN *Date* 10/7/2005 *NVC ELCODE* CEGL006038

Survey date: Oct 3, 2005 **time** 9:30am **Surveyors initials:** CWN, JG, MR, LM

Directions to plot (including any notes on best access route, and mile marker): Cape Hatteras NS: at end of road past lighthouse turnoff & past fishing staging area where road ends at beach, just to left facing ocean. About 25 m SW of little road over dune, from point ~~on~~ on road where #43 sign is on ~~the~~ NE side of road.

return to GPS flag

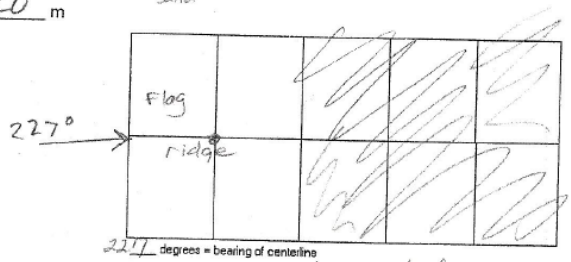
Time taken to walk to plot: 5 minutes

PLOT CONFIGURATION (Depict the plot layout on right with respect to the surrounding area and attempt to draw in points where GPS positions were collected, witness tree, bearing of centerline, locations of pictures taken, and communities near the plot.)

Plot representativeness -Is the surrounding area all the same? ___YES ✓ NO - If not, depict below)

PLOT LOCATION (Below show general plot location)

Plot dimensions: 20 m X 20 m



232 declination not adjusted 227 w/declination adjusted

Est. Extent of occurrence of community:

< 1HA 1-10 HA 10-100HA > 100HA

PIC # 53,54,55,56 Description of pictures (N,E,S & W from GPS point at middle of plot) :

Select one: (UTM) / Lat/long (If lat/long, then values are ___ N ___ W

GPS Techniques/Equipment: Garmin V Datum(pick one) (WGS84) / NAD83 / NAD27 UTM Zone: 18

GPS Unit ID ___ GPS file name CAHA01 (standard = First letter(s) of park + # of plot (e.g. CH04, CL04, MO04)

Field UTM X 0451980 m E Y 3899275 m N Elevation ___ m / ft

Averaging performed (at least 120 observations)? 180 Coordinate accuracy 10 m / (ft) DOP ___ # sats 9 (9 of 11 WAAS enabled)

Community Survey
Page 1

NPS SE COAST PROJECT: Plot Sampling Form

County: DARE Park: CAHA - CALO - MOCR Plot Code: CAHA.1 State: NC Location org: NPS

ENVIRONMENTAL / SITE INFORMATION

Measured Slope ____ ° ____ %

__ Flat	0 °	0 %
✓ Gentle	0-5 °	1-9%
__ Moderate	6-14 °	10-25%
__ Somewhat steep	15-25 °	26-49%
__ Steep	27-45 °	50-100%
__ Very steep	45-69 °	101-275%
__ Abrupt	70-100 °	276-300
__ ovrhng/shltrd	>100 °	>300%

Measured Aspect ____ ° (N=0 °)

__ Flat		✓ SE	113-157 °
__ Variable		__ S	158-202 °
__ N	338-22 °	__ SW	203-247 °
__ NE	23-67 °	__ W	248-292 °
__ E	68-112 °	__ NW	293-337 °

Topographic Position
__ Interfluve (Ridge/summit/crest) __ Toeslope
__ High Slope (upper/convex slope)
__ Midslope __ Low level (terrace)
✓ Lowslope (lower/footslope) __ Channel bed

Cowardin System
✓ Upland __ Palustrine
__ Estuarine __ Lacustrine __ Riverine

Landform (check most applicable)

__ Alluvial flat	__ Bottomlands	__ Interdune Flat	__ Spit
__ Alluvial terrace	__ Carolina Bay	__ Lagoon	__ Streambed
__ Backslope Terrace	__ Channel	__ Lowland	__ Streamhead
__ Bank	__ Depression	__ Mound	__ Swale
__ Bar	__ Draw	__ Mudflat	__ Tidal Flat
__ Barrier Island	✓ Dune	__ Ravine	__ Toe slope
__ Beach	__ Estuary	__ Ridge	__ Washover Fan
__ Beach Ridge	__ Floodplain	__ Seep	__ _____
__ Bench	__ Gap	__ Slope	__ _____
	__ Gravel Bar	__ Slough	__ _____

Rock types present:

Hydrologic Regime *(check only for wetlands)*
✓ Not a wetland (Upland: XERIC : DRY - MESIC : MESIC)
__ Intermittently flooded __ Permanently flooded __ Semipermanently flooded __ Temporarily Flooded (e.g. floodplains) __ Tidally Flooded
__ Seasonally Flooded (e.g. seasonal ponds) __ Saturated (e.g. bogs, perennial seeps) __ Unknown ✓ Irregularly flooded __ Irrglrly exposed

QUALITATIVE ASSESSMENT:

A) HYDROLOGY:
subject to salt spray + storm overwash

B) LANDSCAPE AND LANDUSE HISTORY (including disturbance history and possible threats to sustainability):
Atlantic Coastal barrier island, Sand dune

Soil Texture:
✓ Sand __ Peat __ Silt loam __ Muck
__ Sandy loam __ Loam __ Clay loam __ Clay

Drainage:
✓ Rapidly drained __ Moderately well drained __ Somewhat poorly drained
__ Well drained __ Poorly drained __ Very poorly drained

Ground cover **[Exclusive of living plants; adds to 100%]**

____ % Bedrock	____ % Litter, duff	____ % Other _____
____ % Large rocks (cobbles, boulders >10cm)	____ % Wood (> 1 cm)	
____ % Small rocks (gravel, 0.2-10 cm)	____ % Water	
100 % Loose sand (0.1-2 mm)	____ % Bare soil	

Leaf type:
__ Broad-leaved
__ Needle-leaved
__ Microphyllous
✓ Graminoid
✓ Broad-leaved herbaceous
__ Pteridophyte
__ Extremely xeromorphic
__ Mixed
__ Succulent

Leaf phenology (dominant stratum)
__ Evergreen
__ Cold-deciduous
__ Drought-deciduous
__ Mixed evergreen-cold-deciduous
__ Mixed evergreen drought deciduous
__ Herb - Annual
✓ Herb - Perennial

Physiognomic Class
__ Forest (closed tree canopy)
__ Woodland (open tree canopy)
__ Shrubland
__ Dwarf Shrubland
✓ Herbaceous (less than 25% woody layers)
__ Nonvascular
__ Sparse Vegetation

Natural and Anthropogenic Disturbance

_ logging	_ fire	_ Hydrologic
_ erosion	_ trails/roads	_ Agriculture
_ grazing/browsing	_ wind/ice damage	_ Old Growth
_ pine bark beetle	_ exotic plants	_ Fire Suppression
_ dogwood anthr	_ ORV	

Disturbance and animal use comments:

Community Survey
Page 2

NPS SE COAST PROJECT: Plot Sampling Form

County: Dare Park: CAHA - CALO - MOCR Plot Code: CAHA, 1 State: NC Location org: NPS

QUANTITATIVE VEGETATION SAMPLE

STRATA	STRATA HEIGHT (1 only)	COVER CLASS	DOMINANT/DIAGNOSTIC SPECIES
Emergent – T1			
Tree Canopy T2			
Subcanopy T3			
Tall shrub S1			
Short shrub S2			
Herbaceous	2	70%	Uniola paniculata
Non-vascular			
Vine/liana			

Other notable species (indicators of distinctive conditions, e.g. high pH soil, elevation, geographic region, other particularly abundant species):

Height scale (use tallest one for strata)	% cover for strata = top of cover class
< .5m 1	0-5% 1
.5-1m 2	5-10% 2
1-2m 3	10-20% 3
2-5m 4	20-30% 4
5-10m 5	30-40% 5
10-15m 6	40-50% 6
15-20m 7	50-60% 7
20-35m 8	60-70% 8
35-50m 9	70-80% 9
>50m 10	80-90% 10
	90-100% 11

T1: Emergent | T2: Tree Canopy | T3 Subcanopy | S1 Tall Shrub (>1m; to 5m) | S2 Short Shrub (< 1m) | H Herbaceous | N Nonvascular | V Vines (lianas) | E Epiphytes

SPECIES COMPOSITION AND COVER/ABUNDANCE CLASS BY STRATUM (enter cover values for each stratum AND for Total cover)

T 1	T 2	T 3	S 1	S 2	H	N	V	E	Total Cover	Name (7 letter code or full name)	Collected? Spec #?	Discarded ?
					3					PLANLAN		
					4					HydrBON		
					8					UNIOPAN		
					1					OPun Hum		
					1					CAKI EDE	✓	✓
					3					COMMEREA	✓	✓
					1					CYNO DAC (Bermuda Grass)	✓	✓
					2					SOLI SEM		
					3					CROT PUN		
					5					SPAR PAT		
					1					ERAGROSTIS SPECTABILIS	✓	✓
					1					SALS KAL		
					1					CIRS HOR	✓	
					1					CYNA ANG		
					0					PANI AMARum		

Cover cls	
1	trace
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%

Community Survey
Page 3

Appendix B: Descriptions of Vegetation Types

This subset of the International Ecological Classification Standard covers associations and alliances attributed to Cape Hatteras National Seashore. This classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. Comments and suggestions regarding the contents of this subset should be directed to Mary J. Russo, Central Ecology Data Manager, Durham, NC <mary_russo@natureserve.org> and Carl W. Nordman, Regional Ecologist, Durham, NC <carl_nordman@natureserve.org>. Some classifications were altered by SECN staff and are detailed in the descriptions below. In those instances, comments should be directed to the authors of this report.

Copyright © 2007 NatureServe, 1101 Wilson Blvd, 15th floor
Arlington, VA 22209, U.S.A. All Rights Reserved.

These vegetation data, descriptions and classifications should be cited as:

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 18 December 2007.

Information Warranty Disclaimer: All data are provided as is without warranty as to the currentness, completeness, or accuracy of any specific data. The absence of data in any particular geographic area does not necessarily mean that species or ecological communities of concern are not present. NatureServe hereby disclaims all warranties and conditions with regard to these data, including but not limited to all implied warranties and conditions of merchantability, fitness for a particular purpose, and non-infringement. In no event shall NatureServe be liable for any special, indirect, incidental, consequential damages, or for damages of any kind arising out of or in connection with the use of these data. Because the data in the NatureServe Central Databases are continually being updated, it is advisable to refresh data at least once a year after receipt.

Table of Contents

Page

Table of Contents 52

Forest (I.) 54

Lowland Temperate Seasonal Evergreen Forest (I.A.4.N.a.) 54

Quercus virginiana – (Sabal Palmetto) Forest Alliance (A.99) 54

Saturated Temperate Seasonal Evergreen Forest (I.A.4.N.g.) 58

Magnolia virginiana - Persea palustris Saturated Forest Alliance (A.60) 58

Planted/Cultivated Temperate or Subpolar Needle-leaved Evergreen Forest (I.A.8.C.x.) 64

Pinus elliottii Planted Forest Alliance (A.95) 64

Pinus pinaster Planted Forest Alliance (A.1991) 68

Saturated Temperate or Subpolar Needle-leaved Evergreen Forest (I.A.8.N.g.) 70

Pinus Taeda Saturated Forest Alliance (A.3009) 70

Seasonally Flooded Cold-deciduous Forest (I.B.2.N.e.) 75

Cornus foemina Seasonally Flooded Forest Alliance (A.319) 75

Mixed Needle-leaved Evergreen - Cold-deciduous Forest (I.C.3.N.a) 79

Pinus taeda - Quercus nigra Forest Alliance (A.406) 79

Shrubland (III.) 86

Sclerophyllous Temperate Broad-leaved Evergreen Shrubland (III.A.2.N.c) 86

Quercus virginiana - Ilex vomitoria - (*Morella cerifera*) Shrubland Alliance (A.785) 86

Saturated Temperate Broad-leaved Evergreen Shrubland (III.A.2.N.i) 90

Morella cerifera Saturated Shrubland Alliance (A.1906) 90

Temperate Cold-deciduous Shrubland (III.B.2.N.a) 96

Smilax spp. - Toxicodendron radicans Vine-Shrubland Alliance (A.909) 96

Tidal Cold-deciduous Shrubland (III.B.2.N.h) 100

Baccharis halimifolia - Iva frutescens Tidal Shrubland Alliance (A.1023) *100*

Borrichia frutescens Tidal Shrubland Alliance (A.1026) 108

Herbaceous Vegetation (V.) 113

Planted/Cultivated Temperate or Subpolar Grassland (V.A.5.C.x) 113

Table of Contents (continued)

Page

Eremochloa ophiuroides Planted Herbaceous Alliance (A.1187) 113

Tall Sod Temperate Grassland (V.A.5.N.a) 115

Uniola paniculata Temperate Herbaceous Alliance (A.1199) 115

Medium-tall Sod Temperate or Subpolar Grassland (V.A.5.N.c) 122

Muhlenbergia filipes Herbaceous Alliance (A.1217) 122

Short Sod Temperate or Subpolar Grassland (V.A.5.N.e) 127

Spartina patens – (*Schoenoplectus pungens*) Herbaceous Alliance (A.1274) 127

Seasonally Flooded Temperate or Subpolar Grassland (V.A.5.N.k) 134

Fimbristylis castanea - Schoenoplectus pungens Seasonally Flooded Herbaceous Alliance (A.1372) 134

Typha domingensis Seasonally Flooded Temperate Herbaceous Alliance (A.1392) 138

Tidal Temperate or Subpolar Grassland (V.A.5.N.n) 143

Cladium mariscus ssp. *jamaicense* Tidal Temperate Herbaceous Alliance (A.1473) 143

Juncus roemerianus Tidal Herbaceous Alliance (A.1475) 146

Phragmites australis Tidal Herbaceous Alliance (A.1477) 152

Spartina alterniflora Tidal Herbaceous Alliance (A.1471) 159

Spartina patens – (*Distichlis spicata*) Tidal Herbaceous Alliance (A.1481) 163

Tidal Temperate Perennial Forb Vegetation (V.B.2.N.g) 171

Sarcocornia perennis – (*Distichlis spicata, Salicornia* spp.) Tidal Herbaceous Alliance (A.1704) 171

Sparse Vegetation (VII.) 176

Sand Flats (VII.C.2.N.a) 176

Cakile edentula Sparsely Vegetated Alliance (A.1861) 176

Tidal Sand Flats (VII.C.2.N.d) 184

Sesuvium ssp. – *Atriplex* spp. – *Suaeda* spp. Tidal Sparsely Vegetated Alliance (A.1868) 184

No Alliance Placement 187

Bibliography 189

Forest (I.)

Lowland Temperate Seasonal Evergreen Forest (I.A.4.N.a.)

Quercus virginiana – (Sabal Palmetto) Forest Alliance (A.99)

Alliance Concept

Summary: This alliance includes communities of barrier islands, maritime hammocks, and some more inland coastal hammocks and other fire-protected situations, which are dominated and characterized by *Quercus virginiana* (live oak), and often containing *Sabal palmetto* (cabbage palmetto) and *Juniperus virginiana var. silicicola* (southern redcedar) within their ranges. Habitats for associations in this alliance range from xeric and subxeric to moist. Vegetation of this alliance most typically lies just landward of maritime shrub zones; it ranges from temperate to subtropical and often has a component of deciduous broad-leaved trees as well, particularly in the north. Some examples are affected by varying intensities of salt spray; these situations display more-or-less wind- and salt spray-sculpted vegetation. Other upland examples are not affected by salt spray and correspondingly differ in composition and stature. Composition varies along a latitudinal gradient. Examples occur on sand flats, lower slopes, and on stabilized dunes that are protected from saltwater flooding but which experience light to moderate salt spray. Some more protected examples have relatively closed and diverse canopies and well-developed shrub strata; vines are often conspicuous and abundant, but the herbaceous stratum is typically sparse and low in diversity. This community occurs over moist, sandy soils, on low areas of the mainland coast, and stands are protected from the most extreme maritime influences (i.e., salt spray) but are susceptible to high winds and flooding during hurricanes. Extending south from the vicinity of Cape Fear, North Carolina, the canopy is dominated by *Quercus virginiana* (live oak) and *Pinus taeda* (loblolly pine) with some *Sabal palmetto* (cabbage palmetto). Farther south, *Pinus elliottii var. elliottii* (Honduras pine) replaces *Pinus taeda* (loblolly pine), and *Sabal palmetto* (cabbage palmetto) becomes more prominent. In mid-Florida, tropical species begin to dominate the understory while temperate species retain canopy dominance. South of Martin County, Florida, tropical species such as *Bursera simaruba* (gumbo limbo), *Sideroxylon foetidissimum* (false mastic), and *Ficus aurea* (Florida strangler fig) begin to dominate the forest canopy. The more tropically influenced examples may contain shrubs such as *Eugenia axillaris* (white stopper), *Myrsine floridana* (Guianese colicwood), and *Coccoloba uvifera* (seagrape) on the west coast of Florida, and *Myrcianthes fragrans* (twinberry), *Ardisia escallonoides* (island marlberry), and *Psychotria nervosa* (Seminole balsamo) on the east coast. The alliance also includes tropical/temperate maritime hammocks of the east coast of Florida, in mid-peninsula, characteristically with oak canopy and tropical subcanopy; as well as temperate maritime hammocks of the northeast and Panhandle coasts of Florida. Vegetation of this alliance may be found on xeric to mesic sites, often occurring as linear strands behind frontal dunes. The seaward

edge is generally found on the leeward side of dune complexes which provide shelter from excessive salt spray and overwash; this vegetation is also found on top of relict dune ridges and other areas with xeric to mesic hydrology. While relatively protected, the vegetation frequently exhibits effects of wind-pruning and salt spray. The alliance also includes some dry hammocks, found from Florida to North Carolina; in these examples, *Quercus virginiana* (live oak) is dominant, and sometimes *Juniperus virginiana var. silicicola* (southern redcedar) is present in the canopy. Frequently small *Cladina - Cladonia*-dominated openings are present. On small hammocks in salt marshes, *Juniperus virginiana var. silicicola* (southern redcedar), *Baccharis halimifolia* (eastern baccharis), and *Morella cerifera* (wax myrtle) are characteristic. Another type of xeric hammock contains *Serenoa repens* (saw palmetto) under a *Quercus virginiana* (live oak) canopy. On Amelia Island, Florida, *Magnolia grandiflora* (southern magnolia) is characteristically in the understory, increasing after cutting or with a greater shell content in the soil. Some Mississippi vegetation included here is found on coastal sand ridges along inlets of marsh channels.

Similar Alliances:

- *Quercus virginiana - Carya illinoinensis* Woodland Alliance (A.665)
- *Quercus virginiana - Celtis laevigata* Forest Alliance (A.374)
- *Quercus virginiana - Juniperus virginiana - (Sabal palmetto)* Woodland Alliance (A.479)--related vegetation which occurs under more severe conditions
- *Quercus virginiana - Quercus nigra* Saturated Forest Alliance (A.379)
- *Quercus virginiana - Quercus stellata* Woodland Alliance (A.668)

Related Concepts:

- Cabbage Palmetto: 74 (Eyre 1980) I
- IA9a. Mid-Atlantic Barrier Island Forest (Allard 1990) I
- IA9b. South Atlantic Inland Maritime Forest (Allard 1990) I
- IA9c. Mid-Atlantic Inland Maritime Forest (Allard 1990) I
- IA9d. South Atlantic Barrier Island Forest (Allard 1990) ?
- Interdune Forest (Ambrose 1990a) ?
- Live Oak: 89 (Eyre 1980) I
- Maritime Evergreen Forest (Schafale and Weakley 1990) I
- Maritime Forest (Nelson 1986) I
- Maritime Hammock (FNAI 1990) I
- Maritime Hammock (FNAI 1992a) I
- Maritime Strand Forest (Ambrose 1990a) ?
- Oak-bay forest (Sharitz 1975) ?
- Upland Maritime Forest (Ambrose 1990a) ?
- Xeric Hammock (FNAI 1992a) ?
- Xeric Hammock, Sandhill Hammock subtype (FNAI 1992b) ?

Alliance Description

Environment: These forests occur on barrier islands or coastal hammocks, in situations ranging from xeric and subxeric to moist. Some examples are affected by varying intensities of salt spray; these situations display more-or-less wind- and salt spray-sculpted vegetation. Other upland examples are not affected by salt spray and correspondingly differ in composition and stature. This community occurs over moist, sandy soils, on low areas of the mainland coast, and stands are protected from the most extreme maritime influences (i.e., salt spray) but are susceptible to high winds and flooding during hurricanes. The alliance also includes tropical/temperate maritime hammocks of the east coast of Florida, in mid-peninsula, characteristically with oak canopy and tropical subcanopy; as well as temperate maritime hammocks of the northeast and Panhandle coasts of Florida. Vegetation of this alliance may be found on xeric to mesic sites, often occurring as linear strands behind frontal dunes. The seaward edge is generally found on the leeward side of dune complexes which provide shelter from excessive salt spray and overwash; this vegetation is also found on top of relict dune ridges and other areas with xeric to mesic hydrology. The alliance also includes some dry hammocks, found from Florida to North Carolina. Some Mississippi vegetation included here is found on coastal sand ridges along inlets of marsh channels.

Vegetation: These forest communities are dominated by *Quercus virginiana* (live oak), and often contain *Sabal palmetto* (cabbage palmetto) and *Juniperus virginiana var. silicicola* (southern redcedar) within their ranges. The northernmost examples, in Virginia and extreme northeastern North Carolina, contain *Morella pensylvanica* (northern bayberry) as a shrub. Further south, stabilized dunes where salt spray is light to moderate display wind-sculpted vegetation dominated by *Quercus virginiana* (live oak) and *Quercus hemisphaerica* (Darlington oak) with lesser amounts of *Pinus taeda* (loblolly pine) and *Juniperus virginiana var. silicicola* (southern redcedar); typical understory components here include *Persea borbonia* (redbay), *Carpinus caroliniana ssp. caroliniana* (American hornbeam), *Juniperus virginiana var. silicicola* (southern redcedar), *Cornus florida* (flowering dogwood), *Osmanthus americanus var. americanus* (devilwood), *Ilex opaca var. opaca* (American holly), and *Zanthoxylum clava-herculis* (Hercules' club). Shrub species include *Ilex vomitoria* (yaupon), *Morella cerifera* (wax myrtle), *Sabal minor* (dwarf palmetto), and *Callicarpa americana* (American beautyberry). Dominant vines are *Toxicodendron radicans* (eastern poison ivy), *Vitis rotundifolia* (muscadine), *Smilax* (greenbrier) spp., *Parthenocissus quinquefolia* (Virginia creeper), *Bignonia capreolata* (crossvine), *Berchemia scandens* (Alabama supplejack), *Ampelopsis arborea* (peppervine), and *Gelsemium sempervirens* (evening trumpetflower). Typical herbs are *Mitchella repens* (partridgeberry), *Asplenium platyneuron var. platyneuron* (ebony spleenwort), *Chasmanthium laxum* (slender woodoats), *Piptochaetium avenaceum* (blackseed speargrass), *Galium pilosum* (hairy bedstraw), *Dichanthelium commutatum* (variable panicgrass), *Elephantopus nudatus* (smooth elephantsfoot), and *Passiflora lutea* (yellow passionflower). Canopies in more protected examples are dominated by *Quercus virginiana* (live oak), *Quercus hemisphaerica* (Darlington oak), and *Pinus taeda* (loblolly pine) and may also contain *Quercus falcata* (southern red oak),

Carya glabra (pignut hickory), *Quercus nigra* (water oak), and *Pinus palustris* (longleaf pine). Understory species include *Persea palustris* (swamp bay), *Magnolia virginiana* (sweetbay), *Osmanthus americanus var. americanus* (devilwood), *Ilex opaca var. opaca* (American holly), *Juniperus virginiana var. silicicola* (southern redcedar), and *Sassafras albidum* (sassafras). Typical shrubs in these examples include *Ilex vomitoria* (yaupon), *Morella cerifera* (wax myrtle), *Hamamelis virginiana* (American witchhazel), and *Sabal minor* (dwarf palmetto). Vines include *Vitis rotundifolia* (muscadine), *Smilax bona-nox* (saw greenbrier), *Gelsemium sempervirens* (evening trumpetflower), and *Campsis radicans* (trumpet creeper). Common herbaceous species are *Mitchella repens* (partridgeberry) and *Asplenium platyneuron var. platyneuron* (ebony spleenwort). Extending south from the vicinity of Cape Fear, North Carolina, the canopy is dominated by *Quercus virginiana* (live oak) and *Pinus taeda* (loblolly pine) with some *Sabal palmetto* (cabbage palmetto). Farther south, *Pinus elliottii var. elliottii* (Honduras pine) replaces *Pinus taeda* (loblolly pine), and *Sabal palmetto* (cabbage palmetto) becomes more prominent. In mid-Florida, tropical species begin to dominate the understory while temperate species retain canopy dominance. South of Martin County, Florida, tropical species, such as *Bursera simaruba* (gumbo limbo), *Sideroxylon foetidissimum* (false mastic), and *Ficus aurea* (Florida strangler fig), begin to dominate the forest canopy. These more tropically influenced examples may contain shrubs such as *Eugenia axillaris* (white stopper), *Myrsine floridana* (Guianese colicwood), and *Coccoloba uvifera* (seagrape) on the west coast of Florida, and *Myrcianthes fragrans* (twinberry), *Ardisia escallonoides* (island marlberry), and *Psychotria nervosa* (Seminole balsamo) on the east coast. In some examples, small *Cladina - Cladonia*-dominated openings are present. Other characteristic species include *Scleria triglomerata* (whip nutrush), *Paronychia baldwinii* (Baldwin's nailwort), *Cladina evansii* (Evans' reindeer lichen), *Stipulicida setacea* (pineland scalypink), and *Hypericum hypericoides* (St. Andrew's cross). Some examples (e.g., on Amelia Island, Florida), *Magnolia grandiflora* (southern magnolia) is characteristically in the understory, increasing after cutting or with a greater shell content in the soil.

Dynamics: Habitats for associations in this alliance range from xeric and subxeric to moist. Vegetation of this alliance lies just landward of maritime shrub zones; it ranges from temperate to subtropical and often has a component of deciduous broad-leaved trees as well, particularly in the north. Some examples are affected by varying intensities of salt spray; these situations display more-or-less wind- and salt spray-sculpted vegetation. Other upland examples are not affected by salt spray and correspondingly differ in composition and stature. Composition varies along a latitudinal gradient; the northernmost examples, in Virginia and extreme northeastern North Carolina, contain *Morella pensylvanica* as a shrub. Farther south, stabilized dunes where salt spray is light to moderate display variants of this vegetation as well. Some Mississippi vegetation included here is found on coastal sand ridges along inlets of marsh channels. This alliance occurs on sandy soils which are generally poorly developed and low in natural fertility and organic matter content. It is typically found on old dunes which have been stable for long enough to permit forest growth. While fire cycles are generally long (26-100 years), *Sabal*

palmetto is fire-resistant and produces flammable litter. Under dry conditions, fires will burn in from adjoining pinelands and kill fire-sensitive species such as *Quercus hemisphaerica* and some tropical species. In the northern portion of this community's range, siliceous sands dominate in preference to carbonate ones; the siliceous sands are generally nutrient poor, while carbonate ones are richer. Farther south, the carbonate fraction increases. Carbonate sands begin to dominate in the Deep South, especially along the coast of Florida. Barrier island soils are derived from material carried onto the island by water and wave action and not from weathering of rock. The major nutrient input to the terrestrial vegetation is from salt spray and precipitation.

Alliance Distribution

Range: This alliance is found in the Coastal Plain from Virginia to Alabama and Florida, and possibly Mississippi.

Nations: US

Subnations: AL, FL, GA, MS?, NC, SC, VA

TNC Ecoregions: 53:C, 54:P, 55:C, 56:C, 57:C, 58:?

USFS Ecoregions: 232Bc:CCC, 232Be:CCC, 232Bf:CCC, 232Bg:CCC, 232Bh:CCC, 232Bi:CCP, 232Bj:CCC, 232Bo:CC?, 232Bp:CCP, 232Ca:CCC, 232Cb:CCC, 232Cc:CCP, 232Ce:CCC, 232Cf:CC?, 232Ch:CCC, 232Ci:CCC, 232Db:CCC, 232Dc:CCC, 232Dd:CCC, 232De:CCC, 232Ga:CCP, 232Gb:CCC, 232Gc:CCP, 232Gd:CCP

Federal Lands: DOD (Cape Canaveral, Eglin, Tyndall?); NPS (Canaveral, Cape Hatteras, Cape Lookout, Cumberland Island, Fort Pulaski, Timucuan); USFS (Apalachicola, Croatan, De Soto, Francis Marion, Ocala, Osceola); USFWS (Back Bay, Blackbeard Island?, Bon Secour, Cape Romain, Currituck, Lake Woodruff?, Merritt Island?, Swanquarter?, Wassaw?, Wolf Island?)

Saturated Temperate Seasonal Evergreen Forest (I.A.4.N.g.)

Magnolia virginiana - Persea palustris Saturated Forest Alliance (A.60)

Alliance Concept

Summary: These are saturated forests of the Atlantic and Gulf coastal plains which have canopies typically dominated by *Magnolia virginiana* (sweetbay) and/or *Persea palustris* (swamp bay). Both species are generally present; one or the other may dominate. In some stands and associations now assigned here, dominance of these species may be shared with *Gordonia lasianthus* (loblolly bay), or this species may dominate. This alliance was originally described as lacking substantial dominance by *Gordonia lasianthus* (loblolly bay), this species being present only in small amounts, but the former *Gordonia lasianthus* (loblolly bay) Saturated Forest Alliance has been merged in here. In addition to these species, *Acer rubrum* (red maple), *Pinus serotina* (pond pine), and *Pinus elliottii var. elliottii* (Honduras pine) may also occur.

This alliance includes seepage-fed saturated forests found at the base of steepheads, with cool microclimates; also stream-associated flats and isolated peaty wetlands; as well as peaty soils only slightly above sea level, in swales and seepage-fed areas adjacent to sand dunes. Associated shrubs may include *Cyrilla racemiflora* (swamp titi), *Illicium floridanum* (Florida anisetree), *Ilex coriacea* (large gallberry), *Ilex glabra* (inkberry), *Viburnum nudum var. nudum* (possumhaw), *Clethra alnifolia* (coastal sweetpepperbush), *Itea virginica* (Virginia sweetspire), *Pinckneya bracteata* (fevertree), and *Lyonia lucida* (fetterbush lyonia). In addition, *Cephalanthus occidentalis* (common buttonbush) may occur in wetter examples. Vines (*Smilax laurifolia* (laurel greenbrier), *Smilax glauca* (cat greenbrier), *Vitis rotundifolia* (muscadine)) may also occur. Herbs include *Rhynchospora* (beaksedge) spp., *Peltandra sagittifolia* (white arrow arum), *Peltandra virginica* (green arrow arum), *Sarracenia purpurea* (purple pitcherplant), *Drosera intermedia* (spoonleaf sundew), *Pinguicula pumila* (small butterwort), *Viola X primulifolia* (primroseleaf violet), *Athyrium filix-femina ssp. asplenioides* (asplenium ladyfern), *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis var. spectabilis* (royal fern), *Woodwardia areolata* (netted chainfern), and *Carex atlantica ssp. capillacea* (prickly bog sedge). *Sphagnum* (sphagnum) is common to scattered in examples of this alliance. Some examples occur in association with *Cliftonia monophylla* (buckwheat tree) forest, in slightly drier (though still saturated) situations. Canopy coverage can vary from closed to somewhat open, depending on disturbance; some maritime associations are subject to flooding, hurricanes, or storms which can create canopy openings. A maritime forest dominated by *Persea palustris* (swamp bay) is included here; in this example *Morella cerifera* (wax myrtle) is common in the shrub layer. The herb layer has *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis var. spectabilis* (royal fern), *Woodwardia virginica* (Virginia chainfern), and *Woodwardia areolata* (netted chainfern). This alliance is known from the Atlantic Coastal Plain from North Carolina south to Florida, and in the Florida Gulf Coastal Plain. Occurrences in subtropical Florida have subtropical components, such as *Chrysobalanus icaco* (icaco coco plum), *Ficus aurea* (Florida strangler fig), *Annona glabra* (pond apple), *Sambucus canadensis* (common elderberry), *Myrsine floridana* (Guianese colicwood), *Psychotria tenuifolia* (shortleaf wild coffee), *Dicliptera sexangularis* (sixangle foldwing), *Cladium mariscus ssp. jamaicense* (Jamaica swamp sawgrass), *Acrostichum danaeifolium* (inland leatherfern), *Blechnum serrulatum* (toothed midsorus fern), *Nephrolepis exaltata* (Boston swordfern), *Thelypteris kunthii* (Kunth's maiden fern), *Rivina humilis* (rougeplant), *Habenaria odontopetala* (toothpetal bog orchid), and *Melothria pendula* (Guadeloupe cucumber).

Similar Alliances:

- *Cliftonia monophylla* Saturated Forest Alliance (A.58)
- *Cyrilla racemiflora - Ilex coriacea - (Cliftonia monophylla)* Saturated Shrubland Alliance (A.802)--related vegetation from the West Gulf Coastal Plain
- *Magnolia virginiana - Nyssa biflora - (Quercus laurifolia)* Saturated Forest Alliance (A.378)--includes some related mixed broad-leaved evergreen - cold-deciduous vegetation
- *Pinus serotina* Saturated Woodland Alliance (A.581)
- *Taxodium distichum - Persea palustris - Chrysobalanus icaco* Seasonally Flooded Forest Alliance (A.366)

Related Concepts:

- Bay Forest (Schafale and Weakley 1990) I
- Baygall (FNAI 1992a) I
- Baygall, Loblolly Baygall subtype (FNAI 1992b) ?
- Baygall, Sweetbay Baygall subtype (FNAI 1992b) ?
- Bayhead (Olmsted and Loope 1984) ?
- Bayhead/Swamp Forests (Gunderson and Loftus 1993) ?
- Bog (FNAI 1992a) I
- Bog, Everglades Bayhead subtype (FNAI 1992b) I
- Floodplain Swamp (FNAI 1992a) I
- Floodplain Swamp, Sweet Bay Swamp subtype (FNAI 1992b) ?
- Forest, Carolina bay/Okefenokee swamp (Ambrose 1990a) ?
- IIA2d. Bay Forest (Allard 1990) I
- IIB2a. Bay Forest (Allard 1990) I
- Maritime Shrub Swamp, Red Bay Variant (Schafale and Weakley 1990) ?
- Shark Slough Bayhead Forest (Hilsenbeck et al. 1979) ?
- South Florida Bayhead Swamp Forest (Loope et al. 1994) ?
- Strand Swamp (FNAI 1992a) ?
- Strand Swamp, Everglades Bay Swamp subtype (FNAI 1992b) ?
- Sweetbay - Swamp Tupelo - Redbay: 104 (Eyre 1980) I
- Tropical Hardwoods: 105 (Eyre 1980) I

Alliance Description

Environment: This alliance includes seepage-fed saturated forests of the Atlantic and Gulf coastal plains with cool microclimates found at the base of steepheads and other slopes, also stream-associated flats and isolated peaty wetlands, as well as peaty soils only slightly above sea level, in swales and seepage-fed areas adjacent to sand dunes. This includes streamhead pocosins and other peaty streamhead situations such as large peat dome pocosins and peat-filled Carolina bays.

Vegetation: These are saturated forests of the Atlantic and Gulf coastal plains which have canopies typically dominated by *Magnolia virginiana* (sweetbay) and/or *Persea palustris* (swamp bay). Both species are generally present; one or the other may dominate. In some stands and associations now assigned here, dominance of these species may be shared with *Gordonia lasianthus* (loblolly bay), or this species may dominate. This alliance was originally described as lacking substantial dominance by *Gordonia lasianthus* (loblolly bay), this species being present only in small amounts, but the former *Gordonia lasianthus* (loblolly bay) Saturated Forest Alliance has been merged in here. In addition to these species, *Acer rubrum* (red maple), *Pinus serotina* (pond pine), and *Pinus elliottii var. elliottii* (Honduras pine) may also occur. Associated shrubs may include *Cyrilla racemiflora* (swamp titi), *Illicium floridanum* (Florida anisetree), *Ilex coriacea* (large gallberry), *Ilex glabra* (inkberry), *Viburnum nudum var. nudum* (possumhaw), *Clethra alnifolia* (coastal sweetpepperbush), *Itea virginica* (Virginia sweetspire), *Pinckneya bracteata* (fevertree), and *Lyonia lucida* (fetterbush lyonia). In addition, *Cephalanthus occidentalis* (common buttonbush) may occur in wetter examples. Vines (*Smilax laurifolia* (laurel greenbrier), *Smilax glauca* (cat greenbrier), *Vitis rotundifolia* (muscadine)) may also occur. Herbs include *Rhynchospora* (beaksedge) spp., *Peltandra sagittifolia* (white arrow arum), *Peltandra virginica* (green arrow arum), *Sarracenia purpurea* (purple pitcherplant), *Drosera intermedia* (spoonleaf sundew), *Pinguicula pumila* (small butterwort), *Viola X primulifolia* (primroseleaf violet), *Athyrium filix-femina ssp. asplenioides* (asplenium ladyfern), *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis var. spectabilis* (royal fern), *Woodwardia areolata* (netted chainfern), and *Carex atlantica ssp. capillacea* (prickly bog sedge). *Sphagnum* (sphagnum) is common to scattered in examples of this alliance. A maritime forest dominated by *Persea palustris* (swamp bay) is included here; in this example *Morella cerifera* (wax myrtle) is common in the shrub layer. The herb layer has *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis var. spectabilis* (royal fern), *Woodwardia virginica* (Virginia chainfern), and *Woodwardia areolata* (netted chainfern). In a maritime forest example *Morella cerifera* (wax myrtle) is common in the shrub layer. The herb layer in this type has *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis var. spectabilis* (royal fern), *Woodwardia virginica* (Virginia chainfern), and *Woodwardia areolata* (netted chainfern). Occurrences in subtropical Florida have subtropical components, such as *Chrysobalanus icaco* (icaco coco plum), *Ficus aurea* (Florida strangler fig), *Annona glabra* (pond apple), *Sambucus canadensis* (common elderberry), *Myrsine floridana* (Guianese colicwood), *Psychotria tenuifolia* (shortleaf wild coffee), *Dicliptera sexangularis* (sixangle foldwing), *Cladium mariscus ssp. jamaicense* (Jamaica swamp sawgrass), *Acrostichum danaeifolium* (inland leatherfern), *Blechnum serrulatum* (toothed midsorus fern), *Nephrolepis exaltata* (Boston swordfern), *Thelypteris kunthii* (Kunth's maiden fern), *Rivina humilis* (rougeplant), *Habenaria odontopetala* (toothpetal bog orchid), and *Melothria pendula* (Guadeloupe cucumber).

Dynamics: Canopy coverage can vary, depending on disturbance; some maritime associations are subject to flooding, hurricanes, or storms which can create canopy openings. An example of

this Alliance (CEGL007049) burned in a high-intensity wildfire in 1998 at Bradwell Bay, Apalachicola National Forest.

Alliance Distribution

Range: This alliance is found in the Atlantic and Gulf coastal plains of Mississippi, Florida, Georgia, North Carolina, and South Carolina, and may occur in Alabama and Louisiana.

Nations: US

Subnations: AL?, FL, GA, NC, SC

TNC Ecoregions: 53:C, 54:C, 55:C, 56:C, 57:C

USFS Ecoregions: 232Be:CCC, 232Bf:CCC, 232Bg:CCC, 232Bh:CCC, 232Bi:CCC, 232Bj:CCP, 232Bn:CC?, 232Bo:CC?, 232Bp:CC?, 232Bq:CC?, 232Br:CCC, 232Bs:CC?, 232Bu:CCC, 232Bv:CCP, 232Ca:CCC, 232Cb:CCC, 232Cc:CCC, 232Cd:CCC, 232Ce:CCC, 232Cf:CCC, 232Cg:CC?, 232Ch:CCC, 232Ci:CCC, 232Db:CCC, 232Dc:CCC, 232Ga:CCP, 232Gb:CCC, 232Gc:CCP, 232Gd:CCP, 411Ab:CCC

Federal Lands: DOD (Eglin, Fort Gordon?, Fort Stewart?); NPS (Cape Hatteras, Everglades, Timucuan); USFS (Apalachicola, Croatan, Francis Marion?, Ocala, Osceola)

(CEGL004635) Swampbay / Wax-myrtle Maritime Forest
***Persea palustris / Morella cerifera* Maritime Forest**
Maritime Red Bay Shrub Swamp

NVC Classification

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate broad-leaved seasonal evergreen forest (I.A.4.)
Physiognomic Subgroup	Natural/Semi-natural temperate broad-leaved seasonal evergreen forest (I.A.4.N.)
Formation	Saturated temperate seasonal evergreen forest (I.A.4.N.g.)
Alliance	*Magnolia virginiana - Persea palustris* Saturated Forest Alliance (A.60)
Alliance (English name)	Sweetbay - Swampbay Saturated Forest Alliance
Association	*Persea palustris / Morella cerifera* Maritime Forest
Association (English name)	Swampbay / Wax-myrtle Maritime Forest
Association (Common name)	Maritime Red Bay Shrub Swamp
Ecological System(s):	Central Atlantic Coastal Plain Maritime Forest (CES203.261)

Element Concept

Global Summary: This forest occurs on peaty soils only slightly above sea level, in swales and seepage-fed areas adjacent to sand dunes. The canopy is sometimes open, depending on wetness and recency of disturbance by flooding, hurricane, or storm. *Persea palustris* (swamp bay) is the canopy dominant. *Morella cerifera* (wax myrtle) is common in the shrub layer. The herb layer has *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis var. spectabilis* (royal fern), *Woodwardia virginica* (Virginia chainfern), and *Woodwardia areolata* (netted chainfern). *Sphagnum* (sphagnum) spp. are common.

Environmental Description

USFWS Wetland System: Palustrine

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This maritime bay swamp was sampled once on Cape Hatteras National Seashore. The site is a flat swale with saturated peat soil. The unvegetated surface is made up almost entirely of leaf litter (95% cover) with some wood (5%).

Global Environment: This forest occurs on peaty soils only slightly above sea level, in swales and seepage-fed areas adjacent to sand dunes.

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: The moderate (60% cover) canopy (5-10 m tall) is dominated by *Persea palustris* (swamp bay) and *Quercus virginiana* (live oak). The dense (90%) tall-shrub layer (2-5 m) and dense (80%) short-shrub layer (0.5-1 m) are dominated by *Ilex vomitoria* (yaupon), *Morella cerifera* (wax myrtle), *Persea palustris* (swamp bay), and the state-vulnerable *Juniperus virginiana var. silicicola* (southern redcedar). The sparse (5%) herbaceous layer includes shrub seedlings as well as *Apocynum cannabinum* (Indianhemp), *Boehmeria cylindrica* (smallspike false nettle), *Cicuta maculata* (spotted water hemlock), *Hydrocotyle bonariensis* (largeleaf pennywort), *Leersia virginica* (whitegrass), *Melothria pendula* (Guadeloupe cucumber), *Mikania scandens* (climbing hempvine), *Polygonum hydropiperoides* (swamp smartweed), *Solidago sempervirens* (seaside goldenrod), and *Triadenum walteri* (greater marsh St. Johnswort), among others. Seven species of vine (10%) were recorded in a single plot and include *Parthenocissus quinquefolia* (Virginia creeper), *Smilax auriculata* (earleaf greenbrier) (state-vulnerable), *Smilax bona-nox* (saw greenbrier), and *Toxicodendron radicans ssp. radicans* (eastern poison ivy).

Global Vegetation: *Persea palustris* (swamp bay) is the canopy dominant in stands of this type. *Morella cerifera* (wax myrtle) is common in the shrub layer. The herb layer has *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis var. spectabilis* (royal fern), *Woodwardia virginica* (Virginia chainfern), and *Woodwardia areolata* (netted chainfern). *Sphagnum* (sphagnum) spp. are common.

Most Abundant Species at Cape Hatteras and Cape Lookout National Seashores

Stratum	Lifeform	Species
Tree canopy	Broad-leaved evergreen tree	*Persea palustris* (swamp bay), *Quercus virginiana* (live oak)
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Ilex vomitoria* (yaupon), *Morella cerifera* (wax myrtle), *Persea palustris* (swamp bay)
Tall shrub/sapling	Needle-leaved shrub	*Juniperus virginiana* var. *silicicola* (southern redcedar)
Herb (field)	Vine/Liana	*Smilax auriculata* (earleaf greenbrier), *Smilax bona-nox* (saw greenbrier), *Toxicodendron radicans* ssp. *radicans* (eastern poison ivy)
Herb (field)	Graminoid	*Leersia virginica* (whitegrass)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Juniperus virginiana* var. *silicicola* (southern redcedar), *Lonicera japonica* (Japanese honeysuckle), *Phragmites australis* (common reed), *Quercus virginiana* (live oak), *Smilax auriculata* (earleaf greenbrier), *Solanum ptychanthum* (West Indian nightshade)

Conservation Status Rank

Global Rank & Reasons: G1 (26-Nov-2007). Known only from two protected sites on North Carolina's Outer Banks (Mid-Atlantic Coastal Plain), this wetland forest is extremely rare and vulnerable. Hurricane disturbance is a threat, as there are so few sites, and severe hurricane damage could convert this forest into a shrubland or other kind of non-forested vegetation. If there are any additional unknown and unprotected sites, they would be under significant threat.

Classification
Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments:

Global Similar Associations:

- *Salix caroliniana / Sacciolepis striata - Boehmeria cylindrica* Woodland (CEGL004222)

Element Distribution
Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found at Salvo Day Use Area on Hatteras Island.

Global Range: This association is found in coastal North and South Carolina.

Nations: US

States/Provinces: NC, SC

TNC Ecoregions:

USFS Ecoregions: 232Ci:CCC

Federal Lands: NPS (Cape Hatteras)

Element Sources
Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.12.

Local Description Authors: M.J. Russo

Global Description Authors: A.S. Weakley and M.P. Schafale

References: Schafale and Weakley 1990, Southeastern Ecology Working Group n.d.

Planted/Cultivated Temperate or Subpolar Needle-leaved Evergreen Forest (I.A.8.C.x.)

Pinus elliottii Planted Forest Alliance (A.95)

Alliance Concept:
Summary: This alliance includes planted stands (plantations) of *Pinus elliottii var. elliottii* (Honduras pine) (typically monospecific), within and outside of its natural range. These are cultivated forests and are not considered natural or semi-natural vegetation. They are maintained as plantations for the harvest of forest products (lumber, pulpwood). Stands of this alliance are primarily in uplands, but occasional stands in wetland environments are included here as well.

This alliance is also supposed to include the rare case of "exotic" stands resulting from natural regeneration outside of the natural range of *Pinus elliottii var. elliottii* (Honduras pine), although these are probably better accommodated as examples of *Pinus elliottii var. elliottii - (Pinus palustris)* Managed Forest (CEGL007171), a member of the *Pinus palustris - (Pinus elliottii)* Forest Alliance (A.123).

Classification Comments: Slash pine has been introduced into Kentucky, Virginia and eastern Texas, and now reproduces naturally in these locations.

Similar Alliances: *Pinus palustris - (Pinus elliottii)* Forest Alliance (A.123)--may include examples of abandoned plantations or silviculturally manipulated stands with a semi-natural ground layer.

Related Concepts: Slash Pine: 84 (Eyre 1980) I

Alliance Description

Environment: Stands of this alliance are primarily in uplands, but occasional stands in wetland environments are included here as well.

Vegetation: This alliance includes planted stands (plantations) of *Pinus elliottii var. elliottii* (Honduras pine) (typically monospecific), within and outside of its natural range.

Alliance Distribution

Range: This alliance is found in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Texas, and possibly Kentucky and Virginia. In Arkansas the species is found on industrial timber land. It is reportedly introduced into Kentucky.

Nations: US

Subnations: AL, AR, FL, GA, KY?, LA, MS, NC, SC, TX, VA?

TNC Ecoregions: 40:C, 41:C, 43:C, 52:P, 53:C, 55:C, 56:P, 57:P, 58:P

USFS Ecoregions: 231:C, 232Br:CCC, 232Ca:CCC, 232Cb:CCC, 232Ci:CCC

Federal Lands: DOD (Fort Benning, Fort Bragg, Fort Gordon, Fort Stewart); NPS (Cape Hatteras, Fort Pulaski, Timucuan?); USFS (Angelina, Apalachicola, Conecuh, Kisatchie, Ocala, Osceola, Sabine)

(CEGL007170) Slash Pine Planted Forest
***Pinus elliottii* var. *elliottii* Planted Forest**
Slash Pine Plantation

NVC Classification

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)

Physiognomic Subgroup	Planted/Cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.)
Formation	Planted/cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.x.)
Alliance	*Pinus elliottii* Planted Forest Alliance (A.95)
Alliance (English name)	Slash Pine Planted Forest Alliance
Association	*Pinus elliottii* var. *elliottii* Planted Forest
Association (English name)	Slash Pine Planted Forest
Association (Common name)	Slash Pine Plantation

Ecological System(s):

Element Concept

Global Summary: This association includes planted stands (plantations) of *Pinus elliottii var. elliottii* (Honduras pine) (typically monospecific), within and outside of its natural range. These are cultivated forests and are not considered natural or semi-natural vegetation. They are maintained as plantations for the harvest of forest products (lumber, pulpwood). Stands are primarily in uplands, but occasional stands in wetland environments are included here as well. This concept is also supposed to include the rare case of "exotic" stands resulting from natural regeneration out of the natural range of *Pinus elliottii var. elliottii* (Honduras pine), although these are probably better accommodated as examples of *Pinus elliottii* (slash pine) var. *elliottii - (Pinus palustris)* Managed Forest (CEGL007171), a member of the *Pinus palustris - (Pinus elliottii)* Forest Alliance (A.123).

Environmental Description

USFWS Wetland System:

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: Slash pine plantations are found on Cape Hatteras National Seashore on flat to gently sloping areas with well-drained sand or sandy loam soils. The unvegetated surface is made up almost entirely of leaf litter (95-97% cover) with some wood 3-51%). Evidence of disturbance includes the presence of roads and trails and damage from wind and salt spray.

Global Environment: Stands are primarily in uplands, but occasional stands in wetland environments are included here as well.

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: The moderate (60% cover) canopy (15-35 m tall) is dominated solely by *Pinus elliottii var. elliottii* (Honduras pine). The very sparse (5%) subcanopy (5-15 m) may include *Juniperus virginiana var. silicicola* and *Pinus serotina* (pond pine) along with *Pinus elliottii var. elliottii* (Honduras pine). The sparse (5-20%) tall-shrub layer (2-5 m) and sparse to moderate (20-50%) short-shrub layer (0.5-2 m) are dominated by *Ilex vomitoria* (yaupon), *Morella cerifera* (wax myrtle), *Persea palustris* (swamp bay), and saplings of *Pinus elliottii var. elliottii* (Honduras pine). The herbaceous layer is sparse (5-20%) and made up mostly of tree and shrub seedlings. Vines (up to 40%), which may climb well into the canopy and drape over tall shrubs, include *Parthenocissus quinquefolia* (Virginia creeper), *Smilax auriculata* (earleaf greenbrier) (state-vulnerable), *Smilax bona-nox* (saw greenbrier), *Toxicodendron radicans ssp. radicans* (eastern poison ivy), and *Vitis aestivalis* (summer grape), among others.

Global Vegetation: These are planted stands dominated by *Pinus elliottii var. elliottii* (Honduras pine) (typically monospecific), within and outside of its natural range.

Most Abundant Species at Cape Hatteras and Cape Lookout National Seashores

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus elliottii* var. *elliottii* (Honduras pine)
Tree subcanopy	Needle-leaved tree	*Juniperus virginiana* var. *silicicola* (southern redcedar)
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Ilex vomitoria* (yaupon), *Morella cerifera* (wax myrtle), *Persea palustris* (swamp bay)

Herb (field)	Vine/Liana	*Parthenocissus quinquefolia* (Virginia creeper), *Smilax auriculata* (earleaf greenbrier), *Smilax bona-nox* (saw greenbrier), *Vitis aestivalis* (summer grape)
Herb (field)	Forb	*Toxicodendron radicans* ssp. *radicans* (eastern poison ivy)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Juniperus virginiana* var. *silicicola* (southern redcedar), *Persea borbonia* (redbay), *Smilax auriculata* (earleaf greenbrier).

Conservation Status Rank

Global Rank & Reasons: GNA (cultural) (8-Aug-2000). This community represents vegetation which has been planted in its current location by humans and/or is treated with annual tillage, a modified conservation tillage, or other intensive management or manipulation. It is not a conservation priority and does not receive a conservation rank.

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: These are cultivated forests and are not considered natural or semi-natural vegetation. They are maintained as plantations for the harvest of forest products (lumber, pulpwood). Slash pine has been introduced into Kentucky, Virginia and eastern Texas, and now reproduces naturally in these locations.

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found near Bodie Island Visitors Center and on Ocracoke Island, east of the Hammock Hills Nature Trail.

Global Range: This planted vegetation may be found throughout the lower south, from North Carolina to Texas, in the Coastal Plain and some adjacent ecoregions.

Nations: US

States/Provinces: AL, AR, FL, GA, KY?, LA, MS, NC, SC, TX, VA?

TNC Ecoregions:

USFS Ecoregions: 231:C, 232Br:CCC, 232Ca:CCC, 232Cb:CCC, 232Ci:CCC

Federal Lands: DOD (Fort Benning, Fort Bragg, Fort Gordon, Fort Stewart); NPS (Cape Hatteras, Fort Pulaski, Timucuan?); USFS (Angelina, Apalachicola, Conecuh, Kisatchie, Ocala, Osceola, Sabine)

Element Sources

Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.14, CAHA.59.

Local Description Authors: M.J. Russo

Global Description Authors: A.S. Weakley

References: Schotz pers. comm., Southeastern Ecology Working Group n.d.

Pinus pinaster Planted Forest Alliance (A.1991)

Alliance Concept

Summary: This alliance consists of plantings of *Pinus pinaster* (maritime pine) (native of Mediterranean Europe) along the barrier islands of North Carolina (and possibly elsewhere on the Atlantic coast of North America), with the goal of island stabilization. Older plantations have ingrowth of native woody species, such as *Pinus taeda* (loblolly pine), *Juniperus virginiana var. silicicola* (southern redcedar), *Quercus virginiana* (live oak), *Ilex vomitoria* (yaupon), *Morella cerifera* (wax myrtle), *Prunus serotina var. serotina* (black cherry), and others. Older plantations also have development of native floristic herbaceous composition, including *Spartina patens* (saltmeadow cordgrass), *Muhlenbergia filipes* (gulfhairawn muhly), *Eustachys petraea* (pinewoods fingergrass), etc.

Alliance Description

Environment: This alliance consists of plantings of *Pinus pinaster* (native of Mediterranean Europe) along the barrier islands of North Carolina (and possibly elsewhere on the Atlantic coast of North America), with the goal of island stabilization.

Vegetation: This alliance consists of plantings of *Pinus pinaster* (maritime pine) (native of Mediterranean Europe). Older plantations have ingrowth of native woody species, such as *Pinus taeda* (loblolly pine), *Juniperus virginiana var. silicicola* (southern redcedar), *Quercus virginiana* (live oak), *Ilex vomitoria* (yaupon), *Morella cerifera* (wax myrtle), *Prunus serotina var. serotina* (black cherry), and others. Older plantations also have development of native floristic herbaceous composition, including *Spartina patens* (saltmeadow cordgrass), *Muhlenbergia filipes* (gulfhairawn muhly), *Eustachys petraea* (pinewoods fingergrass), etc.

Alliance Distribution

Range: This alliance is found in North Carolina, and possibly other states.
Nations: US
Subnations: NC
TNC Ecoregions: 57:C
USFS Ecoregions: 232Ci:CCC
Federal Lands: NPS (Cape Hatteras)

(CEGL007945) Maritime Pine Planted Forest
***Pinus pinaster* Planted Forest**
Maritime Pine Plantation

NVC Classification

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)

Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
Physiognomic Subgroup	Planted/Cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.)
Formation	Planted/cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.x.)
Alliance	*Pinus pinaster* Planted Forest Alliance (A.1991)
Alliance (English name)	Maritime Pine Planted Forest Alliance
Association	*Pinus pinaster* Planted Forest
Association (English name)	Maritime Pine Planted Forest
Association (Common name)	Maritime Pine Plantation

Ecological System(s):

Element Concept

Global Summary: This association consists of plantings of *Pinus pinaster* (maritime pine) (native of Mediterranean Europe) along the barrier islands of North Carolina (and possibly elsewhere on the Atlantic coast of North America), with the goal of island stabilization. Older plantations have ingrowth of native woody species, such as *Pinus taeda* (loblolly pine), *Juniperus virginiana var. silicicola* (southern redcedar), *Quercus virginiana* (live oak), *Ilex vomitoria* (yaupon), *Morella cerifera* (wax myrtle), *Prunus serotina var. serotina* (black cherry), and others. Older plantations also have development of native floristic herbaceous composition, including *Spartina patens* (saltmeadow cordgrass), *Muhlenbergia filipes* (gulfhairawn muhly), *Eustachys petraea* (pinewoods fingergrass), etc.

Environmental Description

USFWS Wetland System:

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: *Pinus pinaster* is reported by Brown (1959) to be "introduced from Mediterranean region and planted on sand-flats in vicinity of ... Bodie Island and Hatteras Island 1936-1940."

Global Environment:

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: *Pinus pinaster* (maritime pine) is reported by Brown (1959) to be "introduced from Mediterranean region and planted on sand-flats in vicinity of ... Bodie Island and Hatteras Island 1936-1940.... Now producing seeds and becoming naturalized near Cape Hatteras Lighthouse."

Global Vegetation:

Most Abundant Species at **Cape Hatteras National Seashore and Cape Lookout National Seashore**

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus pinaster* (maritime pine)

Conservation Status Rank

Global Rank & Reasons: GNA (cultural) (8-Aug-2000). This community represents vegetation which has been planted in its current location by humans and/or is treated with annual tillage, a modified conservation tillage, or other intensive management or manipulation. It is not a conservation priority and does not receive a conservation rank.

Classification

Status: Standard

Classification Confidence: 1 - Strong

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: *Pinus pinaster* is reported by Brown (1959) to be "introduced from Mediterranean region and planted on sand-flats in vicinity of Corolla, Currituck Banks, Bodie Island and Hatteras Island 1936-1940.... Now producing seeds and becoming naturalized near Cape Hatteras Lighthouse. More resistant to salt spray than native pines" (Brown 1959). Graetz (1973) discusses its use on the Outer Banks and concludes that it is "not as well adapted to inclement beach conditions as Japanese black pine."

Global Similar Associations:

Global Related Concepts:

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Bodie Island, Hatteras Island, and naturalized near Cape Hatteras Lighthouse (Brown 1959).

Global Range: This association is found along the barrier islands of North Carolina (and possibly elsewhere on the Atlantic coast of North America).

Nations: US

States/Provinces: NC

TNC Ecoregions:

USFS Ecoregions: 232Ci:CCC

Federal Lands: NPS (Cape Hatteras)

Element Sources

Moores Creek National Battlefield Plots: MOCR.10.

Local Description Authors: M.J. Russo and C.W. Nordman

Global Description Authors: R. White, mod. M. Pyne

References: Collins and Anderson 1994, McCrain and Church 1985, NatureServe Ecology - Southeastern U.S. unpubl. data, Schotz pers. comm., Southeastern Ecology Working Group n.d., TDNH unpubl. data

Saturated Temperate or Subpolar Needle-leaved Evergreen Forest (I.A.8.N.g.)

Pinus Taeda Saturated Forest Alliance (A.3009)

Alliance Concept

Summary: Saturated forests dominated by *Pinus taeda* (loblolly pine) that may occur adjacent to salt marsh on the bay side of barrier islands. *Acer rubrum* (red maple), *Persea palustris* (swamp bay), and *Liquidambar styraciflua* (sweetgum) also may be present in the canopy. The understory may have strong dominance by vine species including *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy), and *Parthenocissus quinquefolia* (Virginia creeper).

Classification Comments: Assateague association may be better placed in a temporarily flooded formation (G. Fleming pers. comm.).

Similar Alliances:

- *Pinus taeda - Liquidambar styraciflua - Acer rubrum* Saturated Forest Alliance (A.445)--occurs in a variety of habitats where the abundance of *Pinus taeda* is thought to represent a post-disturbance successional condition.

Similar Alliance Comments:

Related Concepts:

- Estuarine Fringe Loblolly Pine Forest (Schafale and Weakley 1990) ?
- Loblolly Pine: 81 (Eyre 1980) I
- Woodland community (Hill 1986) I
- Coniferous swamp (Shreve et al. 1910) ?
- Loblolly pine association (Brush et al. 1980) I
- Mature loblolly pine stands of wet sites (Bratton and Davison 1987) I
- Pine woodland (Higgins et al. 1971) I

Alliance Description

Environment: Saturated forests dominated by *Pinus taeda* that may occur adjacent to salt marsh on the bay side of barrier islands.

Vegetation: *Acer rubrum* (red maple), *Persea palustris* (swamp bay), and *Liquidambar styraciflua* (sweetgum) also may be present in the canopy. The understory may have strong dominance by vine species including *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy), and *Parthenocissus quinquefolia* (Virginia creeper).

Dynamics:

Alliance Distribution

Range: This alliance is found in North Carolina, Delaware, Maryland, and Virginia, and possibly elsewhere. It occurs on the Northwest and North Landing rivers in North Carolina.

Nations: US

Subnations: DE, MD, NC, NJ, VA

TNC Ecoregions: 57:C, 58:C, 62:C

USFS Ecoregions: 232Ab:CCP, 232Ac:CCC, 232Bx:CCP, 232Bz:CCC, 232Ci:CCC

Federal Lands: NPS (Assateague Island, Cape Hatteras); USFWS (Back Bay, Chesapeake Marshlands, Prime Hook, Swanquarter)

(CEGL006137) Loblolly Pine / Wax-myrtle / Royal Fern Forest
***Pinus taeda / Morella cerifera / Osmunda regalis* var. *spectabilis* Forest**
Coastal Loblolly Pine Wetland Forest

NVC Classification

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
Formation	Saturated temperate or subpolar needle-leaved evergreen forest (I.A.8.N.g.)
Alliance	*Pinus taeda* Saturated Forest Alliance (A.3009)
Alliance (English name)	Loblolly Pine Saturated Forest Alliance
Association	*Pinus taeda / Morella cerifera / Osmunda regalis* var. *spectabilis* Forest
Association (English name)	Loblolly Pine / Wax-myrtle / Royal Fern Forest
Association (Common name)	Coastal Loblolly Pine Wetland Forest
Ecological System(s):	Northern Atlantic Coastal Plain Basin Swamp and Wet Hardwood Forest (CES203.520)
	Northern Atlantic Coastal Plain Maritime Forest (CES203.302)
	Central Atlantic Coastal Plain Maritime Forest (CES203.261)

Element Concept

Global Summary: This maritime/coastal wetland forest occurs in backdune depressions with high water tables and fringing estuaries from Delaware to North Carolina. Examples are characterized by a closed to partially open canopy dominated by *Pinus taeda* (loblolly pine). Other canopy associates may be absent, or may include *Acer rubrum* (red maple), *Persea palustris* (swamp bay), or *Liquidambar styraciflua* (sweetgum). The understory is made up of vines, strongly dominated by *Smilax rotundifolia* (roundleaf greenbrier), with lesser amounts of *Toxicodendron radicans* (eastern poison ivy) and *Parthenocissus quinquefolia* (Virginia creeper). In addition to comprising the majority of the ground layer of these forests, these vines are relatively large-stemmed lianas that contribute significant cover to the canopy by covering the lower branches of trees. *Morella cerifera* (wax myrtle) is a typical shrub of this community. The herbaceous layer is usually relatively sparse, characterized most frequently by ferns such as *Woodwardia areolata* (netted chainfern), *Osmunda regalis var. spectabilis* (royal fern), or *Osmunda cinnamomea* (cinnamon fern), and farther south (in North Carolina) by *Chasmanthium laxum* (slender woodoats). *Polygonum pensylvanicum* (Pennsylvania smartweed) may also occur. On Assateague Island National Seashore, *Pinus taeda* (loblolly pine) dominates the canopy, with occasional *Acer rubrum* (red maple). *Smilax rotundifolia* (roundleaf greenbrier) is the strongly dominant vine of the understory, with lesser amounts of *Toxicodendron radicans* (eastern poison ivy) and *Parthenocissus quinquefolia* (Virginia creeper). *Morella cerifera* (wax myrtle) is also a minor component of this vegetation. Trees tend to occur on slightly elevated hummocks, with standing water evident in hollows. *Phragmites australis* (common reed), *Rubus argutus* (sawtooth blackberry), *Panicum virgatum* (switchgrass), and *Polygonum pensylvanicum* (Pennsylvania smartweed) also occur within this community on Assateague Island National Seashore. Tree diameters range from 12-36 cm dbh. This community occurs primarily on the bay side of the island adjacent to salt marsh. Soils are characterized by moderately shallow muck (15 cm) overlying organic matter-stained sands. This vegetation occurs adjacent to salt marshes, sometimes even forming small 'islands' within high salt marsh. In North Carolina, it may extend well inland fringing bays and sounds on wet saturated flats that are flooded by storm tides.

Environmental Description

USFWS Wetland System: Palustrine

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This maritime wetland forest was sampled once on Cape Hatteras National Seashore. The site is the flat edge of a tidal marsh. The soil is a moderately well-drained sandy loam. The unvegetated surface is made up of equal amounts of leaf litter (50%

cover) and bare soil (49%) with some wood (1%). Evidence of disturbance includes the presence of trash and exotic plants.

Global Environment: This maritime/coastal wetland forest occurs in backdune depressions with high water and as an estuarine fringe along bays and sounds. Tree diameters range from 12-36 cm dbh. This community occurs primarily on the bay side of islands, barrier spits and on mainlands adjacent to salt marsh. Soils are characterized by moderately shallow muck (15 cm) overlying organic matter-stained sands. This vegetation occurs adjacent to salt marshes, sometimes even forming small "islands" within high salt marsh. In North Carolina, it may extend well inland fringing bays and sounds on wet saturated flats that are flooded by storm tides. Trees tend to occur on slightly elevated hummocks, with standing water evident in hollows.

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: *Pinus taeda* (loblolly pine) forms a sparse (total covers were not reported) canopy (5-10 m tall) over a moderate subcanopy (2-5 m) of *Morella cerifera* (wax myrtle), *Persea borbonia* (redbay) (state-imperiled), and *Juniperus virginiana var. silicicola* (southern redcedar) (state-vulnerable). The moderate tall-shrub layer (2-5 m) is comprised of subcanopy species as well as *Hibiscus moscheutos* (crimsoneyed rosemallow). The moderate short-shrub layer (0.5-1 m) includes *Baccharis halimifolia* (eastern baccharis), *Ilex vomitoria* (yaupon), *Iva frutescens* (Jesuit's bark), *Morella cerifera* (wax myrtle), and *Toxicodendron radicans ssp. radicans* (eastern poison ivy). The moderate herbaceous layer is dominated by *Eleocharis rostellata* (beaked spikerush) and includes lesser amounts of *Ammophila breviligulata* (American beachgrass), *Boehmeria cylindrica* (smallspike false nettle), *Borrichia frutescens* (bushy seaside tansy), *Dichanthelium consanguineum* (blood panicgrass), *Elymus virginicus var. halophilus* (Virginia wildrye) (state-critically imperiled), *Hydrocotyle bonariensis* (largeleaf pennywort), *Juncus roemerianus* (needlegrass rush), and *Osmunda regalis var. spectabilis* (royal fern), among others. Vines include *Ampelopsis arborea* (peppervine), *Calystegia sepium* (hedge false bindweed), and *Mikania scandens* (climbing hempvine).

Global Vegetation: Examples are characterized by a closed to partially open canopy dominated by *Pinus taeda* (loblolly pine). Other canopy associates may be absent or may include *Acer rubrum* (red maple), *Persea palustris* (swamp bay), or *Liquidambar styraciflua* (sweetgum). The understory is made up of vines, strongly dominated by *Smilax rotundifolia* (roundleaf greenbrier), with lesser amounts of *Toxicodendron radicans* (eastern poison ivy) and *Parthenocissus quinquefolia* (Virginia creeper). In addition to comprising the majority of the ground layer of these forests, these vines are relatively large-stemmed lianas that contribute significant cover to the canopy by covering the lower branches of trees. *Morella cerifera* (wax myrtle) is a typical shrub of this community. The herbaceous layer is usually relatively sparse, characterized most frequently by ferns such as *Woodwardia areolata* (netted chainfern), *Osmunda regalis var. spectabilis* (royal fern), or *Osmunda cinnamomea* (cinnamon fern), and farther south (in North Carolina) by *Chasmanthium laxum* (slender woodoats). *Polygonum pensylvanicum* (Pennsylvania smartweed) may also occur. On Assateague Island National Seashore, *Pinus taeda* (loblolly pine) dominates the canopy, with occasional *Acer rubrum* (red maple). *Smilax rotundifolia* (roundleaf greenbrier) is the strongly dominant vine of the understory, with lesser amounts of *Toxicodendron radicans* (eastern poison ivy) and *Parthenocissus quinquefolia* (Virginia creeper). *Morella cerifera* (wax myrtle) is also a minor component of this vegetation. *Phragmites australis* (common reed), *Rubus argutus* (sawtooth blackberry), *Panicum virgatum* (switchgrass), and *Polygonum pensylvanicum* (Pennsylvania smartweed) also occur within this community on Assateague Island National Seashore.

Most Abundant Species at Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus taeda* (loblolly pine)
Tree subcanopy	Needle-leaved tree	*Juniperus virginiana* var. *silicicola* (southern redcedar)

Tall shrub/sapling	Broad-leaved deciduous shrub	*Hibiscus moscheutos* (crimsoneyed rosemallow)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Morella cerifera* (wax myrtle), *Persea borbonia* (redbay)
Short shrub/sapling	Vine/Liana	*Toxicodendron radicans* ssp. *radicans* (eastern poison ivy)
Herb (field)	Vine/Liana	*Ampelopsis arborea* (peppervine), *Calystegia sepium* (hedge false bindweed), *Mikania scandens* (climbing hempvine)
Herb (field)	Graminoid	*Eleocharis rostellata* (beaked spikerush)

Global

Stratum	**Lifeform**	**Species**
Tree canopy	Needle-leaved tree	*Pinus taeda* (loblolly pine)
Shrub/sapling (tall & short)	Vine/Liana	*Smilax glauca* (cat greenbrier), *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Morella cerifera* (wax myrtle)
Herb (field)	Fern or fern ally	*Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* (royal fern)

Characteristic Species

Cape Hatteras National Seashore and Cape Lookout National Seashore:

Global: *Morella cerifera* (wax myrtle), *Pinus taeda* (loblolly pine), *Smilax rotundifolia* (roundleaf greenbrier)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Ammophila breviligulata* (American beachgrass), *Elymus virginicus* var. *halophilus* (Virginia wildrye), *Juniperus virginiana* var. *silicicola* (southern redcedar), *Lonicera japonica* (Japanese honeysuckle)

Conservation Status Rank

Global Rank & Reasons: G3 (31-Jan-2005). This community is restricted to barrier islands and coastal areas of the mainland that are directly influenced by the maritime climate. The range is restricted and includes coastal areas from Cape May, New Jersey, to northern North Carolina. As a community in large part restricted to barrier islands, it is faced with threats to barrier islands in general: intense development pressures where it remains unprotected.

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments:

Global Similar Associations:

- *Acer rubrum - Nyssa sylvatica - Magnolia virginiana / Viburnum nudum* var. *nudum / Osmunda cinnamomea - Woodwardia areolata* Forest (CEGL006238)
- *Pinus serotina / Magnolia virginiana / Vaccinium corymbosum / Carex atlantica* Woodland (CEGL006470)
- *Pinus taeda - Nyssa biflora - Liquidambar styraciflua / Lyonia lucida* Saturated Forest (CEGL007560)
- *Pinus taeda / Morella cerifera / Spartina patens* Tidal Woodland (CEGL006849)
- *Pinus taeda / Morella cerifera / Vitis rotundifolia* Forest (CEGL006040)

Global Related Concepts:

- *Pinus taeda / Myrica cerifera / Osmunda regalis var. spectabilis* Forest (Bartgis 1986) ?
- Coniferous swamp (Shreve et al. 1910) =
- Estuarine Fringe Pine Forest (Loblolly Pine Subtype) (Schafale 2000) ?
- Loblolly Pine: 81 (Eyre 1980) B
- Loblolly pine association (Brush et al. 1980) B
- Mature loblolly pine stands of wet sites (Bratton and Davison 1987) B
- Pine woodland (Higgins et al. 1971) B
- Woodland community (Hill 1986) B

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found on Ocracoke Island, east of Hammock Hills Nature Trail.

Global Range: This community ranges from the coast of Delaware and New Jersey to North Carolina.

Nations: US

States/Provinces: DE, MD, NC, NJ:S1?, VA

TNC Ecoregions:

USFS Ecoregions: 232Ab:CCP, 232Ac:CCC, 232Bx:CCP, 232Bz:CCC, 232Ci:CCC

Federal Lands: NPS (Assateague Island, Cape Hatteras); USFWS (Back Bay, Chesapeake Marshlands, Prime Hook, Swanquarter)

Element Sources

Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.58.

Local Description Authors: M.J. Russo

Global Description Authors: mod. J. Teague

References: Bartgis 1986, Bratton and Davison 1987, Breden et al. 2001, Brush et al. 1980, Eastern Ecology Working Group n.d., Eyre 1980, Fleming et al. 2001, Harrison 2004, Higgins et al. 1971, Hill 1986, Schafale 2000, Schafale and Weakley 1990, Shreve et al. 1910

Seasonally Flooded Cold-deciduous Forest (I.B.2.N.e.)

Cornus foemina Seasonally Flooded Forest Alliance (A.319)

Alliance Concept

Summary: Seasonally flooded wetlands dominated by *Cornus foemina* (stiff dogwood). There currently is one very rare association known only from the Outer Banks of North Carolina; it occurs in peaty soil in old interdune swales. It is dominated by a canopy of *Cornus foemina* (stiff dogwood), with much lesser amounts of *Morella cerifera* (wax myrtle), *Persea borbonia*

(redbay), and *Vaccinium stamineum* (deerberry), generally with dense thickets of *Berchemia scandens* (Alabama supplejack), *Ampelopsis arborea* (peppervine), *Smilax bona-nox* (saw greenbrier), *Smilax laurifolia* (laurel greenbrier), and *Smilax rotundifolia* (roundleaf greenbrier). A sparse, emergent supercanopy of *Pinus taeda* (loblolly pine) is often present.

Classification Comments:

Similar Alliances:

Similar Alliance Comments:

Related Concepts: Maritime Shrub Swamp, Dogwood Variant (Schafale and Weakley 1990) ?

Alliance Description

Environment: The one very rare association assigned here is known only from the Outer Banks of North Carolina, and occurs in peaty soil in old interdune swales.

Vegetation: Stands of this alliance are seasonally flooded wetlands dominated by *Cornus foemina* (stiff dogwood). The canopy is dominated by *Cornus foemina* (stiff dogwood), with much lesser amounts of *Morella cerifera* (wax myrtle), *Persea borbonia* (redbay), and *Vaccinium stamineum* (deerberry), generally with dense thickets of *Berchemia scandens* (Alabama supplejack), *Ampelopsis arborea* (peppervine), *Smilax bona-nox* (saw greenbrier), *Smilax laurifolia* (laurel greenbrier), and *Smilax rotundifolia* (roundleaf greenbrier). A sparse, emergent supercanopy of *Pinus taeda* (loblolly pine) is often present.

Dynamics:

Alliance Distribution

Range: This alliance is found on the Outer Banks of North Carolina and possibly Virginia and elsewhere.

Nations: US

Subnations: NC

TNC Ecoregions: 57:C

USFS Ecoregions: 232Ci:CCC

Federal Lands: NPS (Cape Hatteras)

(CEGL007384) Stiff Dogwood / Supplejack Forest
***Cornus foemina / Berchemia scandens* Forest**
Atlantic Coast Stiff Dogwood Dune Swale

NVC Classification

Physiognomic Class	Forest (I)

Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Seasonally flooded cold-deciduous forest (I.B.2.N.e.)
Alliance	*Cornus foemina* Seasonally Flooded Forest Alliance (A.319)
Alliance (English name)	Stiff Dogwood Seasonally Flooded Forest Alliance
Association	*Cornus foemina / Berchemia scandens* Forest
Association (English name)	Stiff Dogwood / Supplejack Forest
Association (Common name)	Atlantic Coast Stiff Dogwood Dune Swale
Ecological System(s):	Northern Atlantic Coastal Plain Maritime Forest (CES203.302)
	Central Atlantic Coastal Plain Maritime Forest (CES203.261)

Element Concept

Global Summary: This association represents peaty wetlands developed in old interdune swales along the North Carolina coast. Examples are dominated by a 4- to 10-m canopy of *Cornus foemina* (stiff dogwood), generally with dense thickets of *Berchemia scandens* (Alabama supplejack). A sparse, emergent supercanopy of *Pinus taeda* (loblolly pine) is often present. Various marsh grasses and forbs can occur in the herb stratum, including *Cladium mariscus ssp. jamaicense* (Jamaica swamp sawgrass), *Pluchea* (camphorweed) sp., *Bidens* (beggarticks) sp., and others.

Environmental Description

USFWS Wetland System: Palustrine

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This peaty wetland association was sampled once on Cape Hatteras National Seashore. The site is a semipermanently flooded depression with very poorly drained muck soil. The unvegetated surface is made up of leaf litter (50% cover), wood (5%), standing water (15%) and bare soil (25%). Evidence of disturbance includes the presence of a boardwalk through the wetland.

Global Environment: This vegetation type occurs in peaty wetlands in old interdune swales along the North Carolina coast. These swales retain surface water in winter, and are located within a matrix of forests largely removed from direct maritime influences (M. Schafale pers. comm.).

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: Vegetation is dominated by a moderately dense (70% cover) tall-shrub layer (2-5 m tall) of *Cornus foemina* (stiff dogwood). In addition, there may be a sparse (10%) emergent tree layer (5-10 m) of *Persea palustris* (swamp bay) and *Quercus hemisphaerica* (Darlington oak). Additional tall shrubs in lesser amounts include *Carpinus caroliniana* (American hornbeam), *Ilex opaca* (American holly), *Ilex vomitoria* (yaupon), *Persea palustris* (swamp bay), and *Vaccinium fuscatum* (black highbush blueberry). The moderately dense (70%) herbaceous layer is dominated by *Boehmeria cylindrica* (smallspike false nettle), *Leersia oryzoides* (rice cutgrass), and *Zizania aquatica* (annual wildrice); additional species include *Chasmanthium laxum* (slender woodoats), *Eupatorium capillifolium* (dogfennel), *Hydrocotyle verticillata* (whorled marshpennywort), *Juncus effusus* (common rush), *Osmunda regalis* (royal fern), *Phyla lanceolata* (lanceleaf fogfruit), *Polygonum hirsutum* (hairy smartweed), *Sagittaria latifolia* (broadleaf arrowhead), *Sanicula canadensis* (Canadian blacksnakeroot), and *Symphyotrichum tenuifolium* (perennial saltmarsh aster). Vines (30%) include *Ampelopsis arborea* (peppervine), *Gelsemium sempervirens* (evening trumpetflower), *Mikania scandens* (climbing hempvine), *Smilax laurifolia* (laurel greenbrier), and *Vitis rotundifolia* (muscadine). This community supports several rare species, including the state-critically imperiled *Polygonum hirsutum* (hairy smartweed) and *Utricularia macrorhiza* (common bladderwort) and the state-imperiled *Zizania aquatica* (annual wildrice).

Global Vegetation:

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Tree subcanopy	Broad-leaved evergreen tree	*Persea palustris* (swamp bay)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Cornus foemina* (stiff dogwood)
Herb (field)	Vine/Liana	*Ampelopsis arborea* (peppervine), *Mikania scandens* (climbing hempvine)
Herb (field)	Forb	*Boehmeria cylindrica* (smallspike false nettle)
Herb (field)	Graminoid	*Leersia oryzoides* (rice cutgrass), *Zizania aquatica* (annual wildrice)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Phyla lanceolata* (lanceleaf fogfruit), *Polygonum hirsutum* (hairy smartweed), *Sabal minor* (dwarf palmetto), *Symphyotrichum tenuifolium* (perennial saltmarsh aster), *Utricularia macrorhiza* (common bladderwort), *Zizania aquatica* (annual wildrice)

Conservation Status Rank

Global Rank & Reasons: G1 (23-Jan-2000). This community type appears to occur only at Buxton Woods, Dare County, North Carolina, where it occurs as a recurring community in a series of wetland interdune swales locally called "sedges." Total acreage is probably about 200 hectares (500 acres); portions of the site are protected, while others are still subject to development and degradation. All occurrences are subject to freshwater withdrawal from a shallow aquifer, altering hydrology.

Classification

Status: Standard

Classification Confidence: 1 - Strong

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: This community type appears to occur only at Buxton Woods, Dare County, North Carolina, where it occurs as a recurring community in a series of wetland interdune swales locally called "sedges." It forms complexes with freshwater marsh vegetation (not yet defined). Revisions and refinement can be based on North Carolina Vegetation Survey data.

Global Similar Associations:

- *Salix caroliniana / Sacciolepis striata - Boehmeria cylindrica* Woodland (CEGL004222)

Global Related Concepts:

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found at Cape Hatteras area, sedges at Buxton (i.e., Jeanette Sedge).

Global Range: This association occurs in old interdune swales along the North Carolina coast.

Nations: US

States/Provinces: NC

TNC Ecoregions:

USFS Ecoregions: 232Ci:CCC

Federal Lands: NPS (Cape Hatteras)

Element Sources
Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.4.

Local Description Authors: M.J. Russo

Global Description Authors: A.S. Weakley

References: Peet et al. unpubl. data 2002, Schafale and Weakley 1990, Schafale pers. comm., Southeastern Ecology Working Group n.d., Wentworth et al. 1993

Mixed Needle-leaved Evergreen - Cold-deciduous Forest (I.C.3.N.a)

Pinus taeda - Quercus nigra Forest Alliance (A.406)

Alliance Concept
Summary: This alliance contains natural and semi-natural, dry to dry-mesic forests of the southeastern Coastal Plain, occurring in fire-protected situations, such as swamp islands and barrier islands. The best-documented, natural examples of this alliance are maritime forests of the Outer Coastal Plain and barrier islands from southern Virginia to North Carolina, which are characterized by *Pinus taeda* (loblolly pine) and *Quercus falcata* (southern red oak) or *Quercus nigra* (water oak). These maritime examples occur on the lee side of maritime dunes and are protected from salt spray and overwash. The substrate is wind-deposited sand which is rapidly drained and nutrient poor. Other canopy associates include *Carya glabra* (pignut hickory), *Fagus grandifolia* (American beech), *Oxydendrum arboreum* (sourwood), *Liquidambar styraciflua* (sweetgum), *Carpinus caroliniana ssp. caroliniana* (American hornbeam), *Persea borbonia* (redbay), and occasional *Quercus virginiana* (live oak) and *Ilex opaca* (American holly). The patchy shrub layer may contain *Morella cerifera* (wax myrtle), *Morella pensylvanica* (northern bayberry), *Rhus copallinum* (flameleaf sumac), and *Vaccinium corymbosum* (highbush blueberry). Vines are abundant and include *Toxicodendron radicans* (eastern poison ivy), *Vitis rotundifolia* (muscadine), *Smilax* (greenbrier) spp., and *Gelsemium sempervirens* (evening trumpetflower). The poorly developed herbaceous layer usually is composed of *Chasmanthium laxum* (slender woodoats), *Mitchella repens* (partridgeberry), *Pteridium aquilinum* (western brackenfern), *Panicum amarum* (bitter panicgrass), and *Hypericum gentianoides* (orangegrass). Infrequently flooded loblolly pine - mixed hardwood forests of the Coastal Plain and, possibly, outer Piedmont are included here as well, but additional work is needed for characterization. Other less-well-documented examples of this alliance include mesic sandy to sandy-loam slopes in the outer and middle Coastal Plain, in fire-sheltered sites, such as 'islands' of higher ground

surrounded by swamps or marshes. These sometimes have some *Quercus michauxii* (swamp chestnut oak) in the canopy. In some parts of the alliance's putative range (e.g., East Gulf Coastal Plain, Upper East Gulf Coastal Plain, Mississippi River Alluvial Plain, Upper West Coastal Plain), information about vegetation of this alliance is either lacking, poorly known, or poorly understood.

Classification Comments: In Arkansas these forests occur on occasionally flooded to dry sites, usually in the Coastal Plain (Foti et al. 1994). More work needs to be done to distinguish this alliance from loblolly - oak - hickory forests in the *Pinus taeda - Quercus (marilandica, falcata, stellata)* Forest Alliance (A.405).

Similar Alliances:

- *Pinus (echinata, taeda) - Quercus (stellata, marilandica, falcata)* Woodland Alliance (A.2011)--dominated by *Pinus taeda*
- *Pinus echinata - Quercus (alba, falcata, stellata, velutina)* Forest Alliance (A.394)
- *Pinus taeda* Forest Alliance (A.130)
- *Quercus falcata* Forest Alliance (A.243)
- *Quercus nigra* Forest Alliance (A.247)--dominated by *Quercus nigra*

Similar Alliance Comments:

Related Concepts:

- IA9a. Mid-Atlantic Barrier Island Forest (Allard 1990) I
- Loblolly Pine - Hardwood: 82 (Eyre 1980) ?
- Lowland Pine - Oak Forest (Foti 1994b) I
- T1B3aIII5b. *Pinus taeda - Quercus (phellos, nigra, stellata)* (Foti et al. 1994) ?

Alliance Description

Environment: This alliance contains natural and semi-natural, dry to dry-mesic forests of the southeastern Coastal Plain, occurring in fire-protected situations, such as swamp islands and barrier islands. The best-documented, natural examples of this alliance are maritime forests of the Outer Coastal Plain and barrier islands from southern Virginia to North Carolina. They occur on the lee side of maritime dunes and are protected from salt spray and overwash. The substrate is wind-deposited sand which is rapidly drained and nutrient poor. Other, less-natural, vegetation types may be included here as well, but they are poorly known.

Vegetation: These forests are typically characterized by canopy dominance of some combination of *Pinus taeda* (loblolly pine), *Quercus falcata* (southern red oak), and/or *Quercus nigra* (water oak). Canopy associates of near-coastal maritime examples include *Carya glabra* (pignut hickory), *Fagus grandifolia* (American beech), *Oxydendrum arboreum* (sourwood), *Liquidambar styraciflua* (sweetgum), *Carpinus caroliniana ssp. caroliniana* (American hornbeam), *Persea borbonia* (redbay), and occasional *Quercus virginiana* (live oak) and *Ilex*

opaca (American holly). The patchy shrub layer may contain *Morella cerifera* (wax myrtle), *Morella pensylvanica* (northern bayberry), *Rhus copallinum* (flameleaf sumac), and *Vaccinium corymbosum* (highbush blueberry). Vines are abundant and include *Toxicodendron radicans* (eastern poison ivy), *Vitis rotundifolia* (muscadine), *Smilax* (greenbrier) spp., and *Gelsemium sempervirens* (evening trumpetflower). The poorly developed herbaceous layer usually is composed of *Chasmanthium laxum* (slender woodoats), *Mitchella repens* (partridgeberry), *Pteridium aquilinum* (western brackenfern), *Panicum amarum* (bitter panicgrass), and *Hypericum gentianoides* (orangegrass). Other less-well-documented examples of this alliance include mesic sandy to sandy-loam slopes in the outer and middle Coastal Plain, in fire-sheltered sites, such as 'islands' of higher ground surrounded by swamps or marshes. These sometimes have some *Quercus michauxii* (swamp chestnut oak) in the canopy. In some parts of the alliance's putative range (e.g., East Gulf Coastal Plain, Upper East Gulf Coastal Plain, Upper West Coastal Plain), information about vegetation of this alliance is either lacking, poorly known, or poorly understood.

Dynamics:

Alliance Distribution

Range: This alliance is found in the southeastern United States from New Jersey to Georgia and Alabama, and possibly in Florida and Mississippi.

Nations: US

Subnations: AL, AR, DE, FL?, GA, MD, MS?, NC, NJ, VA

TNC Ecoregions: 40:P, 42:P, 43:?, 53:C, 56:C, 57:C, 58:C, 62:C

USFS Ecoregions: 231Bd:C??, 231Ea:CCP, 231Eg:CCP, 231En:CC?, 232Ac:CCC, 232Bm:CCC, 232Bq:CCC, 232Bx:CC?, 232Bz:CCC, 232Cb:CCC, 232Ce:CC?, 232Ch:CCC, 232Ci:CCC, 234Ac:PPP

Federal Lands: DOD (Camp Lejeune, Fort Benning); NPS (Assateague Island, Cape Hatteras); USFS (Croatan?); USFWS (Back Bay?, Chesapeake Marshlands, Chincoteague, Prime Hook)

(CEGL006040) Loblolly Pine / Wax-myrtle / Muscadine Forest
***Pinus taeda / Morella cerifera / Vitis rotundifolia* Forest**
Mid-Atlantic Coastal Loblolly Pine Forest

NVC Classification

Physiognomic Class	Forest (I)
Physiognomic Subclass	Mixed evergreen-deciduous forest (I.C.)
Physiognomic Group	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.)
Physiognomic Subgroup	Natural/Semi-natural mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.)
Formation	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a.)
Alliance	*Pinus taeda - Quercus nigra* Forest Alliance (A.406)

Alliance (English name)	Loblolly Pine - Water Oak Forest Alliance
Association	*Pinus taeda / Morella cerifera / Vitis rotundifolia* Forest
Association (English name)	Loblolly Pine / Wax-myrtle / Muscadine Forest
Association (Common name)	Mid-Atlantic Coastal Loblolly Pine Forest
Ecological System(s):	Northern Atlantic Coastal Plain Maritime Forest (CES203.302)

Element Concept

Global Summary: This mid-Atlantic coastal upland loblolly pine forest occurs on the Outer Coastal Plain and on barrier islands in sheltered backdunes protected from salt spray and overwash. The substrate is rapidly drained, nutrient-poor sands or sandy loams. This community is dominated by *Pinus taeda* (loblolly pine), which can be the sole canopy component or can be associated with *Quercus falcata* (southern red oak), *Acer rubrum* (red maple), *Prunus serotina var. serotina* (black cherry), and *Sassafras albidum* (sassafras). The tall-shrub layer is comprised of *Morella cerifera* (wax myrtle) and *Vaccinium corymbosum* (highbush blueberry). Vines and lianas are always present in abundance; *Vitis rotundifolia* (muscadine) is most common, but *Toxicodendron radicans* (eastern poison ivy), *Smilax rotundifolia* (roundleaf greenbrier), *Smilax glauca* (cat greenbrier), and *Parthenocissus quinquefolia* (Virginia creeper) are usually present in abundance as well. The herbaceous layer may be sparse, particularly if shrubs and vines are dense, but *Chasmanthium laxum* (slender woodoats) may be fairly abundant in this community. Other herbs include *Panicum amarum var. amarulum* (bitter panicgrass), *Eupatorium hyssopifolium* (hyssopleaf thoroughwort), and *Elephantopus nudatus* (smooth elephantsfoot). In southern Virginia and North Carolina, *Quercus virginiana* (live oak) and *Gelsemium sempervirens* (evening trumpetflower) may also be present, but *Quercus virginiana* (live oak) is never abundant and when present is usually restricted to the understory. In the Chesapeake Marshlands, small patches of this community were observed on Smith Island and north of Bishops Head Point near the Chesapeake Bay Foundation lodge. Vegetation at Bishops Head occupied a small upland hummock which was presumably an old homesite and therefore very fragmented.

Environmental Description

USFWS Wetland System:

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This upland loblolly pine forest was sampled once on Cape Hatteras National Seashore. The site is on a dry-mesic, gentle slope with moderately well-drained sand soil. The unvegetated surface is made up almost entirely of leaf litter (97% cover) with some wood (3%). Evidence of disturbance includes and the presence of roads and trails; the pines may have been planted on the site.

Global Environment: This community occurs on the Outer Coastal Plain and on barrier islands in sheltered backdunes protected from salt spray and overwash. The substrate is rapidly drained sands or sandy loams which are nutrient poor.

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: The moderately dense (70% cover) canopy (20-35 m tall) is dominated by *Pinus taeda* (loblolly pine) along with lesser amounts of *Pinus elliottii* (slash pine). The sparse (10%) subcanopy (10-15 m) contains *Pinus taeda* (loblolly pine) and *Persea palustris* (swamp bay). The sparse (40%) tall-shrub layer (2-5 m) is dominated by *Morella cerifera* (wax myrtle) and *Persea palustris* (swamp bay), the moderate (50%) short-shrub layer (0.5-1 m) by the tall-shrub species as well as *Ilex vomitoria* (yaupon), *Prunus serotina var. serotina* (black cherry), *Toxicodendron radicans* (eastern poison ivy), and *Vaccinium fuscatum* (black highbush blueberry). The sparse (20%) herbaceous layer is comprised of seedlings of tree and shrub species found in the upper layers. Vines, often draped over shrubs, include *Parthenocissus quinquefolia* (Virginia creeper), *Smilax bona-nox* (saw greenbrier), *Smilax glauca* (cat greenbrier), and *Vitis rotundifolia* (muscadine).

Global Vegetation: This community is a mid-Atlantic coastal upland loblolly pine forest dominated by *Pinus taeda* (loblolly pine). Canopy associates often include *Quercus falcata* (southern red oak), *Acer rubrum* (red maple), *Prunus serotina var. serotina* (black cherry), and *Sassafras albidum* (sassafras). The tall shrub layer is comprised of *Morella cerifera* (wax myrtle) and *Vaccinium corymbosum* (highbush blueberry). Vines and lianas are always present in abundance; *Vitis rotundifolia* (muscadine) is most commonly present, but *Toxicodendron radicans* (eastern poison ivy), *Smilax rotundifolia* (roundleaf greenbrier), *Smilax glauca* (cat greenbrier), and *Parthenocissus quinquefolia* (Virginia creeper) are usually present in abundance as well. The herbaceous layer may be sparse, particularly if shrubs and vines are dense, but *Chasmanthium laxum* (slender woodoats) may be fairly abundant in this community. Other herbs include *Panicum amarum* (bitter panicgrass), *Eupatorium hyssopifolium* (hyssopleaf thoroughwort), and *Elephantopus nudatus* (smooth elephantsfoot). In southern Virginia and North Carolina, *Quercus virginiana* (live oak) and *Gelsemium sempervirens* (evening trumpetflower) may also be present, but *Quercus virginiana* (live oak) is never abundant and when present is usually restricted to the understory.

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus taeda* (loblolly pine)
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Morella cerifera* (wax myrtle), *Persea palustris* (swamp bay)
Short shrub/sapling	Broad-leaved evergreen shrub	*Ilex vomitoria* (yaupon)

Global:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus taeda* (loblolly pine)
Tree canopy	Broad-leaved deciduous tree	*Quercus falcata* (southern red oak)
Shrub/sapling (tall & short)	Vine/Liana	*Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy), *Vitis rotundifolia* (muscadine)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Vaccinium corymbosum* (highbush blueberry)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Morella cerifera* (wax myrtle)
Herb (field)	Graminoid	*Chasmanthium laxum* (slender woodoats)

Characteristic Species

Cape Hatteras National Seashore and Cape Lookout National Seashore:

Global: *Chasmanthium laxum* (slender woodoats), *Pinus taeda* (loblolly pine), *Vitis rotundifolia* (muscadine)

Conservation Status Rank

Global Rank & Reasons: G3 (30-Nov-1999). This coastal forest community is limited to the coast of Delaware, Maryland, Virginia, and North Carolina. Although characterized by two common species (*Pinus taeda* and *Vitis rotundifolia*), the characteristic shrub *Morella cerifera* is more limited in range and is characteristically a coastal species. The community is not confined to the immediate coast and is therefore more common than true maritime forests, but its landscape position within the Coastal Plain faces development pressures, degradation by agriculture practices, as well as cutting (*Pinus taeda* is a desirable and cultivated timber tree). As it has not previously been recognized as a type of more limited distribution, it has received little or no conservation attention to date. These forests are restricted to a narrow geographic range in regions particularly vulnerable to development pressure.

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: This community has floristic affinity with communities of the *Quercus virginiana - (Sabal palmetto)* Forest Alliance (A.55) but is differentiated by a strong dominance by *Pinus taeda* and lack of species of southern maritime forests such as *Sabal minor* and *Osmanthus americanus*. This community also shares a number of species in common with *Prunus serotina / Morella cerifera / Smilax rotundifolia* Scrub Forest (CEGL006319) but is differentiated by a strong dominance by *Pinus taeda*, a structure characterized by generally taller and straighter trees, a better developed herbaceous layer, and in general, a more protected position in backdunes.

Global Similar Associations:

- *Pinus taeda / Morella cerifera / Osmunda regalis* var. *spectabilis* Forest (CEGL006137)--occurs where wetter
- *Pinus taeda / Saccharum alopecuroidum - (Andropogon* spp.) Forest (CEGL007109)--often occurs as inclusions within this association
- *Prunus serotina / Morella cerifera / Smilax rotundifolia* Scrub Forest (CEGL006319)
- *Quercus falcata - Fagus grandifolia - Pinus taeda* Forest (CEGL007540)--is more depauperate
- *Quercus virginiana - Quercus hemisphaerica - Pinus taeda / Persea (borbonia, palustris) - Ilex vomitoria* Forest (CEGL007027)--is more depauperate

Global Related Concepts:

- *Pinus taeda / Myrica cerifera / Vitis rotundifolia* Forest (Bartgis 1986) =
- *Pinus taeda / Myrica cerifera / Vitis rotundifolia* Forest: *Pinus taeda / Myrica* coastal forest association (Clancy 1993a) =
- *Pinus taeda / Myrica* spp. coastal forest association (Clancy 1993b) ?
- *Pinus taeda* community (Harvill 1967) =
- Maritime forest (Clampitt 1991) B
- Mature loblolly pine forest of dry sites (Bratton and Davison 1987) =
- Mature loblolly pine stand (Fleming 1978) =
- Mesic forest (Clampitt 1991) B
- Pine woodland (Stalter 1990) F
- Pine-deciduous hardwood woodland (Stalter 1990) F
- Upland forest (Klotz 1986) B
- Woodland community (Hill 1986) B

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found on Bodie Island, along entrance road to Bodie Island Lighthouse.

Global Range: This association occurs along the mid-Atlantic coast from southern New Jersey to North Carolina.

Nations: US

States/Provinces: DE:S2, MD, NC, NJ, VA

TNC Ecoregions:

USFS Ecoregions: 232Ac:CCC, 232Bx:CC?, 232Bz:CCC, 232Ci:CCC

Federal Lands: NPS (Assateague Island, Cape Hatteras); USFWS (Back Bay?, Chesapeake Marshlands, Chincoteague, Prime Hook)

Element Sources

Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.13.

Local Description Authors: M.J. Russo

Global Description Authors: L.A. Sneddon

References: Bartgis 1986, Bratton and Davison 1987, Breden et al. 2001, Clampitt 1991, Clancy 1993a, Clancy 1993b, Clancy 1996, Eastern Ecology Working Group n.d., Fleming 1978, Fleming 1998, Fleming et al. 2001, Harrison 2004, Harvill 1967, Higgins et al. 1971, Hill 1986, J. Harrison pers. comm., Klotz 1986, Schafale and Weakley 1990, Stalter 1990, Stalter and Lamont 1990

Shrubland (III.)

Sclerophyllous Temperate Broad-leaved Evergreen Shrubland (III.A.2.N.c)

Quercus virginiana - Ilex vomitoria - (Morella cerifera) Shrubland Alliance (A.785)

Alliance Concept

Summary: This alliance consists of upland maritime dune shrublands of southeastern Coastal Plain (southern, mid-Atlantic, and Gulf coasts). Vegetation of this alliance is characteristically 0.5-3 m tall, typically with a single, extremely dense stratum, with *Quercus virginiana* (live oak) dominant or codominant, and often also with species such as *Ilex vomitoria* (yaupon), *Morella cerifera* (wax myrtle), *Quercus geminata* (sand live oak) (in range), *Serenoa repens* (saw palmetto) (in range), *Smilax auriculata* (earleaf greenbrier), *Prunus caroliniana* (Carolina laurelcherry), *Juniperus virginiana var. silicicola* (southern redcedar), *Smilax bona-nox* (saw greenbrier), *Persea borbonia* (redbay), and *Zanthoxylum clava-herculis* (Hercules' club). It occupies linear strands on frontal dune ridges and on the leeward sides and tops of rear dunes, where it is protected from saltwater flooding and extreme salt spray. It also occurs on low dunes and rises on the back sides of barrier islands, as upland rises associated with *Juncus roemerianus* (needlegrass rush) marshes. Examples of this vegetation in Mississippi contain *Baccharis halimifolia* (eastern baccharis).

Classification Comments: This alliance apparently occurs on Cat Island, Mississippi, as scrub thickets with *Ilex vomitoria* dominant and an admixture of *Quercus virginiana* and/or *Quercus geminata*. Occurrences of this (or a closely related alliance) in Louisiana may be better classified as a dwarf forest (*Quercus virginiana / Ilex vomitoria*). In Florida, this alliance is best developed on the Atlantic Coast.

Similar Alliances:

- *Morella cerifera* Saturated Shrubland Alliance (A.1906)--includes related vegetation north of the distribution of *Ilex vomitoria*.

Similar Alliance Comments:

Related Concepts:

- Barrier Island Relict Dune Shrubland/Scrub Oak (Wieland 1994b) ?
- Live Oak: 89 (Eyre 1980) I
- Maritime Shrub (Schafale and Weakley 1990) I
- Maritime dune scrub forest (Ambrose 1990a) ?
- Maritime dune shrub vegetation (Ambrose 1990a) ?
- Maritime interdune shrub vegetation (Ambrose 1990a) ?

Alliance Description

Environment:

Vegetation: Vegetation of this alliance is characteristically 0.5-3 m tall, typically with a single, extremely dense stratum, with *Quercus virginiana* (live oak) dominant or codominant, and often also with species such as *Ilex vomitoria* (yaupon), *Morella cerifera* (wax myrtle), *Quercus geminata* (sand live oak) (in range), *Serenoa repens* (saw palmetto) (in range), *Smilax auriculata* (earleaf greenbrier), *Prunus caroliniana* (Carolina laurelcherry), *Juniperus virginiana var. silicicola* (southern redcedar), *Smilax bona-nox* (saw greenbrier), *Persea borbonia* (redbay), and *Zanthoxylum clava-herculis* (Hercules' club). It occupies linear strands on frontal dune ridges and on the leeward sides and tops of rear dunes, where it is protected from saltwater flooding and extreme salt spray. It also occurs on low dunes and rises on the back sides of barrier islands, as upland rises associated with *Juncus roemerianus* (needlegrass rush) marshes. Examples of this vegetation in Mississippi contain *Baccharis halimifolia* (eastern baccharis).

Dynamics:

(CEGL003833) Live Oak - (Yaupon) Shrubland
***Quercus virginiana - (Ilex vomitoria)* Shrubland**

NVC Classification

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Evergreen shrubland (III.A.)
Physiognomic Group	Temperate broad-leaved evergreen shrubland (III.A.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate broad-leaved evergreen shrubland (III.A.2.N.)
Formation	Sclerophyllous temperate broad-leaved evergreen shrubland (III.A.2.N.c.)
Alliance	*Quercus virginiana - Ilex vomitoria - (Morella cerifera)* Shrubland Alliance (A.785)
Alliance (English name)	Live Oak - Yaupon - (Wax-myrtle) Shrubland Alliance
Association	*Quercus virginiana - (Ilex vomitoria)* Shrubland
Association (English name)	Live Oak - (Yaupon) Shrubland
Ecological System(s):	Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273) Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264) Central Atlantic Coastal Plain Maritime Forest (CES203.261)

Element Concept

Global Summary: This community is a salt-pruned maritime shrubland of the Mid-Atlantic Coastal Plain, generally 0.5-3 m tall, with a single, extremely dense stratum, with *Quercus virginiana* (live oak) dominant, and sometimes codominated by *Ilex vomitoria* (yaupon). Other species may include *Smilax auriculata* (earleaf greenbrier), *Smilax bona-nox* (saw greenbrier), *Persea borbonia* (redbay), *Zanthoxylum clava-herculis* (Hercules' club), *Juniperus virginiana var. silicicola* (southern redcedar), and *Sabal palmetto* (cabbage palmetto).

Environmental Description

USFWS Wetland System:

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This salt-pruned maritime shrubland was sampled at Cape Hatteras National Seashore on both Ocracoke and Hatteras islands and at Cape Lookout National Seashore. Sites are typically gentle to moderate lower to upper slopes of dune fields and ridges. The one sampled site on Ocracoke Island is a tidal flat. Soils are rapidly to well-drained sand. The unvegetated surface is dominated by leaf litter (90-100% cover) with some wood (0-5%) and bare soil/sand (0-20%).

Evidence of human disturbance includes foot paths, ORV use, trash dumping, fire suppression, and the presence of exotic plants; evidence of natural disturbance includes salt spray, wind damage, and storm surge.

Global Environment: In North Carolina this shrubland often occurs at the leading edge of maritime forests (M. Schafale pers. comm.).

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: The moderate to very dense (50-90% cover) stunted canopy (up to 10 m but typically less than 5 m tall) is dominated by *Quercus virginiana* (live oak). Other species that may occur are *Juniperus virginiana var. silicicola* (southern redcedar) (state-vulnerable), *Morella cerifera* (wax myrtle), and *Pinus elliottii var. elliottii* (Honduras pine). The sparse to moderately dense (10-70%) shrub layer (0.5-2 m) is dominated by canopy species, especially *Morella cerifera* (wax myrtle), as well as *Ilex vomitoria* (yaupon) and may include *Diospyros virginiana* (common persimmon) and *Toxicodendron radicans ssp. radicans*. The herbaceous layer is generally very sparse or absent (0-5%). Vines (0-20%), often found draped over taller vegetation, include *Parthenocissus quinquefolia* (Virginia creeper), *Smilax auriculata* (earleaf greenbrier) (state-vulnerable), and *Smilax bona-nox* (saw greenbrier). This community supports many state-vulnerable species; a total of 13 such species were recorded from 7 sampled plots.

Global Vegetation: *Quercus virginiana* (live oak) dominates or codominates this shrubland, forming a continuous salt- and wind-pruned canopy less than 3 m in height. Other components may include *Ilex vomitoria* (yaupon), *Smilax auriculata* (earleaf greenbrier), *Smilax bona-nox* (saw greenbrier), *Persea borbonia* (redbay), *Zanthoxylum clava-herculis* (Hercules' club), *Juniperus virginiana var. silicicola* (southern redcedar), and *Sabal palmetto* (cabbage palmetto). Some occurrences may be codominated by *Ilex vomitoria* (yaupon) or *Juniperus virginiana var. silicicola* (southern redcedar).

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore:

Stratum	Lifeform	Species
Tall shrub/sapling	Needle-leaved shrub	*Juniperus virginiana* var. *silicicola* (southern redcedar)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Diospyros virginiana* (common persimmon)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Morella cerifera* (wax myrtle)
Short shrub/sapling	Broad-leaved evergreen shrub	*Ilex vomitoria* (yaupon), *Quercus virginiana* (live oak)
Herb (field)	Vine/Liana	*Parthenocissus quinquefolia* (Virginia creeper), *Smilax bona-nox* (saw greenbrier)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Ammophila breviligulata* (American beachgrass), *Eustachys petraea* (pinewoods fingergrass), *Galium hispidulum* (coastal bedstraw), *Iresine rhizomatosa* (Juda's bush), *Juniperus virginiana* var. *silicicola* (southern redcedar), *Lonicera japonica* (Japanese honeysuckle), *Oenothera humifusa* (seabeach evening-primrose), *Opuntia pusilla* (cockspur pricklypear), *Quercus virginiana* (live oak), *Rubus trivialis* (southern dewberry), *Sabal minor* (dwarf palmetto), *Smilax auriculata* (earleaf greenbrier), *Triplasis purpurea* (purple sandgrass), *Yucca gloriosa* (moundlily yucca)

Global:

Conservation Status Rank

Global Rank & Reasons: G3 (31-Jan-2001). This maritime scrub community type occurs on barrier islands and barrier spits along the southern Atlantic coast of North America. Extensive coastal development in much of this area has degraded, destroyed, or fragmented remaining occurrences. In addition, artificial dune construction and

maintenance has altered the natural patterns and dynamics of these communities in many places. Remaining acreage is small, in part because this community type naturally occurs in narrow linear bands, but in part because of loss and alteration of this community type. Protected examples occur at Cape Hatteras National Seashore and Cape Lookout National Seashore. Its conservation status at this time is relatively stable.

Classification
Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments:

Global Similar Associations:

- *Quercus virginiana - Quercus hemisphaerica - Pinus taeda / Persea (borbonia, palustris) - Ilex vomitoria* Forest (CEGL007027)--is a forest of the same geographic area that is taller in stature, exhibits more than a single stratum and has a more diverse overstory and understory
- *Quercus virginiana - Serenoa repens - (Ilex vomitoria)* Shrubland [Provisional] (CEGL004241)

Global Related Concepts:

- Maritime Dune Scrub Forest (Ambrose 1990a) ?
- Maritime Dune Shrub Vegetation (Ambrose 1990a) ?

Element Distribution
Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found at Hatteras Island at Salvo Day Use Area and near Cape Hatteras Lighthouse, and on Ocracoke Island and South Core Banks.

Global Range: This maritime scrub community type occurs on barrier islands and barrier spits along the southern Atlantic coast of North America.

Nations: US

States/Provinces: GA, NC, SC, VA

TNC Ecoregions:

USFS Ecoregions: 232Cb:CCC, 232Ce:CCC, 232Ci:CCC

Federal Lands: DOD (Camp Lejeune?); NPS (Cape Hatteras, Cape Lookout); USFWS (Back Bay?, Cape Romain?, Pea Island?)

Element Sources
Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.19, CAHA.23, CAHA.53, CALO.40, CALO.41, CALO.42.

Local Description Authors: M.J. Russo

Global Description Authors: mod. J. Teague

References: Ambrose 1990a, Fleming et al. 2001, Peet et al. unpubl. data 2002, Schafale 2003b, Schafale and Weakley 1990, Schafale pers. comm., Southeastern Ecology Working Group n.d.

Saturated Temperate Broad-leaved Evergreen Shrubland (III.A.2.N.i)

Morella cerifera Saturated Shrubland Alliance (A.1906)

Alliance Concept

Summary: This alliance includes wetland dune swales and other wetland shrubland situations dominated by *Morella cerifera* (wax myrtle), including sheltered backdunes, wetland flats, and interdune swales. Associated shrubs may include *Baccharis halimifolia* (eastern baccharis), *Acer rubrum* (red maple), *Vaccinium formosum* (southern blueberry), *Rosa palustris* (swamp rose), *Ilex opaca var. opaca* (American holly), *Juniperus virginiana var. silicicola* (southern redcedar), and *Morella pensylvanica* (northern bayberry). This shrubland vegetation can form vast thickets in some cases; there may be inclusions of small wetland graminoid-dominated areas. Vines may be frequent and can include *Toxicodendron radicans ssp. radicans* (eastern poison ivy), *Smilax* (greenbrier) spp., *Vitis* (grape) spp., and *Parthenocissus quinquefolia* (Virginia creeper). Associated herbaceous species can include *Boehmeria cylindrica* (smallspike false nettle), *Calystegia sepium* (hedge false bindweed), *Carex albolutescens* (greenwhite sedge), *Carex hormathodes* (marsh straw sedge), *Chasmanthium laxum* (slender woodoats), *Festuca rubra* (red fescue), *Galium obtusum* (bluntleaf bedstraw), *Hydrocotyle* (hydrocotyle) spp., *Juncus dichotomus* (forked rush), *Juncus scirpoides* (needlepod rush), *Leersia virginica* (whitegrass), *Osmunda regalis var. spectabilis* (royal fern), *Panicum* (panicgrass) spp., *Polygonum pensylvanicum* (Pennsylvania smartweed), and *Woodwardia areolata* (netted chainfern) (in the northern part of the range); and *Andropogon glomeratus var. pumilus* (bushy bluestem), *Fimbristylis castanea* (marsh fimbry), *Hydrocotyle bonariensis* (largeleaf pennywort), *Juncus roemerianus* (needlegrass rush), *Muhlenbergia filipes* (gulfhairawn muhly), as well as *Spartina patens* (saltmeadow cordgrass) and *Sabatia stellaris* (rose of Plymouth) (in southern examples). This is maritime shrub vegetation which generally exists in a tension zone between more exposed or active grassland vegetation and more protected and stable maritime forests. Older stands of maritime shrub vegetation ultimately become dominated by stunted and salt-pruned *Quercus virginiana* (live oak). See also the III.A.2.N.c *Quercus virginiana - Ilex vomitoria - (Morella cerifera)* Shrubland Alliance (A.785), which generally occurs in drier and more exposed sites. Soils are deep sands of stabilized dunes, with limited if any horizon development. An overlying layer of 'muck' is reported in northern examples.

Classification Comments:

Similar Alliances:

- *Juncus dichotomus* Seasonally Flooded Herbaceous Alliance (A.1427)
- *Quercus virginiana - Ilex vomitoria - (Morella cerifera)* Shrubland Alliance (A.785)--generally occurs in drier and more exposed sites.

Similar Alliance Comments: Older stands of maritime shrub vegetation ultimately become dominated by stunted and salt-pruned *Quercus virginiana*.

Related Concepts:

- Coastal Interdunal Swale (FNAI 1992a) ?
- Maritime Shrub (Schafale and Weakley 1990) I
- Maritime interdune shrub vegetation (Ambrose 1990a) ?
- Shrub succession community (Hill 1986) I
- Mesic shrub zone (Higgins et al. 1971) I
- Swamp thicket (Klotz 1986) I
- Thicket community (Boule 1979) I

Alliance Description

Environment: This is maritime shrub vegetation which generally exists in a tension zone between more exposed or active grassland vegetation and more protected and stable maritime forests. Older stands of maritime shrub vegetation ultimately become dominated by stunted and salt-pruned *Quercus virginiana*. Soils are deep sands of stabilized dunes, with limited if any horizon development. An overlying layer of 'muck' is reported in northern examples.

Vegetation: This alliance includes wetland dune swales and other wetland shrubland situations dominated by *Morella cerifera* (wax myrtle), including sheltered backdunes, wetland flats, and interdune swales. Associated shrubs may include *Baccharis halimifolia* (eastern baccharis), *Acer rubrum* (red maple), *Vaccinium formosum* (southern blueberry), *Rosa palustris* (swamp rose), *Ilex opaca* (American holly), *Juniperus virginiana var. silicicola* (southern redcedar), and *Morella pensylvanica* (northern bayberry). This shrubland vegetation can form vast thickets in some cases; there may be inclusions of small wetland graminoid-dominated areas. Vines may be frequent and can include *Toxicodendron radicans ssp. radicans* (eastern poison ivy), *Smilax* (greenbrier) spp., *Vitis* (grape) spp., and *Parthenocissus quinquefolia* (Virginia creeper). Associated herbaceous species can include *Boehmeria cylindrica* (smallspike false nettle), *Calystegia sepium* (hedge false bindweed), *Carex albolutescens* (greenwhite sedge), *Carex hormathodes* (marsh straw sedge), *Chasmanthium laxum* (slender woodoats), *Festuca rubra* (red fescue), *Galium obtusum* (bluntleaf bedstraw), *Hydrocotyle* (hydrocotyle) spp., *Juncus dichotomus* (forked rush), *Juncus scirpoides* (needlepod rush), *Leersia virginica* (whitegrass), *Osmunda regalis var. spectabilis* (royal fern), *Panicum* (panicgrass) spp., *Polygonum pensylvanicum* (Pennsylvania smartweed), and *Woodwardia areolata* (netted chainfern) (in the northern part of the range); and *Andropogon glomeratus var. pumilus* (bushy bluestem), *Fimbristylis castanea* (marsh fimbry), *Hydrocotyle bonariensis* (largeleaf pennywort), *Juncus roemerianus* (needlegrass rush), *Muhlenbergia filipes* (gulfhairawn muhly), as well as *Spartina patens* (saltmeadow cordgrass) and *Sabatia stellaris* (rose of Plymouth) (in southern examples).

Dynamics: Older stands of maritime shrub vegetation ultimately become dominated by stunted and salt-pruned *Quercus virginiana*.

Alliance Distribution

Range: This alliance is found in coastal areas from Louisiana and Florida north to New Jersey.

Nations: US

Subnations: DE, FL, GA, LA, MD, NC, NJ, SC, VA

TNC Ecoregions: 31:C, 54:P, 55:C, 56:C, 57:C, 58:C, 62:C

USFS Ecoregions: 232Ab:CCP, 232Ac:CCC, 232Ad:CCP, 232Bx:CCC, 232Bz:CCC, 232Cb:CCP, 232Ce:CCC, 232Ch:CCP, 232Ci:CCC, 232E:CC, 232Gb:CCC

Federal Lands: DOD (Cape Canaveral); NPS (Assateague Island, Canaveral?, Cape Hatteras, Cape Lookout, Fort Pulaski, Timucuan); USFWS (Back Bay?, Cape Romain?, Chincoteague, Merritt Island?, Pea Island, Prime Hook)

(CEGL003839) Wax-myrtle / Saltmeadow Cordgrass Shrubland
***Morella cerifera / Spartina patens* Shrubland**
Atlantic Coast Interdune Swale

NVC Classification

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Evergreen shrubland (III.A.)
Physiognomic Group	Temperate broad-leaved evergreen shrubland (III.A.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate broad-leaved evergreen shrubland (III.A.2.N.)
Formation	Saturated temperate broad-leaved evergreen shrubland (III.A.2.N.i.)
Alliance	*Morella cerifera* Saturated Shrubland Alliance (A.1906)
Alliance (English name)	Wax-myrtle Saturated Shrubland Alliance
Association	*Morella cerifera / Spartina patens* Shrubland
Association (English name)	Wax-myrtle / Saltmeadow Cordgrass Shrubland
Association (Common name)	Atlantic Coast Interdune Swale
Ecological System(s):	Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273)
	Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264)
	Central Atlantic Coastal Plain Maritime Forest (CES203.261)

Element Concept

Global Summary: This association occurs in wetland flats, backdunes and interdune swales along the Atlantic Coast from New Jersey to Florida. The substrate may be sand or loamy sand, sometimes with a thin layer of organic matter. It occurs beyond the reach of most storm tides but may be impacted by salt spray. The water table may often be less than half a meter below the surface. Canopy closure varies from densely closed to moderately open. This vegetation is dominated by *Morella cerifera* (wax myrtle), sometimes intermixed with *Juniperus virginiana var. silicicola* (southern redcedar) (from North Carolina and possibly southern Virginia southward), *Morella pensylvanica* (northern bayberry) (from northern North Carolina northward), *Rhus copallinum* (flameleaf sumac), *Baccharis halimifolia* (eastern baccharis), or *Ilex vomitoria* (yaupon). The shrub layer can vary from 2-8 m in height. Occasionally, a sparse emergent canopy of trees (such as *Juniperus virginiana var. silicicola* (southern redcedar) or *Sabal palmetto* (cabbage palmetto) in the southern parts of the range) may be present. The herbaceous layer is characterized by *Spartina patens* (saltmeadow cordgrass). Other ground flora associates include

Toxicodendron radicans (eastern poison ivy), *Panicum virgatum* (switchgrass), *Andropogon virginicus* (broomsedge bluestem), *Juncus dichotomus* (forked rush), *Solidago sempervirens* (seaside goldenrod), *Smilax* (greenbrier) spp., *Parthenocissus quinquefolia* (Virginia creeper), *Vitis* (grape) spp., and *Schoenoplectus pungens* (common threesquare). Small openings may have wetland graminoids, such as *Juncus roemerianus* (needlegrass rush), *Spartina patens* (saltmeadow cordgrass), *Fimbristylis castanea* (marsh fimbry), *Andropogon glomeratus var. pumilus* (bushy bluestem), *Muhlenbergia filipes* (gulfhairawn muhly), etc., and forbs, such as *Hydrocotyle bonariensis* (largeleaf pennywort), *Sabatia stellaris* (rose of Plymouth), *Polygonum hydropiperoides* (swamp smartweed), *Eleocharis* (spikerush) spp., etc. In other cases, few herbs are present, because of the dense, thicket-like shrub layer.

Environmental Description

USFWS Wetland System: Palustrine

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This wax-myrtle / saltmeadow cordgrass Shrubland is very common on both Cape Hatteras National Seashore and Cape Lookout National Seashore and was sampled at 14 locations (including Shackleford Banks). Sites are typically flat interdunal or tidal flats, depressions and swales; however, this community may also occur on gently sloping low ridges. Sites may be irregularly flooded to seasonally saturated with freshwater from heavy rains or tidally or wind-tidally flooded by water pushed in from the sound. Soils are quite variable, from rapidly drained sand to somewhat poorly to well-drained sandy loam to very poorly drained muck. The unvegetated surface is made up of leaf litter (30-95% cover), wood (0-40%), standing water (0-50%), and bare soil/sand (0-65%). Evidence of human disturbance includes trails/roads, trash and other debris and the presence of exotic plants; evidence of natural disturbance includes salt spray (causing top-kill), wind damage and storm surge from hurricanes, and sand and soil movement from ocean tides.

Global Environment: This association occurs on maritime barrier islands and spits, usually on more protected backdunes, barrier flats, islands within salt marshes, and interdunal swales. It is not tidally flooded and occurs beyond the reach of most storm tides, but it is impacted by salt spray. The substrate may be sand or loamy sand, sometimes with a thin layer of organic matter. The water table is often less than half a meter below the surface.

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: Vegetation generally occurs as one of two expressions: a sparse to moderate (20-60% cover) tall-shrub layer (2-5 m tall) over a moderate to dense (30-80%) short-shrub layer (1-2 m) or simply a moderate to very dense (30-95%) short-shrub layer (0.5-2 m) without a tall-shrub layer. Herbaceous cover ranges from sparse (20%) under dense canopies to very dense (90%) under more open canopies. *Morella cerifera* (wax myrtle) dominates the shrub layers; additional shrubs may include *Baccharis halimifolia* (eastern baccharis), *Ilex vomitoria* (yaupon), and *Juniperus virginiana var. silicicola* (southern redcedar) (state-vulnerable). *Spartina patens* (saltmeadow cordgrass) is the dominant herb; other common or abundant species may include *Hydrocotyle bonariensis* (largeleaf pennywort), *Juncus roemerianus* (needlegrass rush), *Panicum amarum var. amarum* (bitter panicgrass), *Phyla nodiflora* (turkey tangle fogfruit), and *Schizachyrium littorale* (shore little bluestem). Vines include *Smilax bona-nox* (saw greenbrier) and *Toxicodendron radicans ssp. radicans* (eastern poison ivy). This community supports a great many state-rare plant species; a total of 4 state-critically imperiled, 6 state-imperiled, and 15 state-vulnerable species were recorded from 16 plots (including 2 from Hammocks Beach State Park.

Global Vegetation: This vegetation is characterized by a moderately open to densely closed canopy of *Morella cerifera* (wax myrtle). Other canopy associates include *Baccharis halimifolia* (eastern baccharis), *Morella pensylvanica* (northern bayberry) (from northern NC northward), *Juniperus virginiana var. silicicola* (southern redcedar) (from NC and possibly southern VA southward), and *Rhus copallinum* (flameleaf sumac). The herbaceous layer is characterized by *Spartina patens* (saltmeadow cordgrass). Other ground flora associates include

Toxicodendron radicans (eastern poison ivy), *Panicum virgatum* (switchgrass), *Andropogon virginicus* (broomsedge bluestem), *Juncus dichotomus* (forked rush), *Solidago sempervirens* (seaside goldenrod), *Smilax* (greenbrier) spp., *Parthenocissus quinquefolia* (Virginia creeper), *Vitis* (grape) spp., and *Schoenoplectus pungens* (common threesquare). Small openings may have wetland graminoids, such as *Juncus roemerianus* (needlegrass rush), *Spartina patens* (saltmeadow cordgrass), *Fimbristylis castanea* (marsh fimbry), *Andropogon glomeratus var. pumilus* (bushy bluestem), *Muhlenbergia filipes* (gulfhairawn muhly), etc., and forbs, such as *Hydrocotyle bonariensis* (largeleaf pennywort), *Sabatia stellaris* (rose of Plymouth), *Polygonum hydropiperoides* (swamp smartweed), *Eleocharis* (spikerush) spp., etc. In other cases, few herbs are present, because of the dense, thicket-like shrub layer.

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Tall shrub/sapling	Needle-leaved shrub	*Juniperus virginiana* var. *silicicola* (southern redcedar)
Short shrub/sapling	Broad-leaved evergreen shrub	*Baccharis angustifolia* (saltwater false willow), *Ilex vomitoria* (yaupon), *Morella cerifera* (wax myrtle)
Herb (field)	Forb	*Hydrocotyle bonariensis* (largeleaf pennywort)
Herb (field)	Graminoid	*Juncus roemerianus* (needlegrass rush), *Panicum amarum* var. *amarum* (bitter panicgrass), *Schizachyrium littorale* (shore little bluestem), *Spartina patens* (saltmeadow cordgrass)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Ammophila breviligulata* (American beachgrass), *Baccharis angustifolia* (saltwater false willow), *Cladium mariscus* ssp. *jamaicense* (Jamaica swamp sawgrass), *Cynanchum angustifolium* (Gulf Coast swallow-wort), *Cynodon dactylon* (Bermudagrass), *Cyperus esculentus* (chufa flatsedge), *Elymus virginicus* var. *halophilus* (Virginia wildrye), *Eustachys petraea* (pinewoods fingergrass), *Gratiola neglecta* (clammy hedgehyssop), *Iva imbricata* (seacoast marshelder), *Juncus megacephalus* (bighead rush), *Juncus polycephalus* (manyhead rush), *Juniperus virginiana* var. *silicicola* (southern redcedar), *Oenothera humifusa* (seabeach evening-primrose), *Panicum amarum* (bitter panicgrass), *Parietaria praetermissa* (clustered pellitory), *Persea borbonia* (redbay), *Phragmites australis* (common reed), *Phyla lanceolata* (lanceleaf fogfruit), *Phyla nodiflora* (turkey tangle fogfruit), *Physalis walteri* (Walter's groundcherry), *Pluchea rosea* (rosy camphorweed), *Prunus caroliniana* (Carolina laurelcherry), *Rhynchospora colorata* (starrush whitetop), *Rubus trivialis* (southern dewberry), *Schoenoplectus americanus* (chairmaker's bulrush), *Smilax auriculata* (earleaf greenbrier), *Stenotaphrum secundatum* (St. Augustine grass)

Global:

Conservation Status Rank

Global Rank & Reasons: G3G4 (1-Feb-2005). This association occurs in interdune flats on barrier islands and barrier spits from New Jersey south to Florida. Many occurrences have been destroyed by coastal development, as these soils are sandy enough and dry enough that they are often not considered "jurisdictional wetlands" and are therefore destroyed for development. Other occurrences have been left undeveloped but now occur as isolated areas fragmented by development. Fairly extensive occurrences are protected on Cape Hatteras National Seashore and Cape Lookout National Seashore, North Carolina.

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: This association now encompasses two previous associations, one more northerly ranging and the other more southerly ranging along the Atlantic Coast. Where the ranges of these two types overlapped, they were difficult to distinguish floristically and were thus combined.

Global Similar Associations:

- *(Morella cerifera) - Panicum virgatum - Spartina patens* Herbaceous Vegetation (CEGL004129)
- *Morella cerifera - Vaccinium corymbosum* Shrubland (CEGL003906)
- *Morella cerifera / Hydrocotyle verticillata* Shrubland (CEGL003840)

Global Related Concepts:

- Maritime Interdune Shrub Vegetation (Ambrose 1990a) ?
- Mesic shrub community (Higgins et al. 1971) B
- Salt grass sea myrtle red cedar savanna (Martin 1959b) ?
- Salt grass sea myrtle savanna (Martin 1959b) ?
- Shrub succession community (Hill 1986) B
- Thicket community (Boule 1979) =
- Upland thicket (Klotz 1986) =

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found at many places from Haulover Day Use Area on Hatteras Island to Ocracoke Island, Core Banks and Shackleford Banks.

Global Range: This type occurs along the Atlantic Coast from New Jersey south to Florida.

Nations: US

States/Provinces: DE, FL, GA, MD, NC, NJ, SC, VA

TNC Ecoregions:

USFS Ecoregions: 232Ab:CCP, 232Ac:CCC, 232Bz:CCC, 232Cb:CCP, 232Ce:CCC, 232Ch:CCP, 232Ci:CCC, 232Gb:CCC

Federal Lands: DOD (Cape Canaveral); NPS (Assateague Island, Canaveral?, Cape Hatteras, Cape Lookout, Fort Pulaski, Timucuan); USFWS (Back Bay?, Cape Romain?, Chincoteague, Merritt Island?, Pea Island, Prime Hook)

Element Sources

Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.9, CAHA.62, CAHA.66, CALO.8, CALO.9, CALO.12, CALO.19, CALO.20, CALO.26, CALO.30, CALO.32, CALO.35, CALO.53, CALO.65.

Local Description Authors: M.J. Russo

Global Description Authors: A.S. Weakley, mod. J. Teague

References: Ambrose 1990a, Berdine 1998, Boule 1979, Bowman 2000, Breden et al. 2001, FNAI 1992a, Fleming 2001, Harrison 2004, Higgins et al. 1971, Hill 1986, Klotz 1986, Martin 1959b, Schafale and Weakley 1990, Southeastern Ecology Working Group n.d.

Temperate Cold-deciduous Shrubland (III.B.2.N.a)

Smilax Spp. - Toxicodendron radicans Vine-Shrubland Alliance (A.909)

Alliance Concept

Summary: This alliance includes vine-covered maritime sand dunes. Generally confined to barrier beach systems, this vegetation is comprised of dense vines that cover the crests of dunes exposed to salt spray and winds. Very little soil development occurs, and the water table is located greater than 1 m below the soil surface. The dominant species of any single dune may be one of any number of vine species such as *Smilax glauca* (cat greenbrier), *Smilax rotundifolia* (roundleaf greenbrier), *Vitis rotundifolia* (muscadine), *Parthenocissus quinquefolia* (Virginia creeper), or *Toxicodendron radicans* (eastern poison ivy). In some cases, the vines are low-growing and occur directly on the sand surface, but in others, the vegetation has a height of 1 m or more, with vines growing over older stems of the same species, or over other shrubs such as *Morella pensylvanica* (northern bayberry) or *Morella cerifera* (wax myrtle). The vegetation is generally low to the ground (less than 0.5 m tall) and generally covers 70-80% of the surface of the ground, the remainder being exposed sand.

Classification Comments:

Similar Alliances:

Similar Alliance Comments:

Related Concepts:

- Greenbrier thicket (Martin 1959b) ?
- Maritime Dune Community (Swain and Kearsley 2001) ?
- Maritime Shrubland Community (Swain and Kearsley 2001) ?
- Vine dune (Martin 1959b) ?

Alliance Concept

Environment: This alliance includes vine-covered maritime sand dunes. Generally confined to barrier beach systems, this vegetation is comprised of dense vines that cover the crests of dunes exposed to salt spray and winds. Very little soil development occurs, and the water table is greater than 1 m (3 feet) below the soil surface.

Vegetation: The dominant species of any single dune may be one of any number of vine species such as *Smilax glauca* (cat greenbrier), *Smilax rotundifolia* (roundleaf greenbrier), *Vitis*

rotundifolia (muscadine), *Parthenocissus quinquefolia* (Virginia creeper), or *Toxicodendron radicans* (eastern poison ivy). In some cases, the vines are low-growing and occur directly on the sand surface, but in others, the vegetation has a height of 1 m or more, with vines growing over older stems of the same species, or over other shrubs such as *Morella pensylvanica* (northern bayberry) or *Morella cerifera* (wax myrtle). The vegetation is generally low to the ground (<0.5 m tall) and generally covers 70-80% of the surface of the ground, the remainder being exposed sand.

Dynamics:

Alliance Distribution

Range: This alliance is found in North Carolina, Delaware, Maryland, Massachusetts, New Jersey, New York, and possibly Virginia.

Nations: US

Subnations: DE, MA, MD, NC, NJ, NY, VA?

TNC Ecoregions: 57:C, 58:C, 61:P, 62:C

USFS Ecoregions: 221Ab:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Bt:CCP, 232Bz:CCC, 232Ci:CCC, 234An:PPP

Federal Lands: NPS (Assateague Island, Cape Cod, Cape Lookout, Fire Island, Gateway); USFWS (Parker River?)

(CEGL003885) Seaside Greenbrier - Eastern Poison-ivy Vine-Shrubland
***Smilax auriculata* - *Toxicodendron radicans* Vine-Shrubland**
Mid-Atlantic Coastal Plain Vine Dune

NVC Classification

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Temperate cold-deciduous shrubland (III.B.2.N.a.)
Alliance	*Smilax* spp. - *Toxicodendron radicans* Vine-Shrubland Alliance (A.909)
Alliance (English name)	Greenbrier species - Eastern Poison-ivy Vine-Shrubland Alliance
Association	*Smilax auriculata* - *Toxicodendron radicans* Vine-Shrubland
Association (English name)	Seaside Greenbrier - Eastern Poison-ivy Vine-Shrubland
Association (Common name)	Mid-Atlantic Coastal Plain Vine Dune
Ecological System(s):	Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273)

Element Concept

Global Summary: This association consists of vine-covered maritime sand dunes in the Mid-Atlantic Coastal Plain, generally dominated by *Smilax auriculata* (earleaf greenbrier) and *Toxicodendron radicans* (eastern poison ivy). These dense vines cover the crests of dunes exposed to salt spray and winds. The dominant species of any single dune may be variable, possibly including the nominals, but also including other *Smilax* (greenbrier) spp., *Vitis rotundifolia* (muscadine), or *Parthenocissus quinquefolia* (Virginia creeper). In some cases, the vines are low-

growing and occur directly on the sand surface, but in other cases, the vegetation has a height of 1 m or more, with younger vines growing over older stems of the same species, or over other shrubs. The vegetation is generally low to the ground (less than 5 dm (1.5 feet) tall) and generally covers 70-80% of the ground surface with the remainder being exposed sand.

Environmental Description

USFWS Wetland System:

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This maritime vine-shrubland was sampled twice at Cape Lookout National Seashore on South Core Banks. One site is an irregularly flooded, gently sloping channel bed, the other a wind-tidally flooded swale. Soils are moderately well-drained to somewhat excessively drained sandy loam.

Global Environment: This vegetation includes vine-covered maritime sand dunes. Generally confined to barrier beach systems, this vegetation is comprised of dense vines that cover the crests of dunes exposed to salt spray and winds. Very little soil development occurs, and the water table is located greater than 1 m (3 feet) below the soil surface.

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: Vegetation is dominated by a dense (80% cover) layer of vines, 0.5-1.5 m tall, including *Smilax auriculata* (earleaf greenbrier), *Ampelopsis arborea* (peppervine), *Smilax bona-nox* (saw greenbrier), and *Toxicodendron radicans ssp. radicans* (eastern poison ivy). Additional species that may be present in small amounts include short shrubs *Ilex vomitoria* (yaupon) and *Morella cerifera* (wax myrtle) and herbs *Heterotheca subaxillaris* (camphorweed), *Hydrocotyle bonariensis* (largeleaf pennywort), and *Spartina patens* (saltmeadow cordgrass). This community supports several rare species, including the state-critically imperiled *Elymus virginicus var. halophilus* (Virginia wildrye); a total of 8 species were recorded from 3 plots (including one from Fort Mason State Park).

Global Vegetation: The dominant species of any single dune may be variable, possibly including the nominals, but also including other *Smilax* (greenbrier) spp., *Vitis rotundifolia* (muscadine), or *Parthenocissus quinquefolia* (Virginia creeper). In some cases, the vines are low-growing and occur directly on the sand surface, but in other cases, the vegetation has a height of 1 m or more, with younger vines growing over older stems of the same species, or over other shrubs.

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Herb (field)	Vine/Liana	*Ampelopsis arborea* (peppervine), *Smilax auriculata* (earleaf greenbrier)
Herb (field)	Forb	*Toxicodendron radicans* ssp. *radicans* (eastern poison ivy)
Herb (field)	Graminoid	*Spartina patens* (saltmeadow cordgrass)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Cynanchum angustifolium* (Gulf Coast swallow-wort), *Elymus virginicus* var. *halophilus* (Virginia wildrye), *Juniperus virginiana* var. *silicicola* (southern redcedar), *Lonicera japonica* (Japanese honeysuckle), *Oenothera humifusa* (seabeach evening-primrose), *Opuntia pusilla* (cockspur pricklypear), *Physalis walteri* (Walter's groundcherry), *Rubus trivialis* (southern dewberry), *Smilax auriculata* (earleaf greenbrier)

Global:

Conservation Status Rank
Global Rank & Reasons: GNRQ (30-Jan-1998).

Classification
Status: Standard

Classification Confidence: 3 - Weak

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: *Smilax glauca - Toxicodendron radicans* Vine-Shrubland (CEGL003886) is an equivalent type with a more northern distribution.

Global Similar Associations:

- *Smilax glauca - Toxicodendron radicans* Vine-Shrubland (CEGL003886)--is a more northerly distributed type.

Global Related Concepts:

Element Distribution
Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found on South Core Banks.

Global Range: This association is currently report from the North Carolina coast.

Nations: US

States/Provinces: NC

TNC Ecoregions:

USFS Ecoregions: 232Ci:CCC

Federal Lands: NPS (Cape Lookout)

Element Sources
Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CALO.56, CALO.62.

Local Description Authors: M.J. Russo

Global Description Authors: M. Pyne

References: Schafale 2003b, Southeastern Ecology Working Group n.d.

Tidal Cold-deciduous Shrubland (III.B.2.N.h)

Baccharis halimifolia - Iva frutescens Tidal Shrubland Alliance (A.1023)

Alliance Concept

Summary: This alliance includes maritime scrub communities typically dominated by *Iva frutescens* (Jesuit's bark) or *Baccharis halimifolia* (eastern baccharis) or both, growing in association with salt marshes. These communities occur primarily in estuarine margin situations, especially on the sound sides of barrier islands. Characteristically, these communities form an ecotone between salt marsh and upland vegetation or in areas within the salt marsh having slightly higher elevations and lower salinity levels than the surrounding marsh. Storm-induced disturbance causes periodic die-back of the shrubs restricting the extent of their spread. Characteristic species include *Baccharis halimifolia* (eastern baccharis), *Iva frutescens* (Jesuit's bark), *Rosa carolina* (Carolina rose), *Spartina patens* (saltmeadow cordgrass), and *Panicum virgatum* (switchgrass).

Classification Comments:

Similar Alliances:

- *Baccharis halimifolia* Saturated Shrubland Alliance (A.1015)
- *Panicum virgatum* Tidal Herbaceous Alliance (A.1476)

Similar Alliance Comments:

Related Concepts:

- *Baccharis halimifolia* (Klemas et al. 1973) ?
- *Iva frutescens-Baccharis halimifolia* (Good 1965) ?
- *Iva frutescens* (Klemas et al. 1973) ?
- Estuarine Intertidal: Salt Marsh (Swain and Kearsley 2001) ?
- Estuarine scrub-shrub wetland (Tiner 1985b) ?
- Salt Shrub (Schafale and Weakley 1990) I
- Salt bush - salt meadow marsh (Daiber et al. 1976) ?
- Salt marsh community (Hill 1986) I
- Salt marsh complex, marsh-upland border (Breden 1989) ?
- Salt shrub (Reschke 1990) ?
- Tidal Marsh (FNAI 1992a) I
- Salt grass - marsh elder savanna (Martin 1959b) ?
- Salt marsh and upper border (Barry 1980) ?
- Saltbush zone (Boule 1979) ?
- Shrub succession community (Higgins et al. 1971) I
- Swamp thicket (Klotz 1986) I

Alliance Description

Environment: These communities occur primarily in estuarine margin situations, especially on the sound sides of barrier islands. Characteristically, these communities form an ecotone between salt marsh and upland vegetation or in areas within the salt marsh having slightly higher elevations and lower salinity levels than the surrounding marsh. Storm-induced disturbance causes periodic die-back of the shrubs restricting the extent of their spread.

Vegetation: This alliance includes maritime scrub communities typically dominated by *Iva frutescens* (Jesuit's bark) or *Baccharis halimifolia* (eastern baccharis) or both, growing in association with salt marshes. Characteristic species include *Baccharis halimifolia* (eastern baccharis), *Iva frutescens* (Jesuit's bark), *Rosa carolina* (Carolina rose), *Spartina patens* (saltmeadow cordgrass), and *Panicum virgatum* (switchgrass).

Dynamics: Storm-induced disturbance causes periodic die-back of the shrubs restricting the extent of their spread.

Alliance Distribution

Range: This alliance is found throughout the eastern United States from Maine to Florida and west to Texas.

Nations: US

Subnations: AL, CT, DE, FL, GA, LA, MA, MD, MS, NC, NJ, NY, RI, SC, TX, VA

TNC Ecoregions: 31:C, 53:C, 55:?, 56:C, 57:C, 58:C, 62:C

USFS Ecoregions: 212P:PP, 221Aa:CCC, 221Ab:CCC, 221Ac:CCC, 221Ad:CCC, 221Ae:CCP, 221Ak:CCC, 221Dc:CPP, 231Fb:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Ad:CCC, 232Bb:CC?, 232Bc:CCP, 232Bd:CCP, 232Br:CCC, 232Bt:CCC, 232Bx:CCC, 232Bz:CCC, 232Ce:CCC, 232Ch:CCC, 232Ci:CCC, 232Dc:CCC, 232Eb:CCC, 255Dc:CCC

Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Cape Hatteras, Colonial, Fire Island, Fort Pulaski, Gateway, George Washington Birthplace, Timucuan?); USFS (Croatan); USFWS (Anahuac, Aransas, Back Bay?, Big Boggy, Bon Secour, Brazoria, Chesapeake Marshlands, Chincoteague, Matagorda Island, McFaddin, Monomoy?, Parker River, Prime Hook, San Bernard)

(CEGL003920) Groundsel-tree - Maritime Marsh-elder - Wax-myrtle - (Yaupon) Shrubland
***Baccharis halimifolia - Iva frutescens - Morella cerifera - (Ilex vomitoria)* Shrubland**
Coastal Salt Shrub Thicket

NVC Classification

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)

Formation	Tidal cold-deciduous shrubland (III.B.2.N.h.)
Alliance	*Baccharis halimifolia - Iva frutescens* Tidal Shrubland Alliance (A.1023)
Alliance (English name)	Groundsel-tree - Maritime Marsh-elder Tidal Shrubland Alliance
Association	*Baccharis halimifolia - Iva frutescens - Morella cerifera - (Ilex vomitoria)* Shrubland
Association (English name)	Groundsel-tree - Maritime Marsh-elder - Wax-myrtle - (Yaupon) Shrubland
Association (Common name)	Coastal Salt Shrub Thicket
Ecological System(s):	Central Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.376)

Element Concept

Global Summary: This shrubland, dominated by the nominal species, occurs in slightly elevated areas within salt flats and salt marshes as well as in marsh edges throughout much of the East Gulf, South Atlantic, and Mid-Atlantic coastal plains. This community is usually best developed at the upper limit of non-storm tidal inundation, on natural levees deposited by above-normal tides. The most common species are typically *Baccharis halimifolia* (eastern baccharis), *Morella cerifera* (wax myrtle), *Iva frutescens ssp. frutescens* (Jesuit's bark), *Yucca gloriosa* (moundlily yucca), *Juniperus virginiana var. silicicola* (southern redcedar), *Lycium carolinianum* (Carolina desert-thorn), *Baccharis angustifolia* (saltwater false willow), and *Ilex vomitoria* (yaupon). Other species which may be present include *Borrichia frutescens* (bushy seaside tansy), *Fimbristylis castanea* (marsh fimbry), *Limonium carolinianum* (Carolina sealavender), and *Solidago sempervirens* (seaside goldenrod).

Environmental Description

USFWS Wetland System: Estuarine

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This shrubland was sampled twice on Cape Hatteras National Seashore. It occurs on interdunal and salt flats that are subject to irregular storm and tidal flooding. Soils are variable: one site has rapidly drained sand, the other very poorly drained muck. The unvegetated surface is also variable: at one site it is made up almost entirely of leaf litter (95% cover) with some bare sand (5%), the other has equal amounts of leaf litter (50%) and bare soil (50%). Evidence of disturbance includes roads and trails, damage from salt spray and wind, and storm overwash.

Global Environment:

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: Vegetation is dominated by a moderately dense (60-70% cover) short-shrub layer (0.5-1 m tall) of nearly equal amounts of *Baccharis halimifolia* (eastern baccharis), *Iva frutescens* (Jesuit's bark), and *Morella cerifera* (wax myrtle), along with lesser amounts of *Ilex vomitoria* (yaupon) and *Toxicodendron radicans ssp. radicans* (eastern poison ivy). In addition, there may be a sparse (5-30%) emergent tall-shrub layer (2-5 m) of *Juniperus virginiana var. silicicola* (southern redcedar) (state-vulnerable). The sparse (20%) herbaceous layer is dominated by *Juncus roemerianus* (needlegrass rush) and *Spartina patens* (saltmeadow cordgrass); additional species include *Borrichia frutescens* (bushy seaside tansy), *Centella erecta* (erect centella), *Hydrocotyle bonariensis* (largeleaf pennywort), and *Solidago sempervirens* (seaside goldenrod). Vines include *Cynanchum angustifolium* (Gulf Coast swallow-wort) (state-vulnerable), *Mikania scandens* (climbing hempvine), *Parthenocissus quinquefolia* (Virginia creeper), and *Smilax bona-nox* (saw greenbrier).

Global Vegetation:

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Baccharis halimifolia* (eastern baccharis), *Morella cerifera* (wax myrtle)
Tall shrub/sapling	Needle-leaved shrub	*Juniperus virginiana* var. *silicicola* (southern redcedar)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Ilex vomitoria* (yaupon)
Short shrub/sapling	Broad-leaved deciduous shrub	*Iva frutescens* (Jesuit's bark)
Herb (field)	Vine/Liana	*Mikania scandens* (climbing hempvine), *Smilax bona-nox* (saw greenbrier)
Herb (field)	Graminoid	*Juncus roemerianus* (needlegrass rush), *Spartina patens* (saltmeadow cordgrass)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Cynanchum angustifolium* (Gulf Coast swallow-wort), *Iresine rhizomatosa* (Juda's bush), *Juniperus virginiana* var. *silicicola* (southern redcedar), *Persea borbonia* (redbay), *Physalis walteri* (Walter's groundcherry), *Rubus trivialis* (southern dewberry), *Smilax auriculata* (earleaf greenbrier), *Solanum ptychanthum* (West Indian nightshade)

Global:

Conservation Status Rank

Global Rank & Reasons: G4? (11-Aug-1997).

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: An example documented in South Carolina on Old Island had an emergent layer of *Juniperus virginiana var. silicicola*, over *Iva frutescens* and *Borrichia frutescens*. The herbaceous layer consisted of *Cynanchum angustifolium, Juncus roemerianus*, and *Fimbristylis castanea*. This type is not known to occur in VA (G.P. Fleming and P. Coulling pers. comm.).

Global Similar Associations:

- *Baccharis halimifolia - Iva frutescens / Panicum virgatum* Shrubland (CEGL003921)--is potentially overlapping in some areas
- *Iva frutescens / Spartina patens* Shrubland (CEGL006848)

Global Related Concepts:

- Salt Shrub (Inland High Subtype) (Schafale 2000) ?

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found on Hatteras Island at Haulover Day Use Area and on Bodie Island, in vicinity of Bodie Island Lighthouse.

Global Range: This shrubland is found throughout much of the East Gulf, South Atlantic, and Mid-Atlantic coastal plains.

Nations: US

States/Provinces: AL, FL, GA, LA, MS, NC, SC

TNC Ecoregions:

USFS Ecoregions: 232Bz:CCC, 232Ce:CCC, 232Ch:CCC, 232Ci:CCC, 232Dc:CCC, 232Eb:CCC

Federal Lands: NPS (Cape Hatteras, Fort Pulaski, Timucuan?); USFS (Croatan); USFWS (Bon Secour)

Element Sources
Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.10, CAHA.16.

Local Description Authors: M.J. Russo

Global Description Authors:

References: Coulling pers. comm., FNAI 1992a, Fleming pers. comm., Lea 2002b, Schafale 2000, Schotz pers. comm., Southeastern Ecology Working Group n.d., Wolfe 1990

(CEGL003921) Groundsel-tree - Maritime Marsh-elder / Switchgrass Shrubland
***Baccharis halimifolia - Iva frutescens / Panicum virgatum* Shrubland**
Irregularly Flooded Eastern Tidal Salt Shrub

NVC Classification

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Tidal cold-deciduous shrubland (III.B.2.N.h.)
Alliance	*Baccharis halimifolia - Iva frutescens* Tidal Shrubland Alliance (A.1023)
Alliance (English name)	Groundsel-tree - Maritime Marsh-elder Tidal Shrubland Alliance
Association	*Baccharis halimifolia - Iva frutescens / Panicum virgatum* Shrubland
Association (English name)	Groundsel-tree - Maritime Marsh-elder / Switchgrass Shrubland
Association (Common name)	Irregularly Flooded Eastern Tidal Salt Shrub
Ecological System(s):	Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260)
	Atlantic Coastal Plain Northern Salt Pond Marsh (CES203.892)
	Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519)
	Central Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270)

Element Concept
Global Summary: This maritime shrubland of the eastern states occurs in association with salt marshes. *Iva frutescens* (Jesuit's bark) is the most characteristic and dominant shrub species, and *Baccharis halimifolia* (eastern baccharis) is a common associate. Other associated shrubs include *Morella pensylvanica* (northern bayberry) in the northern portion of the range, while *Borrichia frutescens* (bushy seaside tansy), *Morella cerifera* (wax myrtle), and *Juniperus virginiana var. silicicola* (southern redcedar) are frequent associates in the southern part of the range. *Spartina patens* (saltmeadow cordgrass) is a characteristic and usually abundant grass; other common herbaceous

associates include *Panicum virgatum* (switchgrass), *Distichlis spicata* (inland saltgrass), *Hibiscus moscheutos* (crimsoneyed rosemallow), *Toxicodendron radicans* (eastern poison ivy), *Teucrium canadense* (Canada germander), *Festuca rubra* (red fescue), *Limonium carolinianum* (Carolina sealavender), *Atriplex prostrata* (triangle orache), *Sabatia stellaris* (rose of Plymouth), *Sabatia dodecandra* (marsh rose gentian), and in the north *Hierochloe odorata* (vanilla grass) and *Juncus gerardii* (saltmeadow rush), and in the south *Setaria parviflora* (marsh bristlegrass). This community often forms an abrupt transition from salt marsh to upland reflecting the relatively higher elevation and less frequent tidal flooding. Shrub cover in this situation tends to be fairly dense, and herbs are sparsely distributed. Storm-induced disturbance causes periodic die-back of the shrubs restricting the extent of their spread.

Environmental Description

USFWS Wetland System: Estuarine

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This maritime shrubland was sampled once on Cape Hatteras National Seashore on a tidal flat along the edge of Pamlico Sound that is subject to irregular flooding. Soil is a rapidly drained sand. The unvegetated surface is dominated by bare sand (80% cover) with some leaf litter (20%). Evidence of disturbance includes flooding and wind damage.

Global Environment: This maritime and estuarine shrubland of the northeastern seaboard states occurs in association with salt marshes. It forms an ecotone between high salt marsh and adjacent upland vegetation. This shrubland occurs above mean high tide but can be flooded by storm tides. Substrate is organic peat over glacial till, sand, or sandy loam.

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: Vegetation is dominated by a moderately dense (70% cover) short-shrub layer (0.5-1 m tall) of *Iva frutescens* (Jesuit's bark) (dominant), *Baccharis halimifolia* (eastern baccharis), *Morella cerifera* (wax myrtle), and *Toxicodendron radicans ssp. radicans* (eastern poison ivy). In addition, there may be a very sparse (5%) emergent tall-shrub layer (2-5 m) of *Ilex vomitoria* (yaupon) and *Morella cerifera* (wax myrtle). The sparse (20%) herbaceous layer is dominated by *Borrichia frutescens* (bushy seaside tansy), *Juncus roemerianus* (needlegrass rush), and *Spartina patens* (saltmeadow cordgrass); additional species include *Ammophila breviligulata* (American beachgrass) (state-vulnerable), *Atriplex prostrata* (triangle orache), *Ipomoea sagittata* (saltmarsh morning-glory), *Iresine rhizomatosa* (Juda's bush) (state-imperiled), and *Solidago sempervirens* (seaside goldenrod). Vines include *Cynanchum angustifolium* (Gulf Coast swallow-wort) and *Smilax auriculata* (earleaf greenbrier) (both state-vulnerable).

Global Vegetation: This tidal shrubland is dominated by *Iva frutescens* (Jesuit's bark) and *Baccharis halimifolia* (eastern baccharis). Other associated shrubs include *Morella pensylvanica* (northern bayberry) in the northern portion of the range, while *Borrichia frutescens* (bushy seaside tansy), *Morella cerifera* (wax myrtle), and *Juniperus virginiana var. silicicola* (southern redcedar) are frequent associates in the southern part of the range. *Panicum virgatum* (switchgrass) is a characteristic and usually abundant grass; other common herbaceous associates include *Distichlis spicata* (inland saltgrass), *Hibiscus moscheutos* (crimsoneyed rosemallow), *Toxicodendron radicans* (eastern poison ivy), *Teucrium canadense* (Canada germander), *Festuca rubra* (red fescue), *Limonium carolinianum* (Carolina sealavender), and in the south *Setaria parviflora* (marsh bristlegrass). This community often forms an abrupt transition from salt marsh to upland reflecting the relatively higher elevation and less frequent tidal flooding. Shrub cover in this situation tends to be fairly dense, and herbs are sparsely distributed.

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Ilex vomitoria* (yaupon), *Morella cerifera* (wax myrtle)
Short shrub/sapling	Needle-leaved shrub	*Juniperus virginiana* var. *silicicola* (southern redcedar)
Short shrub/sapling	Broad-leaved deciduous shrub	*Iva frutescens* (Jesuit's bark)
Short shrub/sapling	Broad-leaved evergreen shrub	*Baccharis halimifolia* (eastern baccharis)
Short shrub/sapling	Vine/Liana	*Toxicodendron radicans* ssp. *radicans* (eastern poison ivy)
Herb (field)	Vine/Liana	*Cynanchum angustifolium* (Gulf Coast swallow-wort), *Smilax auriculata* (earleaf greenbrier)
Herb (field)	Forb	*Atriplex prostrata* (triangle orache), *Borrichia frutescens* (bushy seaside tansy), *Ipomoea sagittata* (saltmarsh morning-glory), *Iresine rhizomatosa* (Juda's bush), *Solidago sempervirens* (seaside goldenrod)
Herb (field)	Graminoid	*Ammophila breviligulata* (American beachgrass), *Juncus roemerianus* (needlegrass rush), *Spartina alterniflora* (smooth cordgrass), *Spartina patens* (saltmeadow cordgrass)

Global

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Baccharis halimifolia* (eastern baccharis), *Iva frutescens* (Jesuit's bark)
Herb (field)	Graminoid	*Panicum virgatum* (switchgrass)

Characteristic Species

Cape Hatteras National Seashore and Cape Lookout National Seashore:

Global: *Baccharis halimifolia* (eastern baccharis), *Iva frutescens* (Jesuit's bark), *Panicum virgatum* (switchgrass)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Ammophila breviligulata* (American beachgrass), *Cynanchum angustifolium* (Gulf Coast swallow-wort), *Iresine rhizomatosa* (Juda's bush), *Juniperus virginiana* var. *silicicola* (southern redcedar), *Smilax auriculata* (earleaf greenbrier)

Global:

Conservation Status Rank

Global Rank & Reasons: G5 (1-Dec-1997).

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: As shrub cover decreases, the community often grades into high salt marsh associations such as *Panicum virgatum - Spartina patens* Herbaceous Vegetation (CEGL006150) or *Spartina patens*-dominated high marsh associations. Southern analogs of this salt marsh-upland border shrubland include *Baccharis halimifolia - Iva frutescens - Morella cerifera - (Ilex vomitoria)* Shrubland (CEGL003920) along the southern Atlantic Coast from the Carolinas to Florida west to Louisiana and *Iva frutescens ssp. frutescens - Baccharis halimifolia / Spartina spartinae* Shrubland (CEGL004616) along the Texas Gulf Coast. This community is differentiated from *Morella cerifera - Baccharis halimifolia / Spartina patens* Shrubland (CEGL003809) by the presence of *Iva frutescens* and by the influence of tidal flooding.

Global Similar Associations:

- *Baccharis halimifolia - Iva frutescens - Morella cerifera - (Ilex vomitoria)* Shrubland (CEGL003920)
- *Eleocharis rostellata - Spartina patens* Herbaceous Vegetation (CEGL006611)
- *Iva frutescens / Spartina cynosuroides* Tidal Shrubland (CEGL006847)
- *Iva frutescens / Spartina patens* Shrubland (CEGL006848)--has lower species diversity, occurs at the borders of high salt marsh and often intergrades with it; tidal flooding is more regular than in CEGL003921
- *Iva frutescens* ssp. *frutescens - Baccharis halimifolia / Spartina spartinae* Shrubland (CEGL004616)
- *Panicum virgatum - Spartina patens* Herbaceous Vegetation (CEGL006150)

Global Related Concepts:

- *Baccharis halimifolia - Iva frutescens / Panicum virgatum* Herbaceous Vegetation (Harrison and Stango 2003) =
- *Baccharis halimifolia - Iva frutescens ssp. oraria / Spartina patens* Shrubland (Bartgis 1986) =
- *Iva frutescens - Baccharis halimifolia / Spartina patens - Panicum virgatum* Tidal Shrubland (VDNH 2003) =
- *Iva frutescens-Baccharis halimifolia* (Good 1965) ?
- *Iva frutescens* and *Baccharis halimifolia* (Klemas et al. 1973) =
- Estuarine scrub-shrub wetland (Tiner 1985a) =
- Estuarine scrub-shrub wetland (Tiner 1985b) =
- Salt Marsh (Rawinski 1984) ?
- Salt Marsh Complex, marsh-upland border (Breden 1989) B
- Salt Shrub (High Subtype) (Schafale 2000) ?
- Salt bush - salt meadow marsh (Daiber et al. 1976) ?
- Salt marsh and upper border (Barry 1980) B
- Salt marsh community (Hill 1986) B
- Salt shrub (Reschke 1990) B
- Saltbush zone (Boule 1979) B
- Shrub succession community (Higgins et al. 1971) B
- Swamp thicket (Klotz 1986) B

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found on Hatteras Island, Salvo Day Use Area at edge of Pamlico Sound.

Global Range: This association ranges from Massachusetts to South Carolina.

Nations: US

States/Provinces: CT, DE, MA, MD:S5, NC, NJ, NY, RI, SC, VA

TNC Ecoregions:

USFS Ecoregions: 221Aa:CCC, 221Ab:CCC, 221Ac:CCC, 221Ad:CCC, 221Ak:CC?, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Ad:CC?, 232Br:CCC, 232Bt:CCC, 232Bx:CCC, 232Bz:CCC, 232Ch:CCC, 232Ci:CCC

Federal Lands: NPS (Assateague Island, Cape Hatteras, Colonial, Fire Island); USFWS (Back Bay?, Chesapeake Marshlands, Chincoteague, Monomoy?, Parker River, Prime Hook)

Element Sources
Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.11.

Local Description Authors: M.J. Russo

Global Description Authors: L.A. Sneddon

References: Barry 1980, Bartgis 1986, Bell et al. 2002, Berdine 1998, Boule 1979, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1996, Coulling 2002, Coulling pers. comm., Daiber et al. 1976, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming 2001, Fleming et al. 2001, Fleming pers. comm., Good 1965, Harrison 2004, Harrison and Stango 2003, Higgins et al. 1971, Hill 1986, J. Harrison pers. comm., Klemas et al. 1973, Klotz 1986, Martin 1959b, Metzler and Barrett 2001, NRCS 2001b, Rawinski 1984, Reschke 1990, Schafale 2000, Schafale and Weakley 1990, Sneddon et al. 1995, Swain and Kearsley 2001, TNC 1995c, Tiner 1984, Tiner 1985a, Tiner 1985b, VDNH 2003.

Borrichia frutescens Tidal Shrubland Alliance (A.1026)

Alliance Concept

Summary: This alliance includes tidal areas in upper marsh edges and flats dominated by *Borrichia frutescens* (bushy seaside tansy). It occurs at spatial scales ranging from narrow bands to flats in excess of 500 ha; it often occurs either just below *Iva frutescens* (Jesuit's bark) or *Baccharis halimifolia* (eastern baccharis), or just above *Juncus roemerianus* (needlegrass rush) or *Spartina alterniflora* (smooth cordgrass). Other characteristic species include *Spartina patens* (saltmeadow cordgrass), *Iva frutescens ssp. frutescens* (Jesuit's bark), *Iva frutescens ssp. oraria* (Jesuit's bark), and *Limonium carolinianum* (Carolina sealavender). In Texas, the composition of this low-diversity, irregularly tidally flooded shrubland is variable and can include *Spartina spartinae* (gulf cordgrass), *Sporobolus virginicus* (seashore dropseed), *Monanthochloe littoralis* (shoregrass), *Sarcocornia perennis* (chickenclaws), *Limonium carolinianum* (Carolina sealavender), *Lycium carolinianum var. quadrifidum* (Carolina desert-thorn), *Rayjacksonia phyllocephala* (camphor daisy), and *Batis maritima* (turtleweed). Here, these communities often occur just above the lower tidal flat communities *Batis maritima - Sarcocornia perennis* Dwarf-shrubland (CEGL003956) or *Sarcocornia perennis - (Batis maritima, Distichlis spicata)* Dwarf-shrubland (CEGL002278).

Classification Comments: Consideration should be given to placement of this alliance in Class IV. Dwarf-shrubland. Although stature can be more than 0.5 m, it is typically 0.3-0.5 m in height.

Similar Alliances:

Similar Alliance Comments:

Related Concepts:

- Glasswort-Saltwort Series (Diamond 1993) I
- Salt Shrub (Schafale and Weakley 1990) I
- Tidal Marsh (FNAI 1990) ?

Alliance Description

Environment: This alliance occurs along upper marsh edges and in tidal flats ranging in scale from narrow bands to hundreds of hectares. It is found along mainland shores and the bayside of barrier islands.

Vegetation: This alliance is dominated by *Borrichia frutescens* (bushy seaside tansy), often in monospecific stands. Other characteristic species may include *Spartina patens* (saltmeadow cordgrass), *Spartina spartinae* (gulf cordgrass), *Sporobolus virginicus* (seashore dropseed), *Monanthochloe littoralis* (shoregrass), *Iva frutescens ssp. frutescens* (Jesuit's bark), *Iva frutescens ssp. oraria* (Jesuit's bark), *Limonium carolinianum* (Carolina sealavender), *Sarcocornia perennis* (chickenclaws), *Lycium carolinianum var. quadrifidum* (Carolina desert-thorn), *Rayjacksonia phyllocephala* (camphor daisy), and *Batis maritima* (turtleweed).

Dynamics:

Alliance Distribution

Range: This alliance is found throughout the southeastern United States.

Nations: US

Subnations: AL, FL, GA, LA?, MS, NC, SC, TX, VA?

TNC Ecoregions: 31:C, 53:C, 55:C, 56:C, 57:C, 58:C

USFS Ecoregions: 231Fb:CCC, 232Cb:CC?, 232Ce:CCC, 232Ch:CCC, 232Ci:CCC, 232Dc:CCC, 232Eb:CCC, 232Gb:CCC, 255Dc:CCC

Federal Lands: NPS (Canaveral, Cape Lookout, Fort Pulaski, Timucuan?); USFS (Croatan); USFWS (Anahuac, Aransas, Back Bay?, Big Boggy, Brazoria, Laguna Atascosa, Matagorda Island, McFaddin, San Bernard, Texas Point)

(CEGL003924) Seaside Oxeye / (Saltmeadow Cordgrass, Black Needlerush) Shrubland
***Borrichia frutescens / (Spartina patens, Juncus roemerianus)* Shrubland**
Seaside Oxeye Tidal Shrub Flat

NVC Classification

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Tidal cold-deciduous shrubland (III.B.2.N.h.)
Alliance	*Borrichia frutescens* Tidal Shrubland Alliance (A.1026)
Alliance (English name)	Seaside Oxeye Tidal Shrubland Alliance
Association	*Borrichia frutescens / (Spartina patens, Juncus roemerianus)* Shrubland
Association (English name)	Seaside Oxeye / (Saltmeadow Cordgrass, Black Needlerush) Shrubland
Association (Common name)	Seaside Oxeye Tidal Shrub Flat
Ecological System(s):	Central Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.376) Central Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270) Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260) Central and Upper Texas Coast Salt and Brackish Tidal Marsh (CES203.473) Gulf Coast Chenier Plain Salt and Brackish Tidal Marsh (CES203.468)

Element Concept

Global Summary: This association includes upper marsh edges and flats strongly dominated by *Borrichia frutescens* (bushy seaside tansy), ranging in size from narrow bands to flats in excess of 500 ha. It is broadly described to include vegetation ranging from the Middle and South Atlantic Coast to the West Gulf Coast of the United States. It may occur just below *Iva frutescens* (Jesuit's bark) or *Baccharis halimifolia* (eastern baccharis) shrublands and just above marshes dominated by *Juncus roemerianus* (needlegrass rush) or *Spartina alterniflora* (smooth cordgrass). Other characteristic species may include *Spartina patens* (saltmeadow cordgrass), *Iva frutescens* (Jesuit's bark), and *Limonium carolinianum* (Carolina sealavender). In Texas, the composition of this low-diversity, irregularly tidally flooded shrubland is variable and can include *Distichlis spicata* (inland saltgrass), *Schoenoplectus robustus* (sturdy bulrush), *Sporobolus virginicus* (seashore dropseed), *Monanthochloe littoralis* (shoregrass), *Atriplex matamorensis* (Matamoros saltbush) (in south Texas), *Sarcocornia perennis* (chickenclaws), *Limonium carolinianum* (Carolina sealavender), *Lycium carolinianum var. quadrifidum* (Carolina desert-thorn), *Rayjacksonia phyllocephala* (camphor daisy), *Prosopis reptans* (tornillo) (in south Texas), and *Batis maritima* (turtleweed). Here, this community often occurs just above the lower tidal flat communities *Batis maritima - Sarcocornia perennis* Dwarf-shrubland (CEGL003956) or *Sarcocornia perennis - (Batis maritima, Distichlis spicata)* Dwarf-shrubland (CEGL002278).

Environmental Description

USFWS Wetland System: Estuarine

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This tidal shrubland was sampled at five locations on Cape Lookout National Seashore (including one site on Shackleford Banks). It occurs on tidally and wind-tidally flooded tidal flats and swales. Soils are poorly to very poorly drained muck and sand. The unvegetated surface is dominated by either leaf litter (2-80% cover) or bare soil (20-98%). Evidence of disturbance includes the presence of trash, horse trails, and browsing.

Global Environment: This association occurs along upper marsh edges and in tidal flats ranging in scale from narrow bands to hundreds of hectares. It is found along mainland shores and the bayside of barrier islands. In south Texas, it can also occur around the base of lomas.

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: This tidal shrubland is dominated by a sparse to very dense (20-100% cover) shrub layer (0.5-2 m tall) of *Borrichia frutescens* (bushy seaside tansy); additional shrubs include *Baccharis angustifolia* (saltwater false willow) (state-imperiled) and *Iva frutescens* (Jesuit's bark). The moderate to dense (40-80%) herbaceous layer is dominated by *Juncus roemerianus* (needlegrass rush) and *Spartina patens* (saltmeadow cordgrass) and may include lesser amounts of *Cynanchum angustifolium* (Gulf Coast swallow-wort) (state-vulnerable), *Distichlis spicata* (inland saltgrass), *Fimbristylis castanea* (marsh fimbry), and *Limonium carolinianum* (Carolina sealavender). This community supports additional state-vulnerable species, including *Agalinis maritima* (saltmarsh false foxglove), *Phyla nodiflora* (turkey tangle fogfruit), and *Symphyotrichum tenuifolium* (perennial saltmarsh aster).

Global Vegetation: This community is strongly dominated by *Borrichia frutescens* (bushy seaside tansy). Other characteristic species may include *Spartina patens* (saltmeadow cordgrass), *Iva frutescens* (Jesuit's bark), *Distichlis spicata* (inland saltgrass), *Schoenoplectus robustus* (sturdy bulrush), *Sporobolus virginicus* (seashore dropseed), *Monanthochloe littoralis* (shoregrass), *Sarcocornia perennis* (chickenclaws), *Limonium carolinianum* (Carolina sealavender), *Lycium carolinianum var. quadrifidum* (Carolina desert-thorn), *Rayjacksonia phyllocephala* (camphor daisy), and *Batis maritima* (turtleweed). In Texas, *Spartina patens* (saltmeadow cordgrass) is a less important component of this community, but it often forms a fringe along the upper margin.

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Iva frutescens* (Jesuit's bark)
Short shrub/sapling	Broad-leaved evergreen shrub	*Baccharis angustifolia* (saltwater false willow), *Borrichia frutescens* (bushy seaside tansy)
Herb (field)	Graminoid	*Juncus roemerianus* (needlegrass rush), *Spartina patens* (saltmeadow cordgrass)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Agalinis maritima* (saltmarsh false foxglove), *Baccharis angustifolia* (saltwater false willow), *Cynanchum angustifolium* (Gulf Coast swallow-wort), *Phyla nodiflora* (turkey tangle fogfruit), *Symphyotrichum tenuifolium* (perennial saltmarsh aster)

Global: *Grus americana* (whooping crane)

Conservation Status Rank

Global Rank & Reasons: G4 (10-Oct-1997). This is a common tidal flat community along the Gulf and Middle and South Atlantic coasts of the United States.

Classification

Status: Standard

Classification Confidence: 1 - Strong

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: The relationship between this community and the similar community *Borrichia frutescens / Spartina spartinae* Shrubland (CEGL004617) is poorly documented. The ranges of these two communities overlap along the middle and south Texas coast where *Borrichia frutescens / Spartina spartinae* Shrubland (CEGL004617) dominates less saline, higher ground than this community (CEGL003924).

Global Similar Associations:

- *Borrichia frutescens / Spartina spartinae* Shrubland (CEGL004617)

Global Related Concepts:

- Glasswort-Saltwort Series (Diamond 1993) B
- Salt Shrub (Low Subtype) (Schafale 2000) ?

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found at many locations on Cape Lookout National Seashore, North Core Banks, South Core Banks and Shackleford Banks.

Global Range: This association is found in coastal areas from North Carolina to Texas.

Nations: US

States/Provinces: AL, FL, GA, LA?, MS, NC, SC, TX, VA?

TNC Ecoregions:

USFS Ecoregions: 231Fb:CCP, 232Cb:CC?, 232Ce:CCC, 232Ch:CCC, 232Ci:CCC, 232Dc:CCC, 232Eb:CCC, 232Gb:CCC, 255Dc:CPP

Federal Lands: NPS (Canaveral, Cape Lookout, Fort Pulaski, Timucuan?); USFS (Croatan); USFWS (Anahuac, Aransas, Back Bay?, Big Boggy, Brazoria, Laguna Atascosa, Matagorda Island, McFaddin, San Bernard, Texas Point)

Element Sources

Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CALO.2, CALO.37, CALO.4, CALO.52, CALO.68.

Local Description Authors: M.J. Russo

Global Description Authors: A.S. Weakley

References: Diamond 1993, FNAI 1990, FNAI 1992a, McAlister and McAlister 1993, McAlister and McAlister 1995, Peet et al. unpubl. data 2002, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Schotz pers. comm., Southeastern Ecology Working Group n.d.

Herbaceous Vegetation (V.)

Planted/Cultivated Temperate or Subpolar Grassland (V.A.5.C.x)

Eremochloa ophiuroides Planted Herbaceous Alliance (A.1187)

Alliance Distribution

Range: This alliance is currently known from North Carolina.

Nations: US

Subnations: NC, SC

TNC Ecoregions: 57:C

USFS Ecoregions: 232Ci:CCC

Federal Lands: NPS (Cape Lookout)

(CEGL004204) Centipede Grass Planted Herbaceous Vegetation
***Eremochloa ophiuroides* Planted Herbaceous Vegetation [Provisional]**

NVC Classification

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Planted/Cultivated temperate or subpolar grassland (V.A.5.C.)
Formation	Planted/cultivated temperate or subpolar grassland (V.A.5.C.x.)
Alliance	*Eremochloa ophiuroides* Planted Herbaceous Alliance (A.1187)
Alliance (English name)	Centipede Grass Planted Herbaceous Alliance
Association	*Eremochloa ophiuroides* Planted Herbaceous Vegetation [Provisional]
Association (English name)	Centipede Grass Planted Herbaceous Vegetation

Ecological System(s):

Environmental Description

USFWS Wetland System:

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This association was sampled once on Cape Lookout National Seashore. The site is a swale that is prone to storm surges but otherwise probably above tidal influence. Soil is poorly drained sand. The unvegetated surface is dominated by bare sand (90% cover) with some leaf litter (10%). It is likely that the centipede grass was planted or naturalized here. This particular site is outside any exclosure and is being grazed by horses. However, it is similar to vegetation within an adjacent exclosure and to many other swales on the island. Other evidence of disturbance includes the presence of exotic plants species.

Global Environment:

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: Vegetation is dominated by a moderately dense (70% cover) herbaceous layer of the non-native grass *Eremochloa ophiuroides* (centipede

grass), along with additional native graminoids, such as *Andropogon glomeratus* (bushy bluestem), *Eragrostis spectabilis* (purple lovegrass), *Fimbristylis caroliniana* (Carolina fimbry), *Spartina patens* (saltmeadow cordgrass), and *Uniola paniculata* (seaoats), and native forbs, such as *Centella erecta* (erect centella), *Hydrocotyle bonariensis* (largeleaf pennywort), *Polypremum procumbens* (juniper leaf), and *Sabatia stellaris* (rose of Plymouth), among others. Despite its likely anthropogenic origins, this community supports several state-vulnerable species, including *Eustachys petraea* (pinewoods fingergrass), *Juncus megacephalus* (bighead rush), *Phyla nodiflora* (turkey tangle fogfruit), and *Rhynchospora colorata* (starrush whitetop).

Global Vegetation:

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Herb (field)	Forb	*Phyla nodiflora* (turkey tangle fogfruit)
Herb (field)	Graminoid	*Eremochloa ophiuroides* (centipede grass), *Spartina patens* (saltmeadow cordgrass)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Eremochloa ophiuroides* (centipede grass), *Eustachys petraea* (pinewoods fingergrass), *Juncus megacephalus* (bighead rush), *Phyla nodiflora* (turkey tangle fogfruit), *Rhynchospora colorata* (starrush whitetop)

Global:

Conservation Status Rank

Global Rank & Reasons: GNA (cultural) (26-Nov-2007).

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found on Shackleford Banks.

Global Range:

Nations: US

States/Provinces: NC, SC

TNC Ecoregions:

USFS Ecoregions: 232Ci:CCC

Federal Lands: NPS (Cape Lookout)

Element Sources:

Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CALO.50.

Local Description Authors: M.J. Russo

Global Description Authors:

References: Southeastern Ecology Working Group n.d.

Tall Sod Temperate Grassland (V.A.5.N.a)

Uniola paniculata Temperate Herbaceous Alliance (A.1199)

Alliance Concept

Summary: This alliance includes dune grasslands, typically with scattered shrubs and forbs, of the southeastern Coastal Plain, with *Uniola* (seaoats) dominant or codominant. The cover varies from sparse on foredunes and on actively moving sand areas to fairly dense on more stable dunes. In the northern portion of the distribution of this alliance (northern North Carolina and Virginia), *Ammophila breviligulata* (American beachgrass) may be present, indicating a transition towards the V.A.5.N.c *Ammophila breviligulata* (American beachgrass) Herbaceous Alliance (A.1207). On the Chandeleurs and related islands of coastal Louisiana, *Spartina patens* (saltmeadow cordgrass) replaces *Uniola paniculata* (seaoats) (which is present in small amounts) as the dominant grass. Other typical species of this alliance include *Andropogon* (bluestem) spp., *Cakile* (searocket) spp., *Cenchrus* (sandbur) spp., *Chamaesyce* (sandmat) spp., *Croton punctatus* (gulf croton), *Hydrocotyle bonariensis* (largeleaf pennywort), *Iva imbricata* (seacoast marshelder), *Physalis walteri* (Walter's groundcherry), *Spartina patens* (saltmeadow cordgrass), and *Strophostyles helvula* (trailing fuzzybean). In the southern part of the range, additional forbs and vines include *Helianthus debilis* (cucumberleaf sunflower), *Ipomoea pes-caprae* (bayhops), *Ipomoea imperati* (beach morning-glory), and *Sesuvium* (seapurslane) spp. Oceanwards are the annual-dominated, unstable, upper beach communities, often with trailing vines. Landwards are shrub-dominated communities or grasslands dominated by species other than *Uniola* (seaoats), such as *Spartina patens* (saltmeadow cordgrass) or *Muhlenbergia filipes* (gulfhairawn muhly). This dune grassland community occurs almost exclusively on sandy, unstable, droughty substrates (Typic Quartzipsamments) with no soil profile development. Eolian processes cause active sand deposition and erosion. The sand substrate is usually visible, and litter accumulation from plant debris is nearly absent. This community generally occurs on foredunes that receive the force of wind and salt spray but is beyond the influence of most storm tides. The effects of nearly continuous salt spray exclude most other species and maintain the vegetation type.

Similar Alliances:

- *Ammophila breviligulata* Herbaceous Alliance (A.1207)
- *Paspalum monostachyum - (Panicum amarum, Schizachyrium littorale)* Herbaceous Alliance (A.1200)
- *Uniola paniculata* Subtropical Herbaceous Alliance (A.1153)

Similar Alliance Comments: The boundary and relationship between this alliance (A.1199) and the similar alliance (A.1153) needs to be assessed. To the north of this alliance, dune grasslands are dominated by *Ammophila breviligulata*. L. Smith (pers. comm.) states that "very few if any dunes in Louisiana are dominated by, or even have, *Uniola paniculata*." On the Chandeleurs and related islands of coastal Louisiana, *Spartina patens* replaces *Uniola paniculata* as the dominant

grass [also see *Paspalum monostachyum - (Panicum amarum, Schizachyrium littorale)* Herbaceous Alliance (A.1200)]. In the northern portion of the distribution of this alliance (northern North Carolina and Virginia), *Ammophila breviligulata* may be present, indicating a transition towards the *Ammophila breviligulata* Herbaceous Alliance (A.1207).

Related Concepts:

- Beach Dune (FNAI 1990) ?
- Beach Dune (FNAI 1992a) ?
- Dune Grass (Schafale and Weakley 1990) I
- Maritime Grassland (Nelson 1986) I
- Sea Oats-Bitter Panicum Series (Diamond 1993) ?

Alliance Description

Environment: This dune grassland community occurs almost exclusively on sandy, unstable, droughty substrates (Typic Quartzipsamments) with no soil profile development. Eolian processes cause active sand deposition and erosion. The sand substrate is usually visible, and litter accumulation from plant debris is nearly absent. This community generally occurs on foredunes that receive the force of wind and salt spray but is beyond the influence of most storm tides. The effects of nearly continuous salt spray exclude most other species and maintain the vegetation type.

Vegetation: Dune grasslands, typically with scattered shrubs and forbs, of the southeastern Coastal Plain, with *Uniola* (seaoats) dominant or codominant. The cover varies from sparse on foredunes and on actively moving sand areas to fairly dense on more stable dunes. In the northern portion of the distribution of this alliance (northern North Carolina and Virginia), *Ammophila breviligulata* (American beachgrass) may be present, indicating a transition towards the V.A.5.N.c *Ammophila breviligulata* (American beachgrass) Herbaceous Alliance (A.1207). On the Chandeleurs and related islands of coastal Louisiana, *Spartina patens* (saltmeadow cordgrass) replaces *Uniola paniculata* (seaoats) (which is present in small amounts) as the dominant grass. Other typical species include *Andropogon* (bluestem) spp., *Cakile* (searocket) spp., *Cenchrus* (sandbur) spp., *Chamaesyce* (sandmat) spp., *Croton punctatus* (gulf croton), *Hydrocotyle bonariensis* (largeleaf pennywort), *Iva imbricata* (seacoast marshelder), *Physalis walteri* (Walter's groundcherry), *Spartina patens* (saltmeadow cordgrass), and *Strophostyles helvula* (trailing fuzzybean). In the southern part of the range, additional forbs and vines include *Helianthus debilis* (cucumberleaf sunflower), *Ipomoea pes-caprae* (bayhops), *Ipomoea imperati* (beach morning-glory), and *Sesuvium* (seapurslane) spp. Oceanwards are the annual-dominated, unstable, upper beach communities, often with trailing vines. Landwards are shrub-dominated communities or grasslands dominated by species other than *Uniola* (seaoats), such as *Spartina patens* (saltmeadow cordgrass) or *Muhlenbergia filipes* (gulfhairawn muhly).

Dynamics:

Alliance Distribution

Range: This alliance is found in Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Texas, and Virginia.

Nations: US

Subnations: AL, FL, GA, MS, NC, SC, TX, VA

TNC Ecoregions: 30:P, 31:C, 41:P, 53:C, 54:P, 55:C, 56:C, 57:C, 58:P

USFS Ecoregions: 231Fb:CCC, 232Bg:C??, 232Bz:C??, 232Cb:CCC, 232Ce:CCC, 232Ci:CCC, 232Db:CCC, 232Dc:CCC, 232Dd:CCP, 232De:CCC, 232Eb:CCC, 232Ed:CCC, 232Ee:CCC, 232Gb:CCC, 255Dc:CCC

Federal Lands: DOD (Tyndall); NPS (Cape Hatteras, Cape Lookout, Cumberland Island, Padre Island, Timucuan); USFWS (Back Bay, Bon Secour, Cape Romain, Matagorda Island)

(CEGL004039) Sea-oats - Seaside Bluestem - Bitter Panicgrass Herbaceous Vegetation
***Uniola paniculata - Schizachyrium littorale - Panicum amarum* Herbaceous Vegetation**
South Atlantic Loamy Coastal Dunegrass

NVC Classification

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Tall sod temperate grassland (V.A.5.N.a.)
Alliance	*Uniola paniculata* Temperate Herbaceous Alliance (A.1199)
Alliance (English name)	Sea-oats Temperate Herbaceous Alliance
Association	*Uniola paniculata - Schizachyrium littorale - Panicum amarum* Herbaceous Vegetation
Association (English name)	Sea-oats - Seaside Bluestem - Bitter Panicgrass Herbaceous Vegetation
Association (Common name)	South Atlantic Loamy Coastal Dunegrass
Ecological System(s):	Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273)

Element Concept

Global Summary: This dunegrass association occurs on ocean front dunes on barrier islands and barrier spits in the Mid-Atlantic Coastal Plain. *Uniola paniculata* (seaoats) is the dominant species, with *Schizachyrium littorale* (shore little bluestem) and *Panicum amarum* (bitter panicgrass) also common and characteristic. *Ammophila breviligulata* (American beachgrass) may be common in Dare and Currituck counties of northeastern North Carolina, and in southeastern Virginia. Other typical species include *Croton punctatus* (gulf croton), *Oenothera humifusa* (seabeach evening-primrose), *Physalis walteri* (Walter's groundcherry), *Hydrocotyle bonariensis* (largeleaf pennywort), *Heterotheca subaxillaris* (camphorweed), and *Chrysopsis gossypina* (cottony goldenaster). This is the characteristic foredune vegetation immediately south and north of the Outer Banks of North Carolina, perhaps associated with slightly loamier soils with more influence of riverine sediments.

Environmental Description

USFWS Wetland System:

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This dunegrass association occurs on both Cape Hatteras National Seashore and Cape Lookout National Seashore on gently to moderately sloping dunes. Soils range from excessively drained to well-drained sand. The unvegetated surface is dominated by bare sand (85-97% cover) with some leaf litter (2-14%), large rocks (0-1%), and shells (0-3%). Evidence of disturbance includes foot paths, ORV use, trash, and animal (mostly wild horses) grazing/browsing; evidence of natural disturbance includes wind and storm overwash.

Global Environment: This dunegrass association occurs on gently to moderately sloping dunes. Soils range from excessively drained to well-drained sand. The unvegetated surface is dominated by bare sand (85-97% cover) with some leaf litter (2-14%), large rocks (0-1%), and shells (0-3%).

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: Vegetation is a sparse to dense (30-80% cover), relatively tall (0.5-2 m) herbaceous layer dominated by native grasses *Uniola paniculata* (seaoats), *Schizachyrium littorale* (shore little bluestem), and less often *Panicum amarum* (bitter panicgrass) (state-vulnerable) and *Spartina patens* (saltmeadow cordgrass). Forbs always include *Hydrocotyle bonariensis* (largeleaf pennywort) and may include *Gaillardia pulchella* (firewheel), *Heterotheca subaxillaris* (camphorweed), and *Smilax smallii* (lanceleaf greenbrier). This community supports many state-rare species, including *Chamaesyce bombensis* (dixie sandmat), *Chamaesyce polygonifolia* (seaside sandmat), *Iva imbricata* (seacoast marshelder), and *Physalis walteri* (Walter's groundcherry); a total of 13 rare species were recorded from 11 plots (including samples at Fort Mason and Hammocks Beach state parks).

Global Vegetation: Vegetation is a sparse to dense (30-80% cover), relatively tall (0.5-2 m) herbaceous layer dominated by native grasses *Uniola paniculata* (seaoats), *Schizachyrium littorale* (shore little bluestem), and less often *Panicum amarum* (bitter panicgrass) and *Spartina patens* (saltmeadow cordgrass). Forbs always include *Hydrocotyle bonariensis* (largeleaf pennywort) and may include *Gaillardia pulchella* (firewheel), *Heterotheca subaxillaris* (camphorweed), and *Smilax smallii* (lanceleaf greenbrier). This community supports many North Carolina-rare species, including *Chamaesyce bombensis* (dixie sandmat), *Chamaesyce polygonifolia* (seaside sandmat), *Iva imbricata* (seacoast marshelder), and *Physalis walteri* (Walter's groundcherry).

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Panicum amarum* (bitter panicgrass), *Uniola paniculata* (seaoats)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Cakile edentula* (American searocket), *Cenchrus tribuloides* (sanddune sandbur), *Chamaesyce bombensis* (dixie sandmat), *Chamaesyce polygonifolia* (seaside sandmat), *Chenopodium ambrosioides* var. *ambrosioides* (Mexican tea), *Eustachys petraea* (pinewoods fingergrass), *Iva imbricata* (seacoast marshelder), *Juniperus virginiana* var. *silicicola* (southern redcedar), *Oenothera humifusa* (seabeach evening-primrose), *Opuntia pusilla* (cockspur pricklypear), *Panicum amarum* (bitter panicgrass), *Physalis walteri* (Walter's groundcherry), *Smilax auriculata* (earleaf greenbrier), *Triplasis purpurea* (purple sandgrass)

Global: *Amaranthus pumilus* (seaside amaranth)

Conservation Status Rank

Global Rank & Reasons: G3 (30-Jan-2001). This association is limited to dynamic coastal dunes of the Mid-Atlantic Coastal Plain. It is fairly restricted geographically, and many occurrences have been destroyed or altered by coastal development. Beach driving also impacts these communities.

Classification
Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments:

Global Similar Associations:

- *Uniola paniculata* Herbaceous Vegetation (CEGL004038)

Global Related Concepts:

- Dune Grass (Southern Subtype) (Schafale 2000) ?

Element Distribution
Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found most abundantly on Shackleford Banks, but also found on North Core Banks.

Global Range: This association is limited edaphically to dynamic coastal dunes of the Mid-Atlantic Coastal Plain.

Nations: US

States/Provinces: GA?, NC, SC, VA

TNC Ecoregions:

USFS Ecoregions: 232Cb:CCC, 232Ci:CCC

Federal Lands: NPS (Cape Lookout); USFWS (Back Bay, Cape Romain)

Element Sources
Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots**: CALO.18, CALO.39, CALO.48,** CALO.51, CALO.55.

Local Description Authors: M.J. Russo

Global Description Authors: A.S. Weakley, mod. M.J. Russo and C.W. Nordman

References: Fleming et al. 2001, Nelson 1986, Peet et al. unpubl. data 2002, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Southeastern Ecology Working Group n.d.

(CEGL004038) Sea-oats Herbaceous Vegetation
***Uniola paniculata* Herbaceous Vegetation**
Outer Banks Coastal Dunegrass

NVC Classification

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Tall sod temperate grassland (V.A.5.N.a.)
Alliance	*Uniola paniculata* Temperate Herbaceous Alliance (A.1199)
Alliance (English name)	Sea-oats Temperate Herbaceous Alliance
Association	*Uniola paniculata* Herbaceous Vegetation
Association (English name)	Sea-oats Herbaceous Vegetation
Association (Common name)	Outer Banks Coastal Dunegrass
Ecological System(s):	Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273)

Element Concept

Global Summary: This association is the characteristic foredune vegetation along parts of the southern Mid-Atlantic Coast, where *Schizachyrium littorale* (shore little bluestem) is absent, notably the Outer Banks of North Carolina. Other characteristic species include *Hydrocotyle bonariensis* (largeleaf pennywort), *Oenothera humifusa* (seabeach evening-primrose), *Heterotheca subaxillaris* (camphorweed), *Solidago sempervirens var. mexicana* (seaside goldenrod), *Opuntia pusilla* (cockspur pricklypear), and *Physalis walteri* (Walter's groundcherry). This type is depauperate, compared to other Atlantic Coast *Uniola* (seaoats) associations, more notable for lacking many species than for the presence of any. *Calystegia soldanella* (seashore false bindweed) occurs as an apparent exotic.

Environmental Description

Global Summary: This association is the characteristic foredune vegetation along parts of the southern Mid-Atlantic Coast, where *Schizachyrium littorale* (shore little bluestem) is absent, notably the Outer Banks of North Carolina. Other characteristic species include *Hydrocotyle bonariensis* (largeleaf pennywort), *Oenothera humifusa* (seabeach evening-primrose), *Heterotheca subaxillaris* (camphorweed), *Solidago sempervirens var. mexicana* (seaside goldenrod), *Opuntia pusilla* (cockspur pricklypear), and *Physalis walteri* (Walter's groundcherry). This type is depauperate, compared to other Atlantic Coast *Uniola* (seaoats) associations, more notable for lacking many species than for the presence of any. *Calystegia soldanella* (seashore false bindweed) occurs as an apparent exotic.

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: Vegetation is a sparse to moderately dense (20-70% cover), relatively tall (up to 2 m) herbaceous layer dominated by native grass *Uniola paniculata* (seaoats). Additional herbs may include *Hydrocotyle bonariensis* (largeleaf pennywort), *Cynanchum angustifolium* (Gulf Coast swallow-wort) (state-vulnerable), *Gaillardia pulchella* (firewheel), *Heterotheca subaxillaris* (camphorweed), *Oenothera humifusa* (seabeach evening-primrose) (state-vulnerable), *Panicum virgatum* (switchgrass), *Pityopsis graminifolia* (narrowleaf silkgrass), and *Spartina patens* (saltmeadow cordgrass). A few emergent shrubs, including *Iva frutescens* (Jesuit's bark), *Juniperus virginiana var. silicicola* (southern redcedar), and *Smilax auriculata* (earleaf greenbrier) (state-vulnerable), may also be present. This community supports many state-rare species, including *Ammophila breviligulata* (American beachgrass), *Cakile edentula* (American searocket), *Chamaesyce bombensis* (dixie sandmat), *Eustachys petraea* (pinewoods fingergrass), *Iva imbricata* (seacoast marshelder), *Opuntia pusilla* (cockspur pricklypear), and *Physalis walteri* (Walter's groundcherry); a total of 15 rare species were recorded from 16 plots.

Global Vegetation:

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Short shrub/sapling	Needle-leaved shrub	*Juniperus virginiana* var. *silicicola* (southern redcedar)
Short shrub/sapling	Broad-leaved deciduous shrub	*Iva frutescens* (Jesuit's bark)
Short shrub/sapling	Vine/Liana	*Smilax auriculata* (earleaf greenbrier)
Herb (field)	Forb	*Heterotheca subaxillaris* (camphorweed), *Hydrocotyle bonariensis* (largeleaf pennywort), *Pityopsis graminifolia* (narrowleaf silkgrass)
Herb (field)	Graminoid	*Panicum virgatum* (switchgrass), *Spartina patens* (saltmeadow cordgrass), *Uniola paniculata* (seaoats)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Ammophila breviligulata* (American beachgrass), *Cakile edentula* (American searocket), *Cenchrus tribuloides* (sanddune sandbur), *Chamaesyce bombensis* (dixie sandmat), *Cynanchum angustifolium* (Gulf Coast swallow-wort), *Cynodon dactylon* (Bermudagrass), *Eremochloa ophiuroides* (centipede grass), *Eustachys petraea* (pinewoods fingergrass), *Iva imbricata* (seacoast marshelder), *Juniperus virginiana* var. *silicicola* (southern redcedar), *Oenothera humifusa* (seabeach evening-primrose), *Opuntia pusilla* (cockspur pricklypear), *Panicum amarum* (bitter panicgrass), *Physalis walteri* (Walter's groundcherry), *Plantago lanceolata* (narrowleaf plantain), *Rubus trivialis* (southern dewberry), *Salsola kali* (Russian thistle), *Smilax auriculata* (earleaf greenbrier), *Triplasis purpurea* (purple sandgrass)

Global: *Amaranthus pumilus* (seaside amaranth), *Caretta caretta* (loggerhead), *Charadrius melodus* (piping plover), *Dermochelys coriacea* (leatherback)

Conservation Status Rank

Global Rank & Reasons: G3 (23-Jan-2000). This community is the phase of *Uniola paniculata* grassland that occurs on the Outer Banks of North Carolina, notable primarily because of the absence of common codominants characteristically present in dune grasslands of nearer-shore barrier islands. It is not clear whether it should be recognized at the association level, or is better considered a distinctive phase. However, even if combined with related associations of this alliance, a G3 global rank would still be warranted, hence the rank does not contain a "Q" modifier, despite the questionable taxonomy. Occurrences are naturally limited, but have additionally been altered and destroyed by development and recreational use.

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments:

Global Similar Associations:

- *Uniola paniculata* - *Schizachyrium littorale* - *Panicum amarum* Herbaceous Vegetation (CEGL004039)

Global Related Concepts:

- Dune Grass (Outer Banks Subtype) (Schafale 2000) ?

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found along fore dunes the length of Cape Hatteras National Seashore, North Core Banks, South Core Banks and Shackleford Banks.

Global Range: This association is currently known from coastal North Carolina.

Nations: US

States/Provinces: NC

TNC Ecoregions:

USFS Ecoregions: 232Ci:CCC

Federal Lands: NPS (Cape Hatteras, Cape Lookout)

Element Sources

Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.1, CAHA.6, CAHA.21, CAHA.22, CAHA.55, CAHA.56, CAHA.60, CALO.17, CALO.28, CALO.60, CALO.70, CALO.74, CALO.75, CALO.77, CALO.78, CALO.79.

Local Description Authors: M.J. Russo

Global Description Authors: A.S. Weakley

References: Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Southeastern Ecology Working Group n.d.

Medium-tall Sod Temperate or Subpolar Grassland (V.A.5.N.c)

Muhlenbergia filipes Herbaceous Alliance (A.1217)

Alliance Concept

Summary: This alliance includes moist interdune flats dominated or codominated by *Muhlenbergia filipes* (gulfhairawn muhly), from around Nags Head, Dare County, North Carolina, south and west at least to the western coast of peninsular Florida; limits westward not known (the species goes to Texas). These communities are saturated at times, but the coarse sandy substrate drains quickly and are thus placed in upland. A widespread association is codominated by *Muhlenbergia filipes* (gulfhairawn muhly), *Spartina patens* (saltmeadow cordgrass), and *Eustachys petraea* (pinewoods fingergrass). Examples on Cayo Costa and North Captiva islands, Lee County, Florida, are dominated by *Bouteloua hirsuta* (hairy grama), with *Muhlenbergia filipes* (gulfhairawn muhly), *Uniola paniculata* (seaoats), and more typical southeastern Coastal Plain coastal species. Other characteristic species may include *Ernodea littoralis* (coughbush), *Chiococca parvifolia* (pineland milkberry), *Lantana depressa var. sanibelensis* (Sanibel shrubverbena), *Trichostema [sp. nov. ined.]*, *Ambrosia hispida* (coastal

ragweed), *Coccoloba uvifera* (seagrape), *Smilax auriculata* (earleaf greenbrier), *Phyllanthus abnormis* (Drummond's leaf-flower), and *Panicum amarum var. amarulum* (bitter panicgrass).

Classification Comments:

Similar Alliances:

- *Muhlenbergia capillaris* Herbaceous Alliance (A.1216)

Similar Alliance Comments:

Related Concepts:

- Coastal Berm (FNAI 1992a) ?
- Coastal Berm, *Bouteloua* Savanna subtype (FNAI 1992b) ?
- Maritime Wet Grassland (Schafale and Weakley 1990) I
- Southwest Florida coastal grassland (Johnson and Muller 1992) ?

Alliance Description

Environment: This alliance includes moist interdune flats dominated or codominated by *Muhlenbergia filipes*, from around Nags Head, Dare County, North Carolina, south and west at least to the western coast of peninsular Florida; limits westward not known (the species goes to Texas). These communities are saturated at times, but the coarse sandy substrate drains quickly and are thus placed in upland.

Vegetation: A widespread association is codominated by *Muhlenbergia filipes* (gulfhairawn muhly), *Spartina patens* (saltmeadow cordgrass), and *Eustachys petraea* (pinewoods fingergrass). Examples on Cayo Costa and North Captiva islands, Lee County, Florida, are dominated by *Bouteloua hirsuta* (hairy grama), with *Muhlenbergia filipes* (gulfhairawn muhly), *Uniola paniculata* (seaoats), and more typical southeastern Coastal Plain coastal species. Other characteristic species may include *Ernodea littoralis* (coughbush), *Chiococca parvifolia* (pineland milkberry), *Lantana depressa var. sanibelensis* (Sanibel shrubverbena), *Trichostema [sp. nov. ined.]*, *Ambrosia hispida* (coastal ragweed), *Coccoloba uvifera* (seagrape), *Smilax auriculata* (earleaf greenbrier), *Phyllanthus abnormis* (Drummond's leaf-flower), and *Panicum amarum var. amarulum* (bitter panicgrass).

Dynamics:

Alliance Distribution

Range: This alliance is known from around Nags Head, Dare County, North Carolina, south and west at least to the western coast of peninsular Florida; limits westward are not known (the species goes to Texas). It is found in Florida, Georgia, North Carolina, and South Carolina.

Nations: US

Subnations: FL, GA, NC, SC

TNC Ecoregions: 53:C, 55:C, 56:C, 57:C

USFS Ecoregions: 232Ce:CCC, 232Ci:CCC, 232Dc:CC?, 232De:CCC

Federal Lands: NPS (Cape Hatteras, Cape Lookout, Timucuan)

(CEGL004051) Southern Hairgrass - Saltmeadow Cordgrass - Dune Fingergrass Herbaceous Vegetation
***Muhlenbergia filipes - Spartina patens - Eustachys petraea* Herbaceous Vegetation**

NVC Classification

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c.)
Alliance	*Muhlenbergia filipes* Herbaceous Alliance (A.1217)
Alliance (English name)	Southern Hairgrass Herbaceous Alliance
Association	*Muhlenbergia filipes - Spartina patens - Eustachys petraea* Herbaceous Vegetation
Association (English name)	Southern Hairgrass - Saltmeadow Cordgrass - Dune Fingergrass Herbaceous Vegetation
Ecological System(s):	Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273)

Element Concept

Global Summary: This association represents moist interdune flats codominated by some combination of *Muhlenbergia filipes* (gulfhairawn muhly), *Spartina patens* (saltmeadow cordgrass), and *Eustachys petraea* (pinewoods fingergrass). In Florida this community occurs in narrow bands or swales alternating with higher ridges. These often fill with standing water after rains. In North Carolina and Georgia, it may occupy broader grassy flats between the outer dunes and the salt marsh on the inland side of barrier islands, as well as narrow dune swales. Succession to woody vegetation is indicated by increasing cover of *Morella cerifera* (wax myrtle) or *Salix caroliniana* (Coastal Plain willow).

Environmental Description

USFWS Wetland System:

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This common dunegrass association occurs on both Cape Hatteras National Seashore and Cape Lookout National Seashore. Sites include flat to gently sloping interdunal flats and swales that are intermittently flooded or seasonally saturated. Soils are rapidly to well-drained to poorly drained sand. Sites may experience occasional storm/tidal overwash or flooding. The unvegetated surface is made up almost entirely of bare sand (0-100% cover) or leaf litter (0-90%) with some standing water or algae (0-10%). Evidence of disturbance includes erosion, trails/roads, horse browsing/grazing, salt spray, wind damage, storm overwash, and the presence of exotic plants.

Global Environment:

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: Vegetation is a sparse to very dense (20-100% cover) herbaceous layer (typically 0.5-1 m tall) dominated by native grasses *Muhlenbergia filipes* (gulfhairawn muhly), *Spartina patens* (saltmeadow cordgrass), and *Eustachys petraea* (pinewoods fingergrass) (state-vulnerable). Additional graminoids may include lesser amounts of *Andropogon glomeratus*

(bushy bluestem), *Eragrostis spectabilis* (purple lovegrass), *Eremochloa ophiuroides* (centipede grass) (exotic), *Juncus megacephalus* (bighead rush), *Schizachyrium littorale* (shore little bluestem), and *Uniola paniculata* (seaoats). Forbs may include *Centella erecta* (erect centella), *Gaillardia pulchella* (firewheel), *Heterotheca subaxillaris* (camphorweed), *Phyla nodiflora* (turkey tangle fogfruit) (state-vulnerable), *Sisyrinchium atlanticum* (eastern blue-eyed grass), and *Solidago sempervirens* (seaside goldenrod). A sparse (0-10%) layer of emergent shrubs, including *Baccharis halimifolia* (eastern baccharis), *Morella cerifera* (wax myrtle), *Smilax bona-nox* (saw greenbrier), and *Smilax auriculata* (earleaf greenbrier) (state-vulnerable), may also be present. This community supports many state-imperiled and state-vulnerable species, including *Scleria verticillata* (low nutrush), *Chamaesyce bombensis* (dixie sandmat), *Eustachys petraea* (pinewoods fingergrass), *Iva imbricata* (seacoast marshelder), *Mitreola petiolata* (lax hornpod), *Opuntia pusilla* (cockspur pricklypear), *Phyla lanceolata* (lanceleaf fogfruit), *Physalis walteri* (Walter's groundcherry), *Scleria verticillata* (low nutrush), and *Spiranthes vernalis* (spring ladies'-tresses); a total of 23 rare species were recorded from 12 plots (including 2 from Hammock Beach State Park).

Global Vegetation: Vegetation is a sparse to very dense (20-100% cover) herbaceous layer (typically 0.5-1 m tall) dominated by native grasses *Muhlenbergia filipes* (gulfhairawn muhly), *Spartina patens* (saltmeadow cordgrass), and *Eustachys petraea* (pinewoods fingergrass) (state-vulnerable). Additional graminoids may include lesser amounts of *Andropogon glomeratus* (bushy bluestem), *Eragrostis spectabilis* (purple lovegrass), *Eremochloa ophiuroides* (centipede grass) (exotic), *Juncus megacephalus* (bighead rush), *Schizachyrium littorale* (shore little bluestem), and *Uniola paniculata* (seaoats). Forbs may include *Centella erecta* (erect centella), *Gaillardia pulchella* (firewheel), *Heterotheca subaxillaris* (camphorweed), *Phyla nodiflora* (turkey tangle fogfruit), *Sisyrinchium atlanticum* (eastern blue-eyed grass), and *Solidago sempervirens* (seaside goldenrod). A sparse (0-10%) layer of emergent shrubs, including *Baccharis halimifolia* (eastern baccharis), *Morella cerifera* (wax myrtle), *Smilax bona-nox* (saw greenbrier), and *Smilax auriculata* (earleaf greenbrier), may also be present. This community also supports other species, including *Scleria verticillata* (low nutrush), *Chamaesyce bombensis* (dixie sandmat), *Iva imbricata* (seacoast marshelder), *Mitreola petiolata* (lax hornpod), *Opuntia pusilla* (cockspur pricklypear), *Phyla lanceolata* (lanceleaf fogfruit), *Physalis walteri* (Walter's groundcherry), *Scleria verticillata* (low nutrush), and *Spiranthes vernalis* (spring ladies'-tresses). In Florida, species associates of *Muhlenbergia filipes* (gulfhairawn muhly) include *Eragrostis* (lovegrass) spp., *Andropogon virginicus* (broomsedge bluestem), *Andropogon glomeratus* (bushy bluestem), *Juncus scirpoides* (needlepod rush), and *Fuirena scirpoidea* (southern umbrella-sedge). In addition, *Cladium mariscus ssp. jamaicense* (Jamaica swamp sawgrass) often occupies the deeper portions of the swales. Some examples in North Carolina may also lack *Eustachys petraea* (pinewoods fingergrass) (M. Schafale pers. comm.). There may actually be 12 different dominants.

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved evergreen shrub	*Baccharis halimifolia* (eastern baccharis), *Morella cerifera* (wax myrtle)
Herb (field)	Forb	*Eustachys petraea* (pinewoods fingergrass), *Gaillardia pulchella* (firewheel), *Hydrocotyle bonariensis* (largeleaf pennywort), *Solidago sempervirens* (seaside goldenrod)
Herb (field)	Graminoid	*Andropogon glomeratus* (bushy bluestem), *Eragrostis spectabilis* (purple lovegrass), *Muhlenbergia filipes* (gulfhairawn muhly), *Rhynchospora colorata* (starrush whitetop)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Carex alata* (broadwing sedge), *Cenchrus tribuloides* (sanddune sandbur), *Chamaesyce bombensis* (dixie sandmat), *Cuphea carthagenensis*

(Colombian waxweed), *Cynanchum angustifolium* (Gulf Coast swallow-wort), *Eremochloa ophiuroides* (centipede grass), *Eustachys petraea* (pinewoods fingergrass), *Gaura angustifolia* (southern beeblossom), *Gratiola neglecta* (clammy hedgehyssop), *Iva imbricata* (seacoast marshelder), *Juncus megacephalus* (bighead rush), *Juniperus virginiana* var. *silicicola* (southern redcedar), *Ludwigia microcarpa* (smallfruit primrose-willow), *Mitreola petiolata* (lax hornpod), *Oenothera humifusa* (seabeach evening-primrose), *Opuntia pusilla* (cockspur pricklypear), *Panicum amarum* (bitter panicgrass), *Phyla lanceolata* (lanceleaf fogfruit), *Phyla nodiflora* (turkey tangle fogfruit), *Physalis walteri* (Walter's groundcherry), *Plantago lanceolata* (narrowleaf plantain), *Rhynchospora colorata* (starrush whitetop), *Rumex acetosella* (common sheep sorrel), *Scleria verticillata* (low nutrush), *Smilax auriculata* (earleaf greenbrier), *Spiranthes vernalis* (spring ladies'-tresses), *Triplasis purpurea* (purple sandgrass)

Conservation Status Rank

Global Rank & Reasons: G2 (7-Jan-2000). The range of this association is limited to the southeastern U.S., and it is restricted to coastal habitats. It is threatened by coastal development.

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: In Florida *Eustachys petraea* is seldom found in dune swales associated with *Muhlenbergia filipes* (A. Johnson pers. comm.?).

Global Similar Associations:

- *Panicum hemitomon - (Cladium mariscus* ssp. *jamaicense, Muhlenbergia filipes)* Herbaceous Vegetation (CEGL007716)

Global Related Concepts:

- Maritime Wet Grassland (Southern Hairgrass Subtype) (Schafale 2000) ?

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found at Cape Hatteras and at many locations on Cape Lookout National Seashore, Portsmouth Village area on North Core Banks to Shackleford Banks.

Global Range: In Florida this community is found on prograding barrier islands around the state from Amelia Island (Nassau County) to Cape Canaveral (Brevard County) on the Atlantic Coast, from Dog Island (Gulf County) to Shell Island (Bay County) on the panhandle Gulf Coast, and from Caladesi Island (Pinellas County) to Sanibel Island (Lee County) on the southwest Gulf Coast (FNAI database 1999). *Muhlenbergia filipes* has not been reported from coastal swales on Santa Rosa Island, Okaloosa and Santa Rosa counties, Florida (Johnson et al. 1992a), or from South Padre Island, Texas (Lonard and Judd 1980). It is also known from the Outer Banks of North Carolina.

Nations: US

States/Provinces: FL, GA, NC, SC

TNC Ecoregions:

USFS Ecoregions: 232Ce:CCC, 232Ci:CCC

Federal Lands: NPS (Cape Hatteras, Cape Lookout, Timucuan)

Element Sources
Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.2, CALO.10, CALO.16, CALO.25, CALO.29, CALO.34, CALO.49, CALO.58, CALO.66, CALO.67.

Local Description Authors: M.J. Russo

Global Description Authors: R.E. Evans, mod. C.W. Nordman and M.J. Russo

References: FNAI 1990, FNAI 1992b, Johnson 1997, Johnson et al. 1992a, Lonard and Judd 1980, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Schafale pers. comm., Southeastern Ecology Working Group n.d.

Short Sod Temperate or Subpolar Grassland (V.A.5.N.e)

Spartina patens – (Schoenoplectus pungens) Herbaceous Alliance (A.1274)

Alliance Concept
Summary: This alliance includes upland dune grassland of barrier islands of the Mid-Atlantic and Gulf coasts. *Spartina patens* (saltmeadow cordgrass) and *Schoenoplectus pungens* (common threesquare) are characteristically dominant, though other graminoids such as *Schoenoplectus pungens* (common threesquare), *Sporobolus virginicus* (seashore dropseed), *Cenchrus spinifex* (coastal sandbur), *Cenchrus tribuloides* (sanddune sandbur), and *Paspalum distichum* (knotgrass) may be codominant or prominent within their respective ranges. In parts of the range of this alliance, *Spartina patens* (saltmeadow cordgrass) is dominant and *Schoenoplectus pungens* (common threesquare) may be absent. This community characteristically occupies overwash terraces or low dunes, less well-developed than those dominated by *Uniola paniculata* (seaoats) (from North Carolina south and west to Texas and Tamaulipas, Mexico) or by *Ammophila breviligulata* (American beachgrass) (from North Carolina northwards). Total vegetation cover is variable, ranging from quite sparse (25% cover) to dense. Bare sand is often visible through the vegetation, and there is no soil profile development. Species diversity is variable; although it may be quite low and confined to the nominal species in the northern part of the range, it may be of greater diversity. Other components of this vegetation include *Strophostyles helvula* (trailing fuzzybean), *Solidago sempervirens* (seaside goldenrod), *Cenchrus tribuloides* (sanddune sandbur), *Setaria parviflora* (marsh bristlegrass), *Distichlis spicata* (inland saltgrass), *Sabatia stellaris* (rose of Plymouth), *Ammophila breviligulata* (American beachgrass), *Suaeda linearis* (annual seepweed), *Bassia hirsuta* (hairy smotherweed) (an exotic), *Atriplex patula* (spear saltbush), *Polygonum glaucum* (seaside knotweed), *Spergularia salina* (salt sandspurry), *Salicornia bigelovii* (dwarf saltwort), *Salicornia virginica* (Virginia glasswort), *Fimbristylis castanea* (marsh fimbry), and *Cakile edentula ssp. edentula* (American searocket). Woody species may include scattered individuals of *Toxicodendron radicans* (eastern poison ivy), *Solidago sempervirens* (seaside goldenrod), *Lythrum lineare* (wand lythrum), *Kosteletzkya*

virginica (Virginia saltmarsh mallow), and seedlings of *Baccharis halimifolia* (eastern baccharis). The plants of this community are influenced by sand deposited by storm surges. Storm overwash is a prevalent natural disturbance to this community. This community appears to be successional between interdunal herbaceous wetlands and interdunal herbaceous/shrub uplands.

Classification Comments:

Similar Alliances:

- *Spartina patens* Herbaceous Alliance (A.1137)--is tropical in distribution.

Similar Alliance Comments:

Related Concepts:

- Dry community of barrier flats (Travis and Godfrey 1976) ?
- Maritime Dry Grassland (Schafale and Weakley 1990) ?
- Wash (Hill 1986) ?
- Dunegrass community (Higgins et al. 1971) I
- Grassland community (Baumann 1978b) ?
- Low dune community (Boule 1979) ?
- Secondary dunes (Klotz 1986) ?
- Wash (Higgins et al. 1971) ?

Alliance Description

Environment: This alliance includes upland dune grassland of barrier islands of the mid-Atlantic and Gulf coasts. This community characteristically occupies overwash terraces or low dunes, less well-developed than those dominated by *Uniola paniculata* (from North Carolina south and west to Texas and Tamaulipas, Mexico) or by *Ammophila breviligulata* (from North Carolina northwards). Bare sand is often visible through the vegetation, and there is no soil profile development. These plant community are influenced by sand deposited by storm surges. Storm overwash is a prevalent natural disturbance to this community. This community appears to be successional between interdunal herbaceous wetlands and interdunal herbaceous/shrub uplands.

Vegetation: *Spartina patens* (saltmeadow cordgrass) and *Schoenoplectus pungens* (common threesquare) are characteristically dominant, though other graminoids such as *Schoenoplectus pungens* (common threesquare), *Sporobolus virginicus* (seashore dropseed), *Cenchrus spinifex* (coastal sandbur), *Cenchrus tribuloides* (sanddune sandbur), and *Paspalum distichum* (knotgrass) may be codominant or prominent within their respective ranges. In parts of the range of this alliance, *Spartina patens* (saltmeadow cordgrass) is dominant and *Schoenoplectus pungens* (common threesquare) may be absent. Total vegetation cover is variable, ranging from quite sparse (25% cover) to dense. Species diversity is variable; although it may be quite low and

confined to the nominal species in the northern part of the range, it may be of greater diversity. Other components of this vegetation include *Strophostyles helvula* (trailing fuzzybean), *Solidago sempervirens* (seaside goldenrod), *Cenchrus tribuloides* (sanddune sandbur), *Setaria parviflora* (marsh bristlegrass), *Distichlis spicata* (inland saltgrass), *Sabatia stellaris* (rose of Plymouth), *Ammophila breviligulata* (American beachgrass), *Suaeda linearis* (annual seepweed), *Bassia hirsuta* (hairy smotherweed) (an exotic), *Atriplex patula* (spear saltbush), *Polygonum glaucum* (seaside knotweed), *Spergularia salina* (salt sandspurry), *Salicornia bigelovii* (dwarf saltwort), *Salicornia virginica* (Virginia glasswort), *Fimbristylis castanea* (marsh fimbry), and *Cakile edentula ssp. edentula* (American searocket). Woody species may include scattered individuals of *Toxicodendron radicans* (eastern poison ivy), *Solidago sempervirens* (seaside goldenrod), *Lythrum lineare* (wand lythrum), *Kosteletzkya virginica* (Virginia saltmarsh mallow), and seedlings of *Baccharis halimifolia* (eastern baccharis).

Dynamics: The plants of this community are influenced by sand deposited by storm surges. Storm overwash is a prevalent natural disturbance to this community. This community appears to be successional between interdunal herbaceous wetlands and interdunal herbaceous/shrub uplands.

Alliance Distribution

Range: This alliance is reported from coastal areas from New York and Massachusetts on the Atlantic coast around to Tamaulipas, Mexico, on the Gulf Coast.

Nations: MX, US

Subnations: AL, DE, FL, LA, MA, MD, MS?, MXTM?, NC, NJ, NY, TX, VA

TNC Ecoregions: 31:C, 53:C, 55:C, 57:C, 58:C, 62:C

USFS Ecoregions: 221Ab:CCC, 231Fb:PPP, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Bz:CCC, 232Ch:CCP, 232Ci:CCC, 232Dc:CCC, 232Dd:CCC, 232De:CCC, 232Eb:CC?, 232Ed:CCC, 232Ee:CCC, 255Dc:CCC

Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Cape Hatteras, Cape Lookout, Fire Island, Gateway, Padre Island?, Sagamore Hill); USFWS (Back Bay?, Bon Secour, Laguna Atascosa, Matagorda Island, Prime Hook)

(CEGL004097) Saltmeadow Cordgrass - Common Threesquare - Seaside Goldenrod Herbaceous Vegetation
***Spartina patens - Schoenoplectus pungens - Solidago sempervirens* Herbaceous Vegetation**
Overwash Dune Grassland

NVC Classification

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Short sod temperate or subpolar grassland (V.A.5.N.e.)
Alliance	*Spartina patens - (Schoenoplectus pungens)* Herbaceous Alliance (A.1274)
Alliance (English name)	Saltmeadow Cordgrass - (Common Threesquare) Herbaceous Alliance
Association	*Spartina patens - Schoenoplectus pungens - Solidago sempervirens* Herbaceous Vegetation
Association (English name)	Saltmeadow Cordgrass - Common Threesquare - Seaside Goldenrod Herbaceous Vegetation
Association (Common name)	Overwash Dune Grassland
Ecological System(s):	Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273)
	Atlantic Coastal Plain Northern Salt Pond Marsh (CES203.892)
	Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264)

Element Concept

Global Summary: This community is an upland dune grassland or overwash area of Atlantic barrier islands on embryo dunes or back sides of beaches forming from overwash terraces ranging from Massachusetts to North Carolina. It forms a drier, later successional phase beginning from water-deposited sand of storm overwash. Sand movement, plant burial, and dune formation rates are not so high as to form *Ammophila breviligulata* (American beachgrass)-dominated primary dunes, but can be found as a fringe around the outer edge of those dunes. *Spartina patens* (saltmeadow cordgrass) is dominant, ranging from quite sparse (25% cover) to dense, and can be monotypic in early-successional expressions. As the vegetation develops, common associated species can include *Schoenoplectus pungens* (common threesquare) or *Solidago sempervirens* (seaside goldenrod). Less common associates can include *Cyperus grayi* (Gray's flatsedge), *Cenchrus tribuloides* (sanddune sandbur), *Setaria parviflora* (marsh bristlegrass), *Festuca rubra* (red fescue), *Schizachyrium littorale* (shore little bluestem), *Pseudognaphalium obtusifolium* (rabbittobacco), and occasional scattered individuals of *Toxicodendron radicans* (eastern poison ivy) and seedlings of *Baccharis halimifolia* (eastern baccharis). Bare sand is often visible through the vegetation, and there is no soil profile development. *Ammophila breviligulata* (American beachgrass) or *Uniola paniculata* (seaoats) may invade from the surrounding dunes. This community appears to be a successional step between interdunal herbaceous wetlands and interdunal herbaceous/shrub uplands.

Environmental Description

USFWS Wetland System:

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This common dunegrass association occurs on both Cape Hatteras National Seashore and Cape Lookout National Seashore. Sites include interdunal flats and swales and gently sloping barrier beaches that are intermittently wind-tidally flooded. Soils are rapidly to well-drained to somewhat poorly drained sand. Sites may experience occasional storm/tidal overwash or flooding. The unvegetated surface is made up almost entirely of bare sand (90-100% cover) with some leaf litter (0-5%) and shells (0-5%). Evidence of disturbance includes ATV trails, salt spray, wind damage, occasional storm surge overwash, and the presence of exotic plants.

Global Environment: This community is an upland dune grassland or overwash area of Atlantic barrier islands on embryo dunes or back sides of beaches forming from overwash terraces. The plants of this community are

influenced by water-deposited sand caused by storm surges. They differ ecologically from dune grasslands dominated by *Ammophila breviligulata* or *Uniola paniculata*, which are primarily impacted by wind-deposited sand. Storm overwash is a prevalent natural disturbance to this community.

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: Vegetation is a sparse to very dense (20-90% cover) herbaceous layer (typically 0.5-1 m tall) dominated by *Spartina patens* (saltmeadow cordgrass). Additional graminoids may include lesser amounts of *Eragrostis spectabilis* (purple lovegrass), *Fimbristylis castanea* (marsh fimbry), *Panicum amarum* (bitter panicgrass), and state-vulnerable species *Paspalum vaginatum* (seashore paspalum), *Stenotaphrum secundatum* (St. Augustine grass), and *Triplasis purpurea* (purple sandgrass). Forbs may include the ubiquitous *Hydrocotyle bonariensis* (largeleaf pennywort) as well as *Croton punctatus* (gulf croton), *Gaillardia pulchella* (firewheel), *Oenothera humifusa* (seabeach evening-primrose) (state-vulnerable), and *Strophostyles helvula* (trailing fuzzybean). A sparse (0-20%) layer of shrubs may include *Borrichia frutescens* (bushy seaside tansy), *Iva frutescens* (Jesuit's bark), and *Smilax auriculata* (earleaf greenbrier) (state-vulnerable). This community supports several exotic plants but also a great many state-rare species, including *Cenchrus tribuloides* (sanddune sandbur), *Chamaesyce polygonifolia* (seaside sandmat), *Eustachys petraea* (pinewoods fingergrass), *Opuntia pusilla* (cockspur pricklypear), *Phyla nodiflora* (turkey tangle fogfruit), *Physalis walteri* (Walter's groundcherry), and *Elymus virginicus var. halophilus* (Virginia wildrye) (state-critically imperiled); a total of 16 rare species were recorded from 10 plots.

Global Vegetation: *Spartina patens* (saltmeadow cordgrass) is dominant, ranging from quite sparse (25% cover) to dense, and can be monotypic in early-successional expressions. As the vegetation develops, common associated species can include *Schoenoplectus pungens* (common threesquare) or *Solidago sempervirens* (seaside goldenrod). Less common associates can include *Cyperus grayi* (Gray's flatsedge), *Cenchrus tribuloides* (sanddune sandbur), *Setaria parviflora* (marsh bristlegrass), *Festuca rubra* (red fescue), *Schizachyrium littorale* (shore little bluestem), *Pseudognaphalium obtusifolium* (rabbittobacco), and occasional scattered individuals of *Toxicodendron radicans* (eastern poison ivy) and seedlings of *Baccharis halimifolia* (eastern baccharis). *Ammophila breviligulata* (American beachgrass) or *Uniola paniculata* (seaoats) may invade from the surrounding dunes. This community is characterized by upland maritime dune grassland vegetation. *Spartina patens* (saltmeadow cordgrass), and sometimes *Schoenoplectus pungens* (common threesquare), or both are dominant on dunes or overwash terraces. Total vegetation cover is variable, ranging from quite sparse (25% cover) to dense. Bare sand is often visible through the vegetation, and there is no soil profile development. Species diversity is variable; although it may be quite low and confined to the nominate species in the northern part of the range, it may be of greater diversity, including *Strophostyles helvula* (trailing fuzzybean), *Solidago sempervirens* (seaside goldenrod), *Cenchrus tribuloides* (sanddune sandbur), *Setaria parviflora* (marsh bristlegrass), *Distichlis spicata* (inland saltgrass), *Sabatia stellaris* (rose of Plymouth), *Ammophila breviligulata* (American beachgrass), *Suaeda linearis* (annual seepweed), *Bassia hirsuta* (hairy smotherweed), *Atriplex patula* (spear saltbush), *Fimbristylis castanea* (marsh fimbry), and *Cakile edentula ssp. edentula* (American searocket).

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore:

Stratum	Lifeform	Species
Herb (field)	Forb	*Hydrocotyle bonariensis* (largeleaf pennywort), *Oenothera humifusa* (seabeach evening-primrose)
Herb (field)	Graminoid	*Spartina patens* (saltmeadow cordgrass)

Global:

Stratum	Lifeform	Species
Herb (field)	Forb	*Solidago sempervirens* (seaside goldenrod)
Herb (field)	Graminoid	*Schoenoplectus pungens* (common threesquare), *Spartina patens* (saltmeadow cordgrass)

Characteristic Species

Cape Hatteras National Seashore and Cape Lookout National Seashore:

Global: *Schoenoplectus pungens* (common threesquare), *Solidago sempervirens* (seaside goldenrod), *Spartina patens* (saltmeadow cordgrass)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Cenchrus tribuloides* (sanddune sandbur), *Chamaesyce polygonifolia* (seaside sandmat), *Chloris pectinata* (comb windmill grass), *Cynanchum angustifolium* (Gulf Coast swallow-wort), *Cynodon dactylon* (Bermudagrass), *Elymus virginicus* var. *halophilus* (Virginia wildrye), *Eremochloa ophiuroides* (centipede grass), *Eustachys petraea* (pinewoods fingergrass), *Juniperus virginiana* var. *silicicola* (southern redcedar), *Oenothera humifusa* (seabeach evening-primrose), *Opuntia pusilla* (cockspur pricklypear), *Panicum amarum* (bitter panicgrass), *Paspalum vaginatum* (seashore paspalum), *Phyla nodiflora* (turkey tangle fogfruit), *Physalis walteri* (Walter's groundcherry), *Plantago lanceolata* (narrowleaf plantain), *Smilax auriculata* (earleaf greenbrier), *Stenotaphrum secundatum* (St. Augustine grass), *Triplasis purpurea* (purple sandgrass)

Conservation Status Rank

Global Rank & Reasons: G2G3 (4-Nov-1998). This dune grassland community is restricted to overwash areas of major maritime dune systems. It is typically small in extent, not usually more than a few acres in size. It is best developed on barrier islands of Delaware, Maryland, Virginia, and North Carolina; it extends sporadically farther north to Massachusetts. As part of a dynamic system, the community is in a sense ephemeral, being buried over time by sand deposition, and being formed anew in other areas subjected to overwash. Because of the dynamic forces structuring the community, it requires sufficient area in large dune systems to accommodate this shifting mosaic. Although not extremely rare (an estimated 100-200 occurrence exist rangewide), the community is restricted to a specialized habitat and is threatened by a number of activities, including dune stabilization, and outright destruction of habitat through human activities.

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: This community differs ecologically from dune grasslands dominated by *Ammophila breviligulata* or *Uniola paniculata*, which are primarily impacted by wind-deposited sand. This community is impacted by wave-deposited sand. It is drier than brackish swales and vegetation that immediately colonizes water-borne sand from storm overwash, such as *Spartina patens - Eleocharis parvula* Herbaceous Vegetation (CEGL006342). *Spartina patens - Schizachyrium maritimum - Solidago sempervirens* Herbaceous Vegetation (CEGL008445) is a southern analog of this association that occurs along the Gulf Coast.

Global Similar Associations:

- *Spartina patens - Eleocharis parvula* Herbaceous Vegetation (CEGL006342)

- *Spartina patens - Schizachyrium maritimum - Solidago sempervirens* Herbaceous Vegetation (CEGL008445)

Global Related Concepts:

- Dry community of barrier flats (Travis and Godfrey 1976) B
- Dry maritime grassland (Lea 2002b) ?
- Dunegrass community (Higgins et al. 1971) B
- Grassland community (Baumann 1978b) =
- Low dune community (Boule 1979) =
- Maritime Dry Grassland (Typic Subtype) (Schafale 2000) ?
- Secondary dunes (Klotz 1986) B
- Wash (Hill 1986) =
- Wash (Higgins et al. 1971) =

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found from Hatteras Island to Shackelford Banks.

Global Range: This community is an upland dune grassland or overwash area of Atlantic barrier islands from Massachusetts to North Carolina.

Nations: US

States/Provinces: DE:S2S3, MA, MD, NC, NJ, NY, VA

TNC Ecoregions:

USFS Ecoregions: 221Ab:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Bz:CCC, 232Ci:CCC

Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Hatteras, Cape Lookout, Fire Island, Gateway, Sagamore Hill); USFWS (Back Bay?, Prime Hook)

Element Sources

Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.5, CAHA.65, CALO.23, CALO.24, CALO.27, CALO.57, CALO.61, CALO.64, CALO.69, CALO.76.

Local Description Authors: M.J. Russo

Global Description Authors: L.A. Sneddon

References: Baumann 1978b, Berdine 1998, Boule 1979, Bowman 2000, Breden et al. 2001, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fleming et al. 2001, Harrison 2004, Harrison and Stango 2003, Higgins et al. 1971, Hill 1986, Klotz 1986, Lea 2002b, NRCS 2001b, Reschke 1990, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, TNC 1995c, Travis and Godfrey 1976, Zaremba and Leatherman 1984

Seasonally Flooded Temperate or Subpolar Grassland (V.A.5.N.k)

Fimbristylis castanea - Schoenoplectus pungens Seasonally Flooded Herbaceous Alliance (A.1372)

Alliance Concept

Summary: Wetlands dominated or codominated by *Fimbristylis castanea* (marsh fimbry) that often occur in interdune swales. The general aspect and species composition of this vegetation are variable, not only among occurrences, but also over the course of the growing season. Documented from Assateague National Seashore, where it is typically characterized by dense *Schoenoplectus pungens* (common threesquare) (up to 80% cover). When *Schoenoplectus pungens* (common threesquare) is not as dense, it is most often associated with an even mixture of *Spartina patens* (saltmeadow cordgrass) or *Fimbristylis castanea* (marsh fimbry). In spring, *Schoenoplectus pungens* (common threesquare) is generally dominant with few other associates except *Eleocharis* (spikerush) spp., imparting a distinct aerial photo signature. By late summer a number of other species, such as *Fimbristylis castanea* (marsh fimbry) and *Sabatia stellaris* (rose of Plymouth), contribute more substantial cover. Other herbs are sparse and contribute very little to the overall vegetative cover. These associated species include *Andropogon virginicus* (broomsedge bluestem), *Eleocharis rostellata* (beaked spikerush), *Phragmites australis* (common reed), *Pluchea foetida* (stinking camphorweed), *Juncus scirpoides* (needlepod rush), *Hydrocotyle umbellata* (manyflower marshpennywort), *Eleocharis parvula* (dwarf spikerush), *Panicum amarum var. amarulum* (bitter panicgrass), *Fimbristylis autumnalis* (slender fimbry), *Sabatia stellaris* (rose of Plymouth), *Ptilimnium capillaceum* (herbwilliam), and *Juncus canadensis* (Canadian rush). Diagnostic species are *Schoenoplectus pungens* (common threesquare), *Fimbristylis castanea* (marsh fimbry), *Eleocharis* (spikerush) spp., and *Juncus* (rush) spp. There is usually standing water present in these swales in the spring. In Florida, these are early successional, interdune swales which are dominated by *Fimbristylis castanea* (marsh fimbry), sometimes monospecific, sometimes intermixed with *Triglochin striata* (threerib arrowgrass), *Sesuvium portulacastrum* (shoreline seapurslane), and *Lilaeopsis carolinensis* (Carolina grasswort).

Classification Comments:

Similar Alliances:

- *Spartina patens* Seasonally Flooded Herbaceous Alliance (A.1390)
- *Triglochin maritima* Semipermanently Flooded Herbaceous Alliance (A.1681)

Similar Alliance Comments: Additional consideration should be given to the close relationship between this alliance and its component associations and the *Spartina patens* Seasonally Flooded Herbaceous Alliance (A.1390).

Related Concepts:

- *Juncus scirpoides-Scirpus pungens* interdunal wetland association (McAvoy and Clancy 1994) ?
- *Scirpus-Hydrocotyle* community (Tyndall and Levy 1978) ?
- *Spartina-Scirpus* community (Tyndall and Levy 1978) ?
- Fresh marsh community (Hill 1986) I
- Maritime Wet Grassland (Schafale and Weakley 1990) I
- Fresh marsh community (Higgins et al. 1971) I
- Wet community of barrier flats? (Travis and Godfrey 1976) ?

Alliance Description

Environment: Wetlands dominated or codominated by *Fimbristylis castanea* that often occur in interdune swales. The general aspect and species composition of this vegetation are variable, not only among occurrences, but also over the course of the growing season. There is usually standing water present in these swales in the spring. In Florida, these are early successional, interdune swales which are dominated by *Fimbristylis castanea*, sometimes monospecific, sometimes intermixed with *Triglochin striata, Sesuvium portulacastrum*, and *Lilaeopsis carolinensis*.

Vegetation: This alliance includes wetlands dominated or codominated by *Fimbristylis castanea* (marsh fimbry) that often occur in interdune swales. *Fimbristylis castanea* (marsh fimbry) ranges along coasts from North Carolina (Au 1974) south to Florida, Texas, Mexico (Gulf and Pacific coasts), and the West Indies (Sauer 1967). This alliance is documented from Assateague Island National Seashore, where it is typically characterized by dense *Schoenoplectus pungens* (common threesquare) (up to 80% cover). When *Schoenoplectus pungens* (common threesquare) is not as dense, it is most often associated with an even mixture of *Spartina patens* (saltmeadow cordgrass) or *Fimbristylis castanea* (marsh fimbry). In spring, *Schoenoplectus pungens* (common threesquare) is generally dominant with few other associates except *Eleocharis* (spikerush) spp., imparting a distinct aerial photo signature. By late summer a number of other species, such as *Fimbristylis castanea* (marsh fimbry) and *Sabatia stellaris* (rose of Plymouth), contribute more substantial cover. Other herbs are sparse and contribute very little to the overall vegetative cover. These associated species include *Andropogon virginicus* (broomsedge bluestem), *Eleocharis rostellata* (beaked spikerush), *Phragmites australis* (common reed), *Pluchea foetida* (stinking camphorweed), *Juncus scirpoides* (needlepod rush), *Hydrocotyle umbellata* (manyflower marshpennywort), *Eleocharis parvula* (dwarf spikerush), *Panicum amarum var. amarulum* (bitter panicgrass), *Fimbristylis autumnalis* (slender fimbry), *Sabatia stellaris* (rose of Plymouth), *Ptilimnium capillaceum* (herbwilliam), and *Juncus canadensis* (Canadian rush). Diagnostic species are *Schoenoplectus pungens* (common threesquare), *Fimbristylis castanea* (marsh fimbry), *Eleocharis* (spikerush) spp., and *Juncus* (rush) spp. There is usually standing water present in these swales in the spring. In Florida, these are early successional, interdune swales which are dominated by *Fimbristylis castanea* (marsh fimbry), sometimes monospecific,

sometimes intermixed with *Triglochin striata* (threerib arrowgrass), *Sesuvium portulacastrum* (shoreline seapurslane), and *Lilaeopsis carolinensis* (Carolina grasswort).

Dynamics:

Alliance Distribution

Range: This alliance is found in Florida, Delaware, Maryland, North Carolina, and Virginia. Its status in South Carolina and Georgia is unclear.

Nations: US

Subnations: FL, GA?, MD, NC, SC?, VA

TNC Ecoregions: 53:C, 54:P, 55:P, 56:?, 57:C, 58:C

USFS Ecoregions: 232Bz:CCC, 232Cb:CC?, 232Ce:CCP, 232Ch:CC?, 232Ci:CCC, 232Db:CC?, 232Dc:CCC, 232De:CC?, 232Gb:C??

Federal Lands: NPS (Assateague Island, Cape Hatteras); USFWS (Back Bay?)

(CEGL003790) Chestnut Fimbry - Common Threesquare Seasonally Flooded Herbaceous Vegetation
***Fimbristylis castanea* - *Schoenoplectus pungens* Seasonally Flooded Herbaceous Vegetation**

NVC Classification

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
Alliance	*Fimbristylis castanea* - *Schoenoplectus pungens* Seasonally Flooded Herbaceous Alliance (A.1372)
Alliance (English name)	Chestnut Fimbry - Common Threesquare Seasonally Flooded Herbaceous Alliance
Association	*Fimbristylis castanea* - *Schoenoplectus pungens* Seasonally Flooded Herbaceous Vegetation
Association (English name)	Chestnut Fimbry - Common Threesquare Seasonally Flooded Herbaceous Vegetation
Ecological System(s):	Southeastern Coastal Plain Interdunal Wetland (CES203.258)

Element Concept

Global Summary: This interdunal pond or wet swale community represents vegetation dominated by *Fimbristylis castanea* (marsh fimbry) and *Schoenoplectus pungens* (common threesquare) although relative dominance varies seasonally complicating characterization of this type. Characteristic species include *Schoenoplectus pungens* (common threesquare) in association with *Spartina patens* (saltmeadow cordgrass) and *Fimbristylis castanea* (marsh fimbry). There is usually standing water present in these swales in the spring, when *Schoenoplectus pungens* (common threesquare) is generally dominant with few other associates except species of *Eleocharis* (spikerush). By late summer other species such as *Fimbristylis castanea* (marsh fimbry) contribute more substantial cover. Diagnostic species are *Schoenoplectus pungens* (common threesquare), *Fimbristylis castanea* (marsh fimbry), and *Spartina patens* (saltmeadow cordgrass).

Environmental Description

USFWS Wetland System: Palustrine

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This wetland community is found at Cape Hatteras National Seashore on Intermittently-flooded interdunal flats. Soils are poorly drained muck at one site and well-drained sandy loam at another. The unvegetated surface is made up almost entirely of leaf litter (90-99% cover) with some bare soil (1-10%). Evidence of disturbance includes damage from salt spray and wind.

Global Environment: This vegetation is found in interdunal swales.

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: The dense (80-90% cover) herbaceous vegetation is dominated by *Fimbristylis* (fimbry) sp. and *Schoenoplectus* (bulrush) sp. Other common and/or abundant species may include *Distichlis spicata* (inland saltgrass), *Erechtites hieraciifolia* (American burnweed), *Galium obtusum* (bluntleaf bedstraw) (state-vulnerable), *Mikania scandens* (climbing hempvine), *Ptilimnium capillaceum* (herbwilliam), *Spartina patens* (saltmeadow cordgrass), and *Strophostyles helvula* (trailing fuzzybean). Eight state-rare species were recorded from 2 plots and include *Bacopa monnieri* (herb of grace), *Cynanchum angustifolium* (Gulf Coast swallow-wort), *Juncus megacephalus* (bighead rush), *Pluchea rosea* (rosy camphorweed), *Rhynchospora colorata* (starrush whitetop), and *Typha domingensis* (southern cattail) (state-imperiled).

Global Vegetation: Characteristic species include *Schoenoplectus pungens* (common threesquare) in association with *Spartina patens* (saltmeadow cordgrass) and *Fimbristylis castanea* (marsh fimbry). There is usually standing water present in these swales in the spring, when *Schoenoplectus pungens* (common threesquare) is generally dominant with few other associates except species of *Eleocharis* (spikerush). By late summer other species such as *Fimbristylis castanea* (marsh fimbry) contribute more substantial cover. Diagnostic species are *Schoenoplectus pungens* (common threesquare), *Fimbristylis castanea* (marsh fimbry), and *Spartina patens* (saltmeadow cordgrass). Relative dominance of the dominant species varies from season to season, complicating characterization of this type.

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Herb (field)	Forb	*Erechtites hieraciifolia* (American burnweed), *Galium obtusum* (bluntleaf bedstraw), *Ptilimnium capillaceum* (herbwilliam), *Sabatia stellaris* (rose of Plymouth), *Strophostyles helvula* (trailing fuzzybean)
Herb (field)	Graminoid	*Distichlis spicata* (inland saltgrass), *Schoenoplectus robustus* (sturdy bulrush), *Spartina patens* (saltmeadow cordgrass)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Bacopa monnieri* (herb of grace), *Cynanchum angustifolium* (Gulf Coast swallow-wort), *Galium obtusum* (bluntleaf bedstraw), *Juncus megacephalus* (bighead rush), *Pluchea rosea* (rosy camphorweed), *Rhynchospora colorata* (starrush whitetop), *Schoenoplectus robustus* (sturdy bulrush), *Typha domingensis* (southern cattail)

Conservation Status Rank

Global Rank & Reasons: GNR (21-May-2002).

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: This type may possibly occur at Onslow County pond (M. Schafale pers. comm.).

Global Similar Associations:

- *Fimbristylis castanea - Paspalum distichum* Herbaceous Vegetation (CEGL004110)--of Florida.
- *Schoenoplectus pungens - Fimbristylis (castanea, caroliniana)* Herbaceous Vegetation (CEGL004117)--of Chesapeake and Delaware drainages to the north.

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found on Ocracoke Island.

Global Range: *Fimbristylis castanea* ranges along coasts from North Carolina (Au 1974) south to Florida, Texas, Mexico (Gulf and Pacific coasts), and the West Indies (Sauer 1967). This placeholder would cover the range between Virginia and Florida (i.e., Georgia and the Carolinas).

Nations: US

States/Provinces: GA?, NC, SC?

TNC Ecoregions:

USFS Ecoregions: 232Ce:CCP, 232Ci:CCC

Federal Lands: NPS (Cape Hatteras)

Element Sources

Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.61, CAHA.63.

Local Description Authors: M.J. Russo

Global Description Authors: M. Pyne

References: Au 1974, Sauer 1967, Schafale and Weakley 1990, Schafale pers. comm., Southeastern Ecology Working Group n.d.

Typha domingensis Seasonally Flooded Temperate Herbaceous Alliance (A.1392)

Alliance Concept

Summary: This alliance includes temperate, non-tidal wetlands dominated by *Typha domingensis* (southern cattail). This includes wet parts of non-tidal interdune ponds with brackish water from hurricane flooding, storm tides, or island overwash. Other characteristic species may include *Setaria magna* (giant bristlegrass) and *Cyperus* (flatsedge) spp. This alliance can be zonal with other vegetation including *Leptochloa fusca ssp. fascicularis* (bearded

sprangletop) and alien *Phragmites australis* (common reed). This alliance occurs in coastal areas of North Carolina, South Carolina, Florida, Texas, and in scattered localities in the mountains of Colorado and Utah, and the intermountain desert region of California, Arizona and Nevada.

Classification Comments: In the West, *Typha domingensis* communities have been classified by some authors as phases of *Typha latifolia*-dominated communities. It could be that this alliance is more common in the West than is reported due to this classification approach.

Similar Alliances:

- *Typha (angustifolia, latifolia)* - *(Schoenoplectus* spp.) Semipermanently Flooded Herbaceous Alliance (A.1436)
- *Typha domingensis* Semipermanently Flooded Tropical Herbaceous Alliance (A.1175)--similar vegetation in southern Florida
- *Typha latifolia* Seasonally Flooded Herbaceous Alliance (A.1393)--covers peat depressions in Florida
- *Typha* spp. - (*Schoenoplectus* spp., *Juncus* spp.) Seasonally Flooded Herbaceous Alliance (A.1394)--of the midwestern U.S.

Similar Alliance Comments:

Related Concepts:

- Interdune Pond (Schafale and Weakley 1990) I
- Interdune Pond (Nelson 1986) I

Alliance Description

Environment: These are temperate, non-tidal wetlands, found at relatively low elevations. In the Southeast, sites where the alliance is found include wet parts of non-tidal interdune ponds and mainland ponds, impoundments and tanks with brackish water from hurricane flooding, storm tides, or island overwash. In the western United States, these communities are found in freshwater palustrine systems, adjacent to shallow lakes or ponds (Bundy et al. 1996), in areas of standing water or subirrigation along major stream bottoms (Baker 1982), or in old oxbows (Haase 1972). Running water is uncommon, except during periods of extensive irrigation runoff or because of high precipitation. Surface water may be up to 2 m in depth, or during the driest may be as deep as 1.5 m (Bundy et al. 1996). Usually if the water table is below the surface, capillary action will keep the soil saturated to the surface. In Nevada, soils were described by Bundy et al. (1996) to be very deep, somewhat poorly drained soils comprised of fine-grained alluvium. They may be slightly saline, but not strongly so. *Typha domingensis* is more tolerant of alkaline conditions than *Typha latifolia*.

Adjacent vegetation includes other wetland and riparian communities, dominated by species of *Salix, Populus,* or *Carex*. In the West, upland vegetation can include shrublands dominated by *Sarcobatus vermiculatus, Atriplex* spp., or *Artemisia tridentata*.

Vegetation: This alliance is characterized by the dominance of *Typha domingensis* (southern cattail), a tall cattail species. Stands are often dense, with cover of *Typha domingensis* (southern cattail) over 60%. Like other *Typha* (cattail) species, this can form nearly monotypic stands. Other graminoids commonly present can include *Setaria magna* (giant bristlegrass), *Cyperus* (flatsedge) spp., *Schoenoplectus acutus* (hardstem bulrush), *Schoenoplectus americanus* (chairmaker's bulrush), *Schoenoplectus pungens* (common threesquare), or *Eleocharis* (spikerush) spp. When there is surface water, aquatic species such as *Bacopa eisenii* (Gila River waterhyssop), *Potamogeton* (pondweed) spp., or *Sagittaria* (arrowhead) spp. can also be present. This alliance can be zonal with other vegetation including *Leptochloa fusca ssp. fascicularis* (bearded sprangletop) and alien *Phragmites australis* (common reed).

Dynamics: Not much information is available. Baker (1982) reports that these communities are not grazed by cattle, due to usually high water. Drainage and diversion of water could limit or impact stands of this alliance. Haase (1972) reported that *Typha domingensis* communities have expanded their distribution in the lower Gila River basin, due to increased irrigation runoff. Marshes such as these are important for rails, blackbirds and marsh wrens, as well as other many other birds.

Alliance Distribution

Range: This alliance occurs in coastal areas of North Carolina, South Carolina, Alabama, Georgia, Florida, Mississippi, Texas, and in scattered localities in the mountains of Colorado and Utah, and the intermountain desert region of California, Arizona and Nevada. *Typha domingensis* is found in southwestern Oregon, but communities dominated by this species have not been reported from there.

Nations: US

Subnations: AL, AZ, CA, CO, FL, GA, LA?, MS, NC, NV, SC, TX, UT

TNC Ecoregions: 10:C, 11:C, 18:C, 19:C, 20:C, 22:C, 23:C, 30:P, 31:C, 53:C, 55:P, 56:C, 57:C

USFS Ecoregions: 231Fb:PPP, 232B:CC, 232Ch:CCC, 232Ci:CCC, 232Dc:CCC, 232Ga:CCC, 255Dc:CCC, 321A:CC, 322B:CC, 341A:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, M331F:CC, M341B:CC

Federal Lands: DOD (Fort Hood?); NPS (Canyonlands, Cape Hatteras, Cape Lookout, Great Sand Dunes); USFWS (Anahuac?, Aransas, Big Boggy?, Brazoria, Buenos Aires, Laguna Atascosa, Matagorda Island, McFaddin?, Ouray, San Bernard)

(CEGL004138) Southern Cattail - Giant Foxtail Grass Herbaceous Vegetation
***Typha domingensis* - *Setaria magna* Herbaceous Vegetation**

NVC Classification

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
Alliance	*Typha domingensis* Seasonally Flooded Temperate Herbaceous Alliance (A.1392)
Alliance (English name)	Southern Cattail Seasonally Flooded Temperate Herbaceous Alliance
Association	*Typha domingensis* - *Setaria magna* Herbaceous Vegetation
Association (English name)	Southern Cattail - Giant Foxtail Grass Herbaceous Vegetation
Ecological System(s):	Southeastern Coastal Plain Interdunal Wetland (CES203.258)

Element Concept

Global Summary: This association occurs in wet parts of non-tidal interdune ponds with brackish water (from hurricane flooding, storm tides, or island overwash). In addition to the dominant *Typha domingensis* (southern cattail), other characteristic species include *Setaria magna* (giant bristlegrass) and *Cyperus* (flatsedge) spp.

Environmental Description

USFWS Wetland System: Palustrine

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This cattail marsh occurs on both Cape Hatteras National Seashore and Cape Lookout National Seashore in lagoon areas with brackish water which is influenced by rainwater and sound backwash but not by tidal events. Soils are very poorly drained muck. The unvegetated surface is made up of leaf litter (30-70% cover), standing water (30-50% and bare soil (0-20%). Evidence of disturbance includes possibly alteration to the hydrology, wind damage, storm overwash, and the presence of exotic animals (nutria).

Global Environment: This association occurs in wet parts of non-tidal interdune ponds with brackish water (from hurricane flooding, storm tides, or island overwash).

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: The very dense (90% cover) vegetation (up to 2 m tall) is dominated almost exclusively by the state-imperiled *Typha domingensis* (southern cattail). Additional species that may be found in lesser amounts include *Distichlis spicata* (inland saltgrass), *Fimbristylis castanea* (marsh fimbry), *Hydrocotyle bonariensis* (largeleaf pennywort), *Juncus roemerianus* (needlegrass rush), *Mikania scandens* (climbing hempvine), *Schizachyrium littorale* (shore little bluestem) (codominant in one plot), *Schoenoplectus robustus* (sturdy bulrush) (state-vulnerable), *Setaria parviflora* (marsh bristlegrass), and *Solidago sempervirens* (seaside goldenrod). Short shrubs may include *Morella cerifera* (wax myrtle), *Baccharis angustifolia* (saltwater false willow) (state-vulnerable), *Baccharis halimifolia* (eastern baccharis), and *Iva frutescens* (Jesuit's bark). Additional state-rare species including *Cynanchum angustifolium* (Gulf Coast swallow-wort), *Gratiola neglecta* (clammy hedgehyssop), *Lythrum lineare* (wand lythrum), and *Rubus trivialis* (southern dewberry).

Global Vegetation: In addition to the dominant *Typha domingensis* (southern cattail), other characteristic species include *Setaria magna* (giant bristlegrass) and *Cyperus* (flatsedge) spp.

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Herb (field)	Forb	*Mikania scandens* (climbing hempvine)
Herb (field)	Graminoid	*Setaria parviflora* (marsh bristlegrass), *Spartina patens* (saltmeadow cordgrass), *Typha domingensis* (southern cattail)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Baccharis angustifolia* (saltwater false willow), *Cynanchum angustifolium* (Gulf Coast swallow-wort), *Gratiola neglecta* (clammy hedgehyssop), *Lythrum lineare* (wand lythrum), *Rubus trivialis* (southern dewberry), *Schoenoplectus robustus* (sturdy bulrush), *Typha domingensis* (southern cattail)

Conservation Status Rank

Global Rank & Reasons: G2G3 (16-Jan-2001). This community occupies limited acreage on barrier islands of the southern Atlantic coast of North America. It is a fairly dynamic community, being created and destroyed by natural processes (such as hurricane flooding). Like most barrier island communities, it is also impacted by coastal development. It receives some protection as a wetland, though examples in developed areas are often encroached upon and altered. Total acreage is probably less than 3000 acres, and may be less.

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: This association can be zonal with other species including *Leptochloa fusca ssp. fascicularis (= Leptochloa fascicularis var. maritima)* and alien *Phragmites australis.*

Global Similar Associations:

- *Leptochloa fusca* ssp. *fascicularis - Sesuvium maritimum* Herbaceous Vegetation (CEGL004125)
- *Typha domingensis* Seasonally Flooded Gulf Coastal Plain Herbaceous Vegetation (CEGL004137)
- *Typha domingensis* Western Herbaceous Vegetation (CEGL001845)

Global Related Concepts:

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found near Bodie Island Lighthouse and on North Core Banks.

Global Range: This association occurs along the Outer Coastal Plain of the southern Atlantic coast of North America, occurring primarily on barrier islands and barrier spits.

Nations: US

States/Provinces: FL, GA, NC, SC

TNC Ecoregions:

USFS Ecoregions: 232Ch:CCC, 232Ci:CCC, 232Ga:CPP

Federal Lands: NPS (Cape Hatteras, Cape Lookout)

Element Sources
Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.17, CALO.11.

Local Description Authors: M.J. Russo

Global Description Authors: A.S. Weakley

References: Nelson 1986, Schafale and Weakley 1990, Southeastern Ecology Working Group n.d.

Tidal Temperate or Subpolar Grassland (V.A.5.N.n)

Cladium mariscus *ssp.* jamaicense *Tidal Temperate Herbaceous Alliance (A.1473)*

Alliance Concept
Summary: This alliance includes tidal sawgrass marshes, where alkaline chemistry comes from brackish water, rather than from underlying calcareous rock as in the Everglades sawgrass marshes. These communities occur inland from *Juncus roemerianus* (needlegrass rush) or *Typha angustifolia* (narrowleaf cattail) marshes.

Classification Comments:

Similar Alliances:

- *Cladium mariscus* ssp. *jamaicense* Seasonally Flooded Temperate Herbaceous Alliance (A.1369)--includes similar freshwater vegetation.
- *Cladium mariscus* ssp. *jamaicense* Seasonally Flooded Tropical Herbaceous Alliance (A.1157)--includes similar freshwater vegetation.

Similar Alliance Comments:

Related Concepts:

- Brackish Marsh (Schafale and Weakley 1990) I
- Brackish Marsh (Nelson 1986) I
- Tidal Marsh (FNAI 1992a) I

Alliance Distribution
Range: This alliance occurs in the southeastern Coastal Plain from North Carolina south to Florida and west to Mississippi. It may also possibly extend north into Virginia.

Nations: US

Subnations: AL, FL, GA, LA, MS, NC, SC, VA?

TNC Ecoregions: 53:C, 55:C, 56:C, 57:C

USFS Ecoregions: 232B:C?, 232Ci:CCC, 232Db:CCC, 232Dc:CCC, 232Eb:CCC, 232G:CP

Federal Lands: NPS (Cape Hatteras, Cape Lookout, Timucuan); USFS (Croatan)

(CEGL004178) Sawgrass Tidal Herbaceous Vegetation
***Cladium mariscus* ssp. *jamaicense* Tidal Herbaceous Vegetation**
Tidal Sawgrass Marsh

NVC Classification

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Tidal temperate or subpolar grassland (V.A.5.N.n.)
Alliance	*Cladium mariscus* ssp. *jamaicense* Tidal Temperate Herbaceous Alliance (A.1473)
Alliance (English name)	Sawgrass Tidal Temperate Herbaceous Alliance
Association	*Cladium mariscus* ssp. *jamaicense* Tidal Herbaceous Vegetation
Association (English name)	Sawgrass Tidal Herbaceous Vegetation
Association (Common name)	Tidal Sawgrass Marsh
Ecological System(s):	Atlantic Coastal Plain Indian River Lagoon Tidal Marsh (CES203.257)
	Atlantic Coastal Plain Embayed Region Tidal Freshwater Marsh (CES203.259)
	Mississippi Sound Salt and Brackish Tidal Marsh (CES203.303)
	Central Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270)

Element Concept

Global Summary: This association is a brackish marsh of the northern Gulf of Mexico and Atlantic coast. Examples are dominated by *Cladium mariscus ssp. jamaicense* (Jamaica swamp sawgrass) in often dense stands.

Environmental Description

USFWS Wetland System: Estuarine

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment**: This tidal sawgrass marsh** occurs on both Cape Hatteras National Seashore and Cape Lookout National Seashore. Sites are tidal flats with moderately well-drained to very poorly drained sandy loam. The unvegetated surface is made up of nearly equal amounts of leaf litter (50-60% cover) and bare soil (40-50%).

Global Environment: In Florida this association occurs along the Gulf of Mexico in tidally influenced, upper reaches of river mouths where estuarine (salt) marshes blend with freshwater marshes (FNAI 1990). At this juncture, salinity levels are greatly diminished allowing *Cladium mariscus ssp. jamaicense* (which is relatively salt intolerant) to form dense stands.

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: *Cladium mariscus ssp. jamaicense* (Jamaica swamp sawgrass) (state-vulnerable) clearly dominates the dense (70-80% cover) herbaceous layer. Additional species that may be present in small amounts are *Centella erecta* (erect centella), *Hydrocotyle bonariensis* (largeleaf pennywort), *Spartina patens* (saltmeadow cordgrass), and state-vulnerable *Juncus megacephalus* (bighead rush) and *Rhynchospora colorata* (starrush whitetop), among others. A very sparse (0-5%) shrub layer may include *Juniperus virginiana var. silicicola* (southern redcedar) (state-imperiled), *Morella cerifera*

(wax myrtle), and *Persea borbonia* (redbay) (state-imperiled). A total of 10 state-rare species were recorded from 2 sampled plots.

Global Vegetation: Other species present may include *Amaranthus australis* (southern amaranth), *Amaranthus cannabinus* (tidalmarsh amaranth), *Hibiscus* (rosemallow) sp., and *Solidago sempervirens var. mexicana* (seaside goldenrod).

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Needle-leaved shrub	*Juniperus virginiana* var. *silicicola* (southern redcedar)
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Persea borbonia* (redbay)
Short shrub/sapling	Broad-leaved evergreen shrub	*Morella cerifera* (wax myrtle)
Herb (field)	Vine/Liana	*Berchemia scandens* (Alabama supplejack)
Herb (field)	Forb	*Centella erecta* (erect centella), *Cynanchum angustifolium* (Gulf Coast swallow-wort), *Galium obtusum* (bluntleaf bedstraw), *Hibiscus moscheutos* (crimsoneyed rosemallow), *Hydrocotyle bonariensis* (largeleaf pennywort), *Ipomoea sagittata* (saltmarsh morning-glory), *Linum medium* var. *texanum*, *Mikania scandens* (climbing hempvine), *Mitreola petiolata* (lax hornpod), *Phyla lanceolata* (lanceleaf fogfruit), *Pluchea rosea* (rosy camphorweed), *Ptilimnium capillaceum* (herbwilliam), *Solidago sempervirens* (seaside goldenrod), *Strophostyles helvula* (trailing fuzzybean), *Toxicodendron radicans* ssp. *radicans* (eastern poison ivy)
Herb (field)	Graminoid	*Cladium mariscus* ssp. *jamaicense* (Jamaica swamp sawgrass), *Dichanthelium dichotomum* (cypress panicgrass), *Juncus marginatus* (grassleaf rush), *Juncus megacephalus* (bighead rush), *Juncus roemerianus* (needlegrass rush), *Rhynchospora colorata* (starrush whitetop), *Setaria parviflora* (marsh bristlegrass), *Spartina patens* (saltmeadow cordgrass)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Cladium mariscus* ssp. *jamaicense* (Jamaica swamp sawgrass), *Cynanchum angustifolium* (Gulf Coast swallow-wort), *Galium obtusum* (bluntleaf bedstraw), *Juncus megacephalus* (bighead rush), *Juniperus virginiana* var. *silicicola* (southern redcedar), *Mitreola petiolata* (lax hornpod), *Persea borbonia* (redbay), *Phyla lanceolata* (lanceleaf fogfruit), *Pluchea rosea* (rosy camphorweed), *Rhynchospora colorata* (starrush whitetop)

Global:

Conservation Status Rank

Global Rank & Reasons: G4? (13-Aug-1997).

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: This type is found in tidal rivers of southern and central North Carolina as well as in wind-tidal (microtidal) embayed region. This type is not know to occur on the Atlantic coast of Florida (A. Johnson pers. comm.).

Global Similar Associations:

Global Related Concepts:

- Tidal Freshwater Marsh (Sawgrass Subtype) (Schafale 2000) ?

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found on Ocracoke Island and on North Core Banks.

Global Range: This association occurs from the northern Gulf of Mexico to the mid-Atlantic coast.

Nations: US

States/Provinces: AL, FL, GA, LA, MS, NC, SC, VA?

TNC Ecoregions:

USFS Ecoregions: 232B:C?, 232Ci:CCC, 232Db:CCC, 232Dc:CCC, 232Eb:CCC, 232G:CP

Federal Lands: NPS (Cape Hatteras, Cape Lookout, Timucuan); USFS (Croatan)

Element Sources

Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.67, CALO.22.

Local Description Authors: M.J. Russo

Global Description Authors: A.S. Weakley

References: FNAI 1990, FNAI 1992a, Johnson pers. comm., Nelson 1986, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Schotz pers. comm., Southeastern Ecology Working Group n.d.

Juncus roemerianus Tidal Herbaceous Alliance (A.1475)

Alliance Concept

Summary: *Juncus roemerianus* (needlegrass rush)-dominated marshes with tidal hydrology. Associations in this alliance have a range of water chemistry, including saline, brackish, and (rarely) freshwater. This widely distributed salt marsh alliance occurs in association with low salt marshes or in brackish marshes, and is characterized by discrete, dense patches of vegetation usually strongly dominated by *Juncus roemerianus* (needlegrass rush) with few other associates. Associates which occur at low cover may include *Borrichia frutescens* (bushy seaside tansy),

Baccharis halimifolia (eastern baccharis), *Spartina alterniflora* (smooth cordgrass), *Distichlis spicata* (inland saltgrass), *Schoenoplectus robustus* (sturdy bulrush), *Symphyotrichum tenuifolium* (perennial saltmarsh aster), and *Symphyotrichum subulatum* (eastern annual saltmarsh aster). This community may occur as isolated patches within low salt marsh, or may dominate vast areas at the heads of tidal creeks that drain the marsh. Its hydrology is generally irregularly tidally flooded. Soils of this association are generally poorly to very poorly drained, often with standing water atop peat accumulations (averaging 15 cm in depth) which in turn overlie gleyed sands. Degree of tidal inundation and relative elevation control the distribution of salt marsh vegetation in general; *Juncus roemerianus* (needlegrass rush) is typically found at lower elevation than the associated *Spartina patens* (saltmeadow cordgrass) marshes or mixed marshes. *Juncus roemerianus* (needlegrass rush) generally occurs on sandy substrates. The alliance may more rarely occur in freshwater, wind tidal situations. In these examples, *Juncus roemerianus* (needlegrass rush) is the dominant, but other characteristic species may include *Thelypteris palustris var. pubescens* (eastern marsh fern), *Polygonum punctatum* (dotted smartweed), *Cladium mariscus ssp. jamaicense* (Jamaica swamp sawgrass), *Asclepias lanceolata* (fewflower milkweed), *Osmunda regalis var. spectabilis* (royal fern), *Eleocharis fallax* (creeping spikerush), *Boehmeria cylindrica* (smallspike false nettle), and others. This species composition is indicative of the freshwater marsh conditions, as they do not occur in more brackish and saline associations in the *Juncus roemerianus* (needlegrass rush) alliance.

Classification Comments: Few associations have been described; more may be necessary to accommodate variation in this wide-ranging alliance.

Similar Alliances:

- *Schoenoplectus americanus* Tidal Herbaceous Alliance (A.2007)
- *Spartina patens - (Distichlis spicata)* Tidal Herbaceous Alliance (A.1481)

Similar Alliance Comments:

Related Concepts:

- Brackish Marsh (Nelson 1986) I
- Brackish Marsh (Schafale and Weakley 1990) I
- Brackish Marsh (Wieland 1994b) I
- Brackish Marsh (Smith 1996a) I
- Brackish Marsh (Wieland 1994a) ?
- Smooth Cordgrass Series (Diamond 1993) I
- Tidal Marsh (FNAI 1992a) I

Alliance Distribution

Environment: *Juncus roemerianus*-dominated marshes with tidal hydrology. Associations in this alliance have a range of water chemistry, including saline, brackish, and (rarely) freshwater.

This community may occur as isolated patches within low salt marsh, or may dominate vast areas at the heads of tidal creeks that drain the marsh. Its hydrology is generally irregularly tidally flooded. Soils of this association are generally poorly to very poorly drained, often with standing water atop peat accumulations (averaging 15 cm in depth) which in turn overlie gleyed sands. Degree of tidal inundation and relative elevation control the distribution of salt marsh vegetation in general; *Juncus roemerianus* is typically found at lower elevation than the associated *Spartina patens* marshes or mixed marshes. *Juncus roemerianus* generally occurs on sandy substrates. The alliance may more rarely occur in freshwater, wind tidal situations.

Vegetation: This widely distributed salt marsh alliance occurs in association with low salt marshes or in brackish marshes, and is characterized by discrete, dense patches of vegetation usually strongly dominated by *Juncus roemerianus* (needlegrass rush) with few other associates. Associates which occur at low cover may include *Borrichia frutescens* (bushy seaside tansy), *Baccharis halimifolia* (eastern baccharis), *Spartina alterniflora* (smooth cordgrass), *Distichlis spicata* (inland saltgrass), *Schoenoplectus robustus* (sturdy bulrush), *Symphyotrichum tenuifolium* (perennial saltmarsh aster), and *Symphyotrichum subulatum* (eastern annual saltmarsh aster). The alliance may more rarely occur in freshwater, wind tidal situations. In these examples, *Juncus roemerianus* (needlegrass rush) is the dominant, but other characteristic species may include *Thelypteris palustris var. pubescens* (eastern marsh fern), *Polygonum punctatum* (dotted smartweed), *Cladium mariscus ssp. jamaicense* (Jamaica swamp sawgrass), *Asclepias lanceolata* (fewflower milkweed), *Osmunda regalis var. spectabilis* (royal fern), *Eleocharis fallax* (creeping spikerush), *Boehmeria cylindrica* (smallspike false nettle), and others. This species composition is indicative of the freshwater marsh conditions, as they do not occur in more brackish and saline associations in the *Juncus roemerianus* (needlegrass rush) alliance.

Dynamics:

Alliance Distribution

Range: This alliance occurs in the southeastern Coastal Plain from Maryland south to Florida and west to Louisiana and Texas.

Nations: US

Subnations: AL, DE, FL, GA, LA?, MD, MS, NC, SC, TX, VA

TNC Ecoregions: 30:P, 31:C, 41:P, 42:P, 53:C, 54:C, 55:C, 56:C, 57:C, 58:C

USFS Ecoregions: 231Fb:CCC, 232Ad:CCC, 232Br:CCC, 232Bx:CCC, 232Bz:CCC, 232Cb:CCC, 232Ce:CCC, 232Ch:CCC, 232Ci:CCC, 232Cj:CCC, 232Db:CCP, 232Dc:CCC, 232Dd:CCC, 232De:CCP, 232Eb:CCC, 232Ec:CC?, 232Ed:CCC, 232Gb:CCC, 255Da:CCP, 255Dc:CCC

Federal Lands: NPS (Assateague Island, Canaveral, Cape Hatteras, Cape Lookout, Fort Pulaski, Timucuan); USFS (Croatan); USFWS (Anahuac, Back Bay, Big Boggy, Bon Secour, Brazoria, Chesapeake Marshlands, McFaddin, San Bernard, Texas Point)

(CEGL004186) Black Needlerush Herbaceous Vegetation

***Juncus roemerianus* Herbaceous Vegetation**
Needlerush High Marsh

NVC Classification

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Tidal temperate or subpolar grassland (V.A.5.N.n.)
Alliance	*Juncus roemerianus* Tidal Herbaceous Alliance (A.1475)
Alliance (English name)	Black Needlerush Tidal Herbaceous Alliance
Association	*Juncus roemerianus* Herbaceous Vegetation
Association (English name)	Black Needlerush Herbaceous Vegetation
Association (Common name)	Needlerush High Marsh
Ecological System(s):	Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260)
	Atlantic Coastal Plain Indian River Lagoon Tidal Marsh (CES203.257)
	Florida Big Bend Salt and Brackish Tidal Marsh (CES203.508)
	Mississippi Delta Salt and Brackish Tidal Marsh (CES203.471)
	Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519)
	Central Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270)
	Mississippi Sound Salt and Brackish Tidal Marsh (CES203.303)
	Central and Upper Texas Coast Salt and Brackish Tidal Marsh (CES203.473)
	Gulf Coast Chenier Plain Salt and Brackish Tidal Marsh (CES203.468)

Element Concept

Global Summary: This broad-ranging *Juncus roemerianus* (needlegrass rush) salt marsh community is characterized by discrete, dense patches usually strongly dominated by *Juncus roemerianus* (needlegrass rush), often with few other associates, or with low cover of *Distichlis spicata* (inland saltgrass), *Spartina alterniflora* (smooth cordgrass), *Spartina patens* (saltmeadow cordgrass), and *Limonium carolinianum* (Carolina sealavender). As currently defined, this community occurs in a variety of settings in different marsh regions including both "high" and "low" marshes. For example, large expanses of this type are found in northwest Florida at or below the mean high water line. In other regions it may be found as isolated patches within high salt marsh, or may dominate vast areas at the heads of tidal creeks. In general, the prevalence of *Juncus roemerianus* (needlegrass rush) in Florida indicates the prevalence of high marshes (above mean high water). Its hydrology is generally irregularly tidally flooded.

Environmental Description

USFWS Wetland System: Estuarine

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This needlerush high marsh is common on both Cape Hatteras National Seashore and Cape Lookout National Seashore occurring on irregularly to permanently tidally flooded tidal flats and mudflats. Soils are somewhat poorly to very poorly drained muck and sand. The unvegetated surface is dominated either by leaf litter (3-100% cover) (including storm-deposited wrack found near the high-tide line) or by bare soil (0-95%) with some standing water (0-20%). Evidence of disturbance includes dredge spoils, wind damage, and storm surge.

Global Environment: Large expanses of this type are found in northwest Florida, where approximately 60% of the salt marshes consist of monospecific stands of this type. These stands extend nearly to the water's edge and may be considered low marsh (Montague and Wiegert 1990). In other regions of Florida, including northeast Florida, Indian River (central Atlantic coast), and south Florida, *Juncus roemerianus* occurs in smaller discrete patches of high marsh (Montague and Wiegert 1990). Presumably, this type also occurs primarily as high salt marsh along the Atlantic coast as well (Hackney and de la Cruz 1982). In Mississippi *Juncus roemerianus* marsh was inundated less than 5.4% of the time that any portion of the marsh was flooded (Eleuterius and Eleuterius 1979). Due to longer and more frequent periods of exposure and resulting evaporation, interstitial water salinity may be higher than more frequently inundated zones. In addition, the interstitial water salinity was generally higher and more stable than flood water (Hackney and de la Cruz 1982). A range of soil conditions may be present in this broadly defined association, but soils are generally poorly to very poorly drained. In some areas, including tall-growth zones, soils were highly organic and peaty (averaging 15 cm in depth?), while shorter zones occurred on sandy soils underlain by clay (Eleuterius and Caldwell 1984). In general, *Juncus roemerianus* occurs on sandy substrates (Penfound 1952). pH at the Mississippi site was 6.2 (Hackney and de la Cruz 1982).

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: The vegetation is a near monoculture of *Juncus roemerianus* (needlegrass rush) in the very dense herb layer (80-100% cover). Additional species that may occur in small amounts include *Andropogon glomeratus* (bushy bluestem), *Distichlis spicata* (inland saltgrass), *Hydrocotyle bonariensis* (largeleaf pennywort), *Mikania scandens* (climbing hempvine) (codominant in one plot), *Panicum virgatum* (switchgrass), and *Spartina patens* (saltmeadow cordgrass). A sparse (0-20%) shrub layer may include *Baccharis angustifolia* (saltwater false willow) (state-imperiled), *Borrichia frutescens* (bushy seaside tansy), and *Iva frutescens* (Jesuit's bark). A total of 9 state-rare species were recorded from 10 sampled plots, including *Ptilimnium nodosum* (piedmont mock bishopweed) (globally imperiled and state-critically imperiled) and state-vulnerable *Carex comosa* (longhair sedge), *Lythrum lineare* (wand lythrum), *Phyla nodiflora* (turkey tangle fogfruit), and *Symphyotrichum tenuifolium* (perennial saltmarsh aster).

Global Vegetation: Tall and short growth-form zones have been noted in several areas (Kruczynski et al. 1978, Hackney and de la Cruz 1982, Stout 1984, Montague and Wiegert 1990). Associates that do occur at low cover may include *Borrichia frutescens* (bushy seaside tansy), *Baccharis halimifolia* (eastern baccharis), *Spartina alterniflora* (smooth cordgrass), *Distichlis spicata* (inland saltgrass), *Schoenoplectus robustus* (sturdy bulrush), *Limonium carolinianum* (Carolina sealavender), *Symphyotrichum tenuifolium* (perennial saltmarsh aster), *Symphyotrichum subulatum* (eastern annual saltmarsh aster), and (in more southern occurrences) *Ipomoea sagittata* (saltmarsh morning-glory).

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Iva frutescens* (Jesuit's bark)
Short shrub/sapling	Broad-leaved evergreen shrub	*Baccharis angustifolia* (saltwater false willow), *Borrichia frutescens* (bushy seaside tansy)
Herb (field)	Forb	*Mikania scandens* (climbing hempvine)
Herb (field)	Graminoid	*Juncus roemerianus* (needlegrass rush)

Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Juncus roemerianus* (needlegrass rush)

Characteristic Species

Cape Hatteras National Seashore and Cape Lookout National Seashore:

Global: *Juncus roemerianus* (needlegrass rush)

Other Noteworthy Species
Cape Hatteras National Seashore and Cape Lookout National Seashore: *Baccharis angustifolia* (saltwater false willow), *Carex comosa* (longhair sedge), *Cuphea carthagenensis* (Colombian waxweed), *Cynanchum angustifolium* (Gulf Coast swallow-wort), *Lythrum lineare* (wand lythrum), *Panicum amarum* (bitter panicgrass), *Phyla nodiflora* (turkey tangle fogfruit), *Ptilimnium nodosum* (piedmont mock bishopweed), *Rubus trivialis* (southern dewberry), *Symphyotrichum tenuifolium* (perennial saltmarsh aster)

Global:

Conservation Status Rank
Global Rank & Reasons: G5 (29-Mar-2001). This is a common coastal marsh of the Gulf and Atlantic coasts of the United States.

Classification
Status: Standard

Classification Confidence: 1 - Strong

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: This community is common on the southeastern seaboard, but large undisturbed areas are of high conservation concern. Although this community exhibits little floristic variation across its range, the associated animal species may vary to a greater extent. This community may not occur west of Texas. *Juncus roemerianus* was found to be lower in elevation than the associated *Spartina patens* type and mixed type (Cooper and Waits 1973).

Global Similar Associations:

- *Spartina alterniflora - Juncus roemerianus - Distichlis spicata* Louisianian Zone Salt Tidal Herbaceous Vegetation (CEGL004190)
- *Spartina patens - Distichlis spicata - (Juncus roemerianus)* Herbaceous Vegetation (CEGL004197)

Global Related Concepts:

- *Juncus roemerianus* Tidal Herbaceous Vegetation (Harrison 2001) =
- *Juncus roemerianus* Tidal Herbaceous Vegetation (VDNH 2003) =
- *Juncus roemerianus* Tidal Herbaceous Vegetation (Coulling 2002) =
- *Juncus roemerianus* association of the low marsh (Adams 1963) =
- *Juncus* type (Cooper and Waits 1973) =
- *Spartina - Distichlis - Juncus* associes (Penfound 1952) B
- Brackish Marsh (Wieland 1994b) B
- Brackish Marsh (Needlerush Subtype) (Schafale 2000) ?
- Irregularly flooded salt marsh (Jenkins 1974) =
- Lower high marsh (Stalter 1973a) =
- Needlerush - saltmeadow type (Nicholson and Van Deusen 1954) =
- Saline Marsh (Wieland 1994a) B
- Salt marsh (Higgins et al. 1971) B
- Salt marsh community (Hill 1986) B
- Smooth Cordgrass Series (Diamond 1993) B

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found at many places on the sound side of both Cape Hatteras and Cape Lookout national seashores.

Global Range: This community is widespread along the Atlantic and Gulf coasts of North America ranging from Delaware south to Florida, and west to Texas.

Nations: US

States/Provinces: AL:S2S3, DE:S2S3, FL, GA, LA?, MD:S4, MS, NC, SC, TX, VA:S5

TNC Ecoregions:

USFS Ecoregions: 231Fb:CCC, 232Ad:CCC, 232Br:CCC, 232Bx:CCC, 232Bz:CCC, 232Cb:CCC, 232Ce:CCC, 232Ch:CCC, 232Ci:CCC, 232Cj:CCC, 232Db:CCP, 232Dc:CCC, 232Dd:CCC, 232De:CCP, 232Eb:CCC, 232Ec:CC?, 232Ed:CCC, 232Gb:CCC, 255Da:CCP, 255Dc:CCC

Federal Lands: NPS (Assateague Island, Canaveral, Cape Hatteras, Cape Lookout, Fort Pulaski, Timucuan); USFS (Croatan); USFWS (Anahuac, Big Boggy, Bon Secour, Brazoria, Chesapeake Marshlands, McFaddin, San Bernard, Texas Point)

Element Sources

Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.15, CAHA.52, CALO.1, CALO.21, CALO.33, CALO.59, CALO.72, CALO.80, CALO.81.

Local Description Authors: M.J. Russo

Global Description Authors: R.E. Evans, mod. L.A. Sneddon

References: Adams 1963, Bowman 2000, Cooper and Waits 1973, Coulling 2002, Diamond 1993, Eleuterius and Caldwell 1984, Eleuterius and Eleuterius 1979, Fleming et al. 2001, Hackney and de la Cruz 1981, Hackney and de la Cruz 1982, Harrison 2001, Harrison 2004, Higgins et al. 1971, Hill 1986, Jenkins 1974, Kruczynski et al. 1978, Lynch 1941, Montague and Wiegert 1990, Nelson 1986, Nicholson and Van Deusen 1954, Peet et al. unpubl. data 2002, Penfound 1952, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Schotz pers. comm., Smith 1996a, Southeastern Ecology Working Group n.d., Stalter 1973a, Stalter 1973b, Stout 1984, VDNH 2003, Wieland 1994a, Wieland 1994b, Wieland 2000b

Phragmites australis Tidal Herbaceous Alliance (A.1477)

Alliance Concept

Summary: This alliance includes both natural and invasive fresh to brackish tidal marsh communities dominated by (often essentially monospecific) *Phragmites australis* (common reed). Although *Phragmites australis* (common reed) rhizomes have been noted in salt marsh sediments exceeding 3000 years in age and it is thus a native component of salt marshes in some areas of North America, the growth habit of the species in its native condition was likely to have been significantly different than the dense monotypic, invasive stands documented in this alliance. Evidence suggests that a new, more invasive genotype of *Phragmites australis*

(common reed) was introduced to the U. S. from the Old World. This new genotype, along with a continued increase in and variety of disturbances, may explain the heightened invasiveness of this species. Evidence suggests that along the Gulf Coast of Louisiana and Texas, the genotype found in invasive communities differs from the genotype found in natural, stable communities. Although invasive and natural communities of *Phragmites australis* (common reed) are difficult to differentiate, this can be accomplished by considering the degree of disturbance at a site and observing a given stand over time to determine the degree of invasiveness. Based on observations of this nature by individuals familiar with the coastal marshes of Louisiana and Texas, apparently stable, natural communities dominated by *Phragmites australis* (common reed) are present. However, the dominance of *Phragmites australis* (common reed) in many tidal wetlands today often indicates human-induced disturbance, either through direct habitat manipulation or through passive introduction of reproductive material to naturally disturbed substrates.

In many areas of the southeastern United States, it is well documented that *Phragmites* (reed) is recently introduced and spreading rapidly in tidal and non-tidal situations. In invasive communities, associated species are highly variable, depending on the vegetation that has been invaded. Spreading in large colonies, *Phragmites* (reed) may eventually dominate disturbed areas at coverage up to 100%. More typically, though, scattered individuals of other species may occur, such as sparse *Morella cerifera* (wax myrtle) shrubs, *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Calystegia sepium* (hedge false bindweed), *Boehmeria cylindrica* (smallspike false nettle), *Typha angustifolia* (narrowleaf cattail), *Apocynum cannabinum* (Indianhemp), *Rosa palustris* (swamp rose), *Polygonum* (knotweed) sp., and *Mikania scandens* (climbing hempvine). Vines of *Toxicodendron radicans* (eastern poison ivy) are also frequent, but typically occur at low cover.

In areas where *Phragmites australis* (common reed) is highly invasive, if *Phragmites australis* (common reed) is a significant component of the vegetation but the vegetation retains sufficient species composition to retain its identity, the site is considered an unhealthy or degraded example of that vegetation type. In these same areas, if *Phragmites australis* (common reed) cover is so high that native species have been excluded and the original community is no longer recognizable, then the occurrence falls within an invasive association within the *Phragmites australis* (common reed) Tidal Herbaceous Alliance (A.1477). In natural communities, associated species may include *Sagittaria platyphylla* (delta arrowhead), *Spartina alterniflora* (smooth cordgrass), *Schoenoplectus americanus* (chairmaker's bulrush), *Vigna luteola* (hairypod cowpea), *Typha* (cattail) spp., and others.

Classification Comments:

Similar Alliances:

- *Phragmites australis* Herbaceous Alliance (A.1196)

- *Phragmites australis* Semipermanently Flooded Herbaceous Alliance (A.1431)
- *Phragmites australis* Temporarily Flooded Herbaceous Alliance (A.1345)

Similar Alliance Comments:

Related Concepts:

- *Phragmites australis* Association (Fleming 1998) ?
- *Phragmites australis* community (Metzler and Barrett 1992) ?
- *Phragmites australis* tidal marsh association (Clancy 1993b) ?
- Estuarine Intertidal: Brackish Tidal Marsh (Swain and Kearsley 2001) ?
- Tidal Freshwater Marsh (Nelson 1986) I

Alliance Description

Environment: This alliance is found in fresh to brackish tidal marshes along the Gulf and Atlantic coasts of the United States.

Vegetation: This vegetation can occur in invasive or natural situations. In both cases, it is strongly dominated by *Phragmites australis* (common reed). Although invasive and natural communities of *Phragmites australis* (common reed) are difficult to differentiate, this can be accomplished by considering the degree of disturbance at a site and observing a given stand over time to determine the degree of invasiveness (Marks et al. 1994). Evidence suggests that a new, more invasive genotype of *Phragmites australis* (common reed) was introduced to the U. S. from the Old World (Metzler and Rosza 1987) and that along the Gulf Coast of Louisiana and Texas, the genotype found in invasive communities differs from the genotype found in natural, stable communities (Hauber pers. comm. 1992 in Marks et al. 1994). In invasive communities, associated species are highly variable, depending on the vegetation that has been invaded. Spreading in large colonies, *Phragmites* (reed) may eventually dominate disturbed areas at coverage up to 100%. More typically, though, scattered individuals of other species may occur, such as sparse *Morella cerifera* (wax myrtle) shrubs, *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Calystegia sepium* (hedge false bindweed), *Boehmeria cylindrica* (smallspike false nettle), *Typha angustifolia* (narrowleaf cattail), *Apocynum cannabinum* (Indianhemp), *Rosa palustris* (swamp rose), *Polygonum* (knotweed) sp., and *Mikania scandens* (climbing hempvine). Vines of *Toxicodendron radicans* (eastern poison ivy) are also frequent, but typically occur at low cover. In natural communities, associated species may include *Sagittaria platyphylla* (delta arrowhead), *Spartina alterniflora* (smooth cordgrass), *Schoenoplectus americanus* (chairmaker's bulrush), *Vigna luteola* (hairypod cowpea), *Typha* (cattail) spp., and others.

Dynamics: The presence of a new genotype, along with a continued increase in and variety of disturbances, may explain the heightened invasiveness of this species. Although invasive and natural communities of *Phragmites australis* are difficult to differentiate, this can be accomplished by considering the degree of disturbance at a site and observing a given stand over time to determine the degree of invasiveness. Based on observations of this nature by individuals

familiar with the coastal marshes of Louisiana and Texas, apparently stable, natural communities dominated by *Phragmites australis* are present. However, the dominance of *Phragmites australis* in many tidal wetlands today often indicates human-induced disturbance, either through direct habitat manipulation or through passive introduction of reproductive material to naturally disturbed substrates. In many areas of the southeastern United States, it is well documented that *Phragmites* is recently introduced and spreading rapidly in tidal and non-tidal situations.

Alliance Distribution

Range: This alliance is found in coastal states from Maine to Texas, and most likely in the maritime provinces of Canada.

Nations: CA?, US

Subnations: AL, CT, DE, FL, GA, LA, LB?, MA, MD, ME, MS, NC, NF?, NH, NJ, NS?, NY, PA, PE?, QC?, RI, SC, TX, VA

TNC Ecoregions: 31:C, 53:C, 55:P, 56:C, 57:C, 58:C, 59:C, 62:C

USFS Ecoregions: 221Ab:CCC, 231Fb:CCC, 232Aa:CCC, 232Ac:CCC, 232Bz:CCC, 232Ch:CCC, 232Ci:CCC, 232Dc:CCC, 232Eb:CCC, 255Dc:CCC

Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Cape Hatteras, Colonial, Fire Island, Gateway, George Washington Birthplace, Saugus Iron Works); USFWS (Anahuac, Aransas, Back Bay, Big Boggy, Bon Secour, Brazoria, Chesapeake Marshlands, McFaddin, Rachel Carson, San Bernard)

(CEGL004187) Common Reed Tidal Herbaceous Vegetation
***Phragmites australis* Tidal Herbaceous Vegetation**
Reed Tidal Marsh

NVC Classification

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Tidal temperate or subpolar grassland (V.A.5.N.n.)
Alliance	*Phragmites australis* Tidal Herbaceous Alliance (A.1477)
Alliance (English name)	Common Reed Tidal Herbaceous Alliance
Association	*Phragmites australis* Tidal Herbaceous Vegetation
Association (English name)	Common Reed Tidal Herbaceous Vegetation
Association (Common name)	Reed Tidal Marsh
Ecological System(s):	Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260)
	Central Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270)
	Atlantic Coastal Plain Embayed Region Tidal Freshwater Marsh (CES203.259)
	Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519)

Element Concept

Global Summary: This community is a dense tall grassland indicative of disturbance. It occurs in a range of tidal wetland habitats from fresh to brackish in salinity. It is characterized by dense stands of *Phragmites australis*

(common reed), a species which tends to grow in colonies of tall, stout, leafy plants often to the exclusion of all other vascular plant species. Associated species are highly variable, depending on the community that has been invaded. Spreading in large colonies, *Phragmites* (reed) eventually dominates disturbed areas at coverage up to 100%. More typically, though, scattered individuals of other species may occur, such as sparse *Morella cerifera* (wax myrtle) shrubs, *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Calystegia sepium* (hedge false bindweed), *Boehmeria cylindrica* (smallspike false nettle), *Typha angustifolia* (narrowleaf cattail), *Apocynum cannabinum* (Indianhemp), *Rosa palustris* (swamp rose), *Polygonum* (knotweed) sp., and *Mikania scandens* (climbing hempvine). Vines of *Toxicodendron radicans* (eastern poison ivy) are also frequent, but typically occur at low cover. This community has a broad geographic range, including coastal areas of the eastern and southeastern United States and Canada.

Environmental Description

USFWS Wetland System: Estuarine

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: Reed tidal marsh occurs on Cape Hatteras National Seashore on intermittently-flooded brackish flats. Soils are very poorly drained muck. The unvegetated surface is made up almost entirely of bare muck soil (85-95% cover) with leaf litter (5%) and standing water (0-5%). Evidence of disturbance includes a boardwalk through one marsh, wind damage, and the presence of exotic plants.

Global Environment: This community is a dense tall grassland indicative of disturbance. It occurs in a range of tidal wetland habitats from fresh to brackish in salinity.

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: The vegetation is a near monoculture of *Phragmites australis* (common reed) in the very dense herb layer (90% cover). Additional species that may occur in small amounts include *Boehmeria cylindrica* (smallspike false nettle), *Erechtites hieraciifolia* (American burnweed), *Galium obtusum* (bluntleaf bedstraw), *Juncus roemerianus* (needlegrass rush), *Mikania scandens* (climbing hempvine) (codominant in one plot), *Spartina patens* (saltmeadow cordgrass), *Setaria parviflora* (marsh bristlegrass), *Thelypteris palustris* (eastern marsh fern), and *Typha domingensis* (southern cattail). A very sparse (0-5%) shrub layer may include *Baccharis halimifolia* (eastern baccharis), *Iva frutescens* (Jesuit's bark), *Morella cerifera* (wax myrtle), and *Toxicodendron radicans ssp. radicans* (eastern poison ivy). A total of 6 state-rare species were recorded from 2 sampled plots.

Global Vegetation: This community is a broadly defined reed-grass marsh. It is characterized by dense stands of *Phragmites australis* (common reed), a species which tends to grow in colonies of tall, stout, leafy plants often to the exclusion of all other vascular plant species. Associated species are highly variable, depending on the community that has been invaded. Spreading in large colonies, *Phragmites* (reed) eventually dominates disturbed areas at coverage up to 100%. More typically, though, scattered individuals of other species may occur, such as sparse *Morella cerifera* (wax myrtle) shrubs, *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Calystegia sepium* (hedge false bindweed), *Boehmeria cylindrica* (smallspike false nettle), *Typha angustifolia* (narrowleaf cattail), *Apocynum cannabinum* (Indianhemp), *Rosa palustris* (swamp rose), *Polygonum* (knotweed) sp., and *Mikania scandens* (climbing hempvine). Vines of *Toxicodendron radicans* (eastern poison ivy) are also frequent but typically occur at low cover.

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Short shrub/sapling	Vine/Liana	*Toxicodendron radicans* ssp. *radicans* (eastern poison ivy)
Herb (field)	Vine/Liana	*Mikania scandens* (climbing hempvine)
Herb (field)	Graminoid	*Juncus roemerianus* (needlegrass rush), *Phragmites australis* (common reed)

Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Phragmites australis* (common reed)

Characteristic Species

Cape Hatteras National Seashore and Cape Lookout National Seashore:

Global: *Phragmites australis* (common reed)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Cyperus esculentus* (chufa flatsedge), *Galium obtusum* (bluntleaf bedstraw), *Phragmites australis* (common reed), *Rubus trivialis* (southern dewberry), *Schoenoplectus americanus* (chairmaker's bulrush), *Schoenoplectus robustus* (sturdy bulrush), *Typha domingensis* (southern cattail)

Global:

Conservation Status Rank

Global Rank & Reasons: GNA (invasive) (22-Nov-1997).

Classification

Status: Standard

Classification Confidence: 1 - Strong

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: Although *Phragmites australis* rhizomes have been noted in salt marsh sediments exceeding three thousand years in age (Niering and Warren 1977) and is thus a native component of salt marshes in some areas in North America, the growth of the species in its native condition was likely to have been significantly different than the dense monotypic stands that characterize this community in parts of its range today. The invasive, non-native strain has been labeled haplotype M (Saltonstall 2002). The presence of the *Phragmites australis* community in wetlands today generally indicates human-induced disturbance, either through direct habitat manipulation or through passive introduction of reproductive material to naturally disturbed substrates. Historically, without alteration, these sites would generally be more saline. In New England, *Phragmites* tends to invade behind artificial/man-made levees where regular salt input is blocked, making the sites more brackish and less saline than prior to levee construction and anthropogenic modification. In cases where *Phragmites australis* is a significant component of the vegetation but the vegetation retains sufficient species composition to retain its identity, the site is considered an unhealthy or degraded example of that original community. Where *Phragmites australis* cover is so high that native species have been excluded and the original community is no longer recognizable, the occurrence is then treated as an example of *Phragmites australis* Tidal Herbaceous Vegetation (CEGL004187).

Global Similar Associations:

- *Phragmites australis - (Sagittaria platyphylla, Vigna luteola)* Tidal Herbaceous Vegetation (CEGL007891)
- *Phragmites australis* Eastern North America Temperate Semi-natural Herbaceous Vegetation (CEGL004141)

Global Related Concepts:

- *Phragmites australis* Association (Fleming 1998) ?
- *Phragmites australis* community (Metzler and Barrett 1992) ?
- *Phragmites australis* tidal marsh association (Clancy 1993b) ?
- Brackish Tidal Marsh (Rawinski 1984) ?
- Salt Marsh Complex (Breden 1989) B

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found on Ocracoke Island, Hatteras Island and Bodie Island, near the lighthouse.

Global Range: This community has a broad geographic range, including coastal areas of the eastern and southeastern United States and Canada.

Nations: CA?, US

States/Provinces: AL, CT, DE, FL, GA, LA, LB?, MA, MD, ME, MS, NC, NF?, NH, NJ, NS?, NY, PA, PE?, QC?, RI, SC, TX, VA

TNC Ecoregions:

USFS Ecoregions: 221Ab:CCC, 232Aa:CCC, 232Ac:CCC, 232Bz:CCC, 232Ch:CCC, 232Ci:CCC, 232Dc:CCC

Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Cape Hatteras, Colonial, Fire Island, Gateway, George Washington Birthplace, Saugus Iron Works); USFWS (Back Bay, Bon Secour, Chesapeake Marshlands)

Element Sources

Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.8, CAHA.18, CAHA.64.

Local Description Authors: M.J. Russo

Global Description Authors: R.E. Zaremba

References: Bell et al. 2002, Bowman 2000, Breden 1989, Clancy 1993b, Edinger et al. 2002, Fleming 1998, Harrison 2001, Metzler and Barrett 1992, Metzler and Barrett 1996, Metzler and Barrett 2001, NRCS 2001b, Nelson 1986, Niering and Warren 1977, Odum et al. 1984, Rawinski 1984, Saltonstall 2002, Schafale and Weakley 1990, Schotz pers. comm., Southeastern Ecology Working Group n.d., Swain and Kearsley 2001

Spartina alterniflora Tidal Herbaceous Alliance (A.1471)

Alliance Concept

Summary: This alliance includes various tidal marshes dominated by *Spartina alterniflora* (smooth cordgrass). The hydrology is usually regularly tidally flooded. In the northern part of its range, southern Maine to Cape Hatteras, North Carolina, this alliance is generally limited to the zone between mean sea level and the mean high water level. The habitat occurs in protected inlets behind barrier beaches or in drowned river valleys. Peat depth ranges from a few feet, if the community formed over a mud flat, to 80 feet in drowned river valleys. *Spartina alterniflora* (smooth cordgrass) is limited to the low marsh zone by moderate salinity; it can withstand longer submergence than other salt marsh grasses, but still requires periodic exposure of the substrate. It also requires moderately high levels of iron (7-15 ppm). This community is commonly known as the 'low salt marsh,' occurring as a tall grassland strongly dominated by *Spartina alterniflora* (smooth cordgrass). There is little variation in vascular plant species composition across the range. It occurs in nearly pure stands, with occasional low-growing species such as *Spergularia salina* (salt sandspurry), *Salicornia* (pickleweed) spp., *Suaeda maritima* (herbaceous seepweed), and seaweeds such as *Ulva lactuca* and other algae such as *Fucus vesiculosus* and *Ascophyllum nodosum*, which grow at the bases of the *Spartina* (cordgrass) plants. Herbs of *Salicornia virginica* (Virginia glasswort) and *Salicornia bigelovii* (dwarf saltwort) can be quite common mixed in with the *Spartina* (cordgrass), often becoming more apparent later in the growing season. *Limonium carolinianum* (Carolina sealavender) is another characteristic herb, but only as scattered individuals. More detailed information is needed on the variability of the alliance in the southern parts of its range.

Classification Comments:

Similar Alliances:

- *Schoenoplectus americanus* Tidal Herbaceous Alliance (A.2007)
- *Spartina patens - (Distichlis spicata)* Tidal Herbaceous Alliance (A.1481)

Similar Alliance Comments:

Related Concepts:

- Brackish Marsh (Nelson 1986) I
- Estuarine Intertidal: Brackish Tidal Marsh (Swain and Kearsley 2001) ?
- Estuarine Intertidal: Salt Marsh (Swain and Kearsley 2001) ?
- Saline Marsh (Wieland 1994b) I
- Saline Marsh (Wieland 1994a) I
- Salt Marsh (Smith 1996a) ?
- Salt Marsh (Nelson 1986) ?
- Salt Marsh (Schafale and Weakley 1990) ?

- Smooth Cordgrass Marsh (Wharton 1978) ?
- Smooth Cordgrass Series (Diamond 1993) I
- Tidal Marsh (FNAI 1992a) I

Alliance Description

Environment: This alliance includes various tidal marshes dominated by *Spartina alterniflora*. The hydrology is usually regularly tidally flooded. In the northern part of its range, southern Maine to Cape Hatteras, North Carolina, this alliance is generally limited to the zone between mean sea level and the mean high water level. The habitat occurs in protected inlets behind barrier beaches or in drowned river valleys. Peat depth ranges from a few feet, if the community formed over a mud flat, to 80 feet in drowned river valleys. *Spartina alterniflora* is limited to the low marsh zone by moderate salinity; it can withstand longer submergence than other salt marsh grasses, but still requires periodic exposure of the substrate. It also requires moderately high levels of iron (7-15 ppm).

Vegetation: This community is commonly known as the 'low salt marsh,' occurring as a tall grassland strongly dominated by *Spartina alterniflora* (smooth cordgrass). There is little variation in vascular plant species composition across the range. It occurs in nearly pure stands, with occasional low-growing species such as *Spergularia salina* (salt sandspurry), *Salicornia* (pickleweed) spp., *Suaeda maritima* (herbaceous seepweed), and seaweeds such as *Ulva lactuca* and other algae such as *Fucus vesiculosus* and *Ascophyllum nodosum*, which grow at the bases of the *Spartina* (cordgrass) plants. Herbs of *Salicornia virginica* (Virginia glasswort) and *Salicornia bigelovii* (dwarf saltwort) can be quite common mixed in with the *Spartina* (cordgrass), often becoming more apparent later in the growing season. *Limonium carolinianum* (Carolina sealavender) is another characteristic herb, but only as scattered individuals.

Dynamics:

Alliance Distribution

Range: This alliance is found in coastal states from Maine to Texas.

Nations: CA, US

Subnations: AL, CT, DE, FL, GA, LA, MA, MD, ME, MS, NB, NC, NH, NJ, NS, NY, RI, SC, TX, VA

TNC Ecoregions: 30:P, 31:C, 41:P, 53:C, 54:P, 55:P, 56:C, 57:C, 58:C, 62:C, 63:C

USFS Ecoregions: 212Cb:CCC, 212Db:CCC, 212Dc:CCC, 221Aa:CCP, 221Ab:CCC, 221Ac:CCC, 221Ad:CCC, 221Ae:CCC, 221Ak:CCC, 221Dc:CPP, 231Fb:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Ad:CCC, 232Ae:CCC, 232Bb:CCP, 232Bc:CCP, 232Bd:CCP, 232Br:CCC, 232Bt:CCC, 232Bx:CCC, 232Bz:CCC, 232Cb:CCC, 232Ce:CCC, 232Ch:CCC,

232Ci:CCC, 232Cj:CCC, 232Db:CCP, 232Dc:CCC, 232Dd:CCC, 232De:CCP, 232Eb:CCC, 232Ed:CCC, 232Ee:CCC, 232Gb:CPP, 255Da:CC?, 255Dc:CCC

Federal Lands: NPS (Acadia, Assateague Island, Boston Harbor Islands, Cape Cod, Cape Hatteras, Cape Lookout, Colonial, Fire Island, Fort Pulaski, Gateway, George Washington Birthplace, Muskeget Island, Sagamore Hill, Timucuan); USFS (Croatan); USFWS (Anahuac?, Aransas?, Back Bay?, Big Boggy, Bon Secour, Brazoria, Chesapeake Marshlands, Chincoteague, Matagorda Island, McFaddin, Monomoy, Moosehorn?, Parker River, Prime Hook, Rachel Carson, San Bernard, Texas Point)

(CEGL004191) Saltmarsh Cordgrass Carolinian Zone Herbaceous Vegetation
***Spartina alterniflora* Carolinian Zone Herbaceous Vegetation**
Southern Atlantic Coast Salt Marsh

NVC Classification

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Tidal temperate or subpolar grassland (V.A.5.N.n.)
Alliance	*Spartina alterniflora* Tidal Herbaceous Alliance (A.1471)
Alliance (English name)	Saltmarsh Cordgrass Tidal Herbaceous Alliance
Association	*Spartina alterniflora* Carolinian Zone Herbaceous Vegetation
Association (English name)	Saltmarsh Cordgrass Carolinian Zone Herbaceous Vegetation
Association (Common name)	Southern Atlantic Coast Salt Marsh
Ecological System(s):	Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260) Atlantic Coastal Plain Indian River Lagoon Tidal Marsh (CES203.257) Central Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270)

Element Concept

Global Summary: This vegetation includes various tidal marshes dominated by *Spartina alterniflora* (smooth cordgrass), from Cape Hatteras, North Carolina, south to the Atlantic Coast of the Florida peninsula. The hydrology is usually regularly tidally flooded. *Spartina alterniflora* (smooth cordgrass) is limited to the low marsh zone by moderate salinity; it can withstand longer submergence than other salt marsh grasses, but still requires periodic exposure of the substrate. It also requires moderately high levels of iron (7-15 ppm). This community is commonly known as the 'low salt marsh,' occurring as a tall grassland strongly dominated by *Spartina alterniflora* (smooth cordgrass). There is little variation in vascular plant species composition across the range. *Spartina alterniflora* (smooth cordgrass) occurs in nearly pure stands, occasionally with other low stature species.

Environmental Description

USFWS Wetland System: Estuarine

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This coastal salt marsh occurs on both Cape Hatteras National Seashore and Cape Lookout National Seashore. Sites are permanently to irregularly tidally flooded flats. Soils are either very poorly drained muck or well-drained sand. The unvegetated surface is made up of standing water (40-95% cover), leaf litter (0-10%) and bare sand/soil (0-85%). Evidence of disturbance includes horse grazing, wind damage, tidal influence, salt spray, storm overwash, surges and strong winds.

Global Environment: This vegetation is found along the margins of sounds and estuaries, backs of barrier islands, and old flood tide delates near closed inlets (Schafale and Weakley 1990). These are areas with diurnal salt tides. The hydrology is estuarine, tidally flooded, and euhaline (30-40 ppt). This range is consistent with the "Carolinian Province" of Cowardin et al. (1979).

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: The vegetation is clearly dominated by *Spartina alterniflora* (smooth cordgrass) in the sparse to very dense herb layer (30-100% cover). Additional species that may occur in lesser amounts include *Borrichia frutescens* (bushy seaside tansy), *Distichlis spicata* (inland saltgrass), *Juncus roemerianus* (needlegrass rush), *Limonium carolinianum* (Carolina sealavender), *Sarcocornia pacifica* (Pacific swampfire), and state-vulnerable *Symphyotrichum tenuifolium* (perennial saltmarsh aster).

Global Vegetation: This community is commonly known as the 'low salt marsh,' occurring as a tall grassland strongly dominated by *Spartina alterniflora* (smooth cordgrass). There is little variation in vascular plant species composition across the range. *Spartina alterniflora* (smooth cordgrass) occurs in nearly pure stands, occasionally with other low-stature species. *Salicornia* (pickleweed) sp. can be quite common mixed in with the *Spartina* (cordgrass), often becoming more apparent later in the growing season. *Limonium carolinianum* (Carolina sealavender) is another characteristic herb, but only as scattered individuals. More detailed information is needed on the composition of this vegetation and how it differs floristically from its northern equivalent, *Spartina alterniflora / (Ascophyllum nodosum)* Acadian/Virginian Zone Herbaceous Vegetation (CEGL004192).

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Herb (field)	Forb	*Sarcocornia pacifica* (Pacific swampfire)
Herb (field)	Graminoid	*Juncus roemerianus* (needlegrass rush)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Symphyotrichum tenuifolium* (perennial saltmarsh aster)

Conservation Status Rank

Global Rank & Reasons: G5 (1-Dec-1997). Since it occurs over large areas, this community is in no danger of disappearing. However, its role in the functioning of ecosystems makes the presence of large areas very important. Losses of this community could have serious consequences for nutrient cycling and reproduction of estuarine and marine organisms (Schafale and Weakley 1990).

Classification

Status: Standard

Classification Confidence: 1 - Strong

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments:

Global Similar Associations:

- *Spartina alterniflora / (Ascophyllum nodosum)* Acadian/Virginian Zone Herbaceous Vegetation (CEGL004192)

Global Related Concepts:

- Salt Marsh (Carolinian Subtype) (Schafale 2000) ?

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found in tidal areas on the sound side of the barrier islands throughout Cape Hatteras and Cape Lookout national seashores.

Global Range: This vegetation ranges from Cape Hatteras, North Carolina, south to the Atlantic Coast of the Florida peninsula (Cowardin 1979). The northern limit corresponds with the southern limit of the Virginian province of the American Atlantic Temperate Region, a transitional area harboring animal species of both southern and northern affinities.

Nations: US

States/Provinces: FL, GA, NC, SC

TNC Ecoregions:

USFS Ecoregions: 232Cb:CCC, 232Ce:CCC, 232Ch:CCC, 232Ci:CCC

Federal Lands: NPS (Cape Hatteras, Cape Lookout, Fort Pulaski, Timucuan); USFS (Croatan)

Element Sources

Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.51, CAHA.57, CALO.15, CALO.3, CALO.36, CALO.5, CALO.63, CALO.71.

Local Description Authors: M.J. Russo

Global Description Authors: A.S. Weakley

References: Cowardin et al. 1979, FNAI 1992a, Nelson 1986, Peet et al. unpubl. data 2002, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Southeastern Ecology Working Group n.d.

Spartina patens – (Distichlis spicata) Tidal Herbaceous Alliance (A.1481)

Alliance Concept

Summary: This alliance comprises "high salt marsh" vegetation dominated or codominated by *Spartina patens* (saltmeadow cordgrass) along the Gulf and Atlantic coasts from Maine to Texas. The high salt marsh is irregularly flooded by tides and forms at slightly higher elevations than regularly flooded low marshes; they establish where peat accumulation raises the marsh surface above mean high tide. Landward the vegetation can transition to brackish marsh or upland vegetation. Vegetation of this alliance also occurs in mesohaline zones along lower reaches of tidal rivers.

Variation in codominant species occurs across the geographic range. From the Canadian maritime provinces south to Delaware (discontinuously south to Virginia), this alliance is characterized by the dominance of *Spartina patens* (saltmeadow cordgrass), *Distichlis spicata* (inland saltgrass), and *Juncus gerardii* (saltmeadow rush) and the presence of more northerly distributed marsh species such as *Puccinellia fasciculata* (saltmarsh alkaligrass), *Plantago maritima* (goose tongue), and *Triglochin maritima* (seaside arrowgrass). In brackish reaches of tidal rivers, this alliance includes *Spartina patens* (saltmeadow cordgrass)-dominated vegetation that may also be characterized by the presence of *Agrostis stolonifera* (creeping bentgrass), *Festuca rubra* (red fescue), *Symphyotrichum novi-belgii* (New York aster), *Hierochloe odorata* (vanilla grass), *Carex paleacea* (chaffy sedge), or *Spartina pectinata* (prairie cordgrass).

From Delaware south to Florida, this high salt marsh coastal community is dominated by *Spartina patens* (saltmeadow cordgrass), forming meadows at slightly higher elevations in relation to the adjacent *Spartina alterniflora* (smooth cordgrass) Tidal Herbaceous Alliance (A.1471). Diagnostic species for this community are *Spartina patens* (saltmeadow cordgrass), *Distichlis spicata* (inland saltgrass), *Borrichia frutescens* (bushy seaside tansy), *Kosteletzkya virginica* (Virginia saltmarsh mallow), and *Pluchea odorata* (sweetscent). Shrub seedlings such as *Baccharis halimifolia* (eastern baccharis) and *Morella cerifera* (wax myrtle) may also be present. The associated *Juncus roemerianus* (needlegrass rush) Tidal Herbaceous Alliance (A.1475) often occurs as discrete patches which may reach substantial size.

This alliance also includes mesohaline to oligohaline marshes of the Gulf Coast of Texas and Louisiana. In these associations, *Spartina patens* (saltmeadow cordgrass) may strongly dominate, *Distichlis spicata* (inland saltgrass), *Spartina alterniflora* (smooth cordgrass), and *Spartina patens* (saltmeadow cordgrass) may codominate, *Distichlis spicata* (inland saltgrass) may form pure stands, *Paspalum vaginatum* (seashore paspalum) may strongly dominate, or *Spartina patens* (saltmeadow cordgrass) and *Vigna luteola* (hairypod cowpea) may codominate. Other characteristic species include *Juncus roemerianus* (needlegrass rush), *Spartina spartinae* (gulf cordgrass), *Spartina cynosuroides* (big cordgrass) (within its range), *Schoenoplectus robustus* (sturdy bulrush), *Schoenoplectus americanus* (chairmaker's bulrush), *Sagittaria lancifolia* (bulltongue arrowhead), *Phragmites australis* (common reed), and *Eragrostis* (lovegrass) spp. Here, this alliance forms mosaics with *Spartina spartinae* (gulf cordgrass) and *Spartina alterniflora* (smooth cordgrass) marshes and saline herbaceous vegetation.

Western states have a different alliance for inland situations dominated by *Distichlis spicata* (inland saltgrass), the *Distichlis spicata* (inland saltgrass) Intermittently Flooded Herbaceous Alliance (A.1332).

Classification Comments: This may represent multiple zones; more research is needed.

Similar Alliances:

- *Distichlis spicata* Intermittently Flooded Herbaceous Alliance (A.1332)

- *Distichlis spicata* Tidal Herbaceous Alliance (A.1882)
- *Juncus roemerianus* Tidal Herbaceous Alliance (A.1475)
- *Schoenoplectus americanus* Tidal Herbaceous Alliance (A.2007)
- *Spartina alterniflora* Tidal Herbaceous Alliance (A.1471)

Similar Alliance Comments: From Delaware south to Florida, this high salt marsh coastal community, dominated by *Spartina patens*, forms meadows at slightly higher elevations in relation to the adjacent *Spartina alterniflora* Tidal Herbaceous Alliance (A.1471). The associated *Juncus roemerianus* Tidal Herbaceous Alliance (A.1475) occurs as discrete patches which may reach substantial size. Western states have a different alliance for inland situations, the *Distichlis spicata* Intermittently Flooded Herbaceous Alliance (A.1332). In coastal Texas and possibly elsewhere along the Gulf Coast, the relationship between this alliance and the similar *Schoenoplectus americanus* Tidal Herbaceous Alliance (A.2007) is not well understood. Dominance patterns are likely related to gradients in salinity and hydrology. *Schoenoplectus americanus* may dominate in areas with higher average water levels, lower salinities, and lower frequency of flooding than areas typically dominated by *Spartina patens* or *Distichlis spicata*.

Related Concepts:

- Brackish Marsh (Wieland 1994b) I
- Brackish Marsh (Nelson 1986) I
- Estuarine Intertidal: Brackish Tidal Marsh (Swain and Kearsley 2001) ?
- Estuarine Intertidal: Salt Marsh (Swain and Kearsley 2001) ?
- Intermediate Marsh (Smith 1996a) ?
- Marshhay Cordgrass Series (Diamond 1993) I
- Salt Marsh (Wieland 1994b) I
- Salt Marsh (Schafale and Weakley 1990) I
- Salt Marsh (Nelson 1986) I
- Salt Marsh (Smith 1996a) I
- Saltgrass-Cordgrass Series (Diamond 1993) ?

Alliance Description

Environment: The high salt marsh is irregularly flooded by tides and forms at slightly higher elevations than regularly flooded low marshes; they establish where peat accumulation raises the marsh surface above mean high tide. Landward the vegetation can transition to brackish marsh or upland vegetation. Vegetation of this alliance also occurs in mesohaline zones along lower reaches of tidal rivers. The substrate is peat of variable depths overlying sand.

Vegetation: Variation in codominant species occurs across the geographic range. From the Canadian maritime provinces south to Delaware (discontinuously south to Virginia), this alliance is characterized by the dominance of *Spartina patens* (saltmeadow cordgrass), *Distichlis spicata* (inland saltgrass), and *Juncus gerardii* (saltmeadow rush) and the presence of more northerly distributed marsh species such as *Puccinellia fasciculata* (saltmarsh alkaligrass), *Plantago*

maritima (goose tongue), and *Triglochin maritima* (seaside arrowgrass). In brackish reaches of tidal rivers, this alliance includes *Spartina patens* (saltmeadow cordgrass)-dominated vegetation that may also be characterized by the presence of *Agrostis stolonifera* (creeping bentgrass), *Festuca rubra* (red fescue), *Symphyotrichum novi-belgii* (New York aster), *Hierochloe odorata* (vanilla grass), *Carex paleacea* (chaffy sedge), or *Spartina pectinata* (prairie cordgrass). From Delaware south to Florida, this high salt marsh coastal community is dominated by *Spartina patens* (saltmeadow cordgrass), forming meadows at slightly higher elevations in relation to the adjacent *Spartina alterniflora* (smooth cordgrass) Tidal Herbaceous Alliance (A.1471). *Distichlis spicata* (inland saltgrass), *Limonium carolinianum* (Carolina sealavender), *Agalinis maritima* (saltmarsh false foxglove), *Salicornia virginica* (Virginia glasswort), *Sabatia stellaris* (rose of Plymouth), *Borrichia frutescens* (bushy seaside tansy), *Lythrum lineare* (wand lythrum), *Schoenoplectus pungens* (common threesquare), *Eleocharis rostellata* (beaked spikerush), *Solidago sempervirens* (seaside goldenrod), *Fimbristylis castanea* (marsh fimbry), *Pluchea odorata* (sweetscent), *Hibiscus moscheutos* (crimsoneyed rosemallow), and *Atriplex prostrata* (triangle orache) are characteristic associates. Diagnostic species are *Spartina patens* (saltmeadow cordgrass), *Distichlis spicata* (inland saltgrass), *Borrichia frutescens* (bushy seaside tansy), *Kosteletzkya virginica* (Virginia saltmarsh mallow), and *Pluchea odorata* (sweetscent). This alliance also includes mesohaline to oligohaline marshes of the Gulf Coast of Texas and Louisiana. In these associations, *Spartina patens* (saltmeadow cordgrass) may strongly dominate, *Distichlis spicata* (inland saltgrass), *Spartina alterniflora* (smooth cordgrass), and *Spartina patens* (saltmeadow cordgrass) may codominate, *Distichlis spicata* (inland saltgrass) may form pure stands, *Paspalum vaginatum* (seashore paspalum) may strongly dominate, or *Spartina patens* (saltmeadow cordgrass) and *Vigna luteola* (hairypod cowpea) may codominate. Other characteristic species include *Juncus roemerianus* (needlegrass rush), *Spartina spartinae* (gulf cordgrass), *Spartina cynosuroides* (big cordgrass) (within its range), *Schoenoplectus robustus* (sturdy bulrush), *Schoenoplectus americanus* (chairmaker's bulrush), *Sagittaria lancifolia* (bulltongue arrowhead), *Phragmites australis* (common reed), and *Eragrostis* (lovegrass) spp. Here, this alliance forms mosaics with *Spartina spartinae* (gulf cordgrass) and *Spartina alterniflora* (smooth cordgrass) marshes and saline herbaceous vegetation.

Dynamics: Dominance patterns are likely related to gradients in salinity and hydrology and are not well understood.

Alliance Distribution

Range: This alliance is found along the Atlantic and Gulf coasts from Maine south to Florida and west to Texas.

Nations: US

Subnations: AL, CT, DE, FL, GA, LA, MA, MD, ME, MS, NC, NH, NJ, NY, RI, SC, TX, VA

TNC Ecoregions: 30:P, 31:C, 41:P, 53:C, 54:P, 55:P, 56:C, 57:C, 58:C, 62:C, 63:C

USFS Ecoregions: 212Cb:CCC, 212Db:CCC, 212Dc:CCC, 221Aa:CCC, 221Ab:CCC, 221Ac:CCC, 221Ad:CCC, 221Ae:CCC, 221Ak:CCC, 221Dc:CCC, 231Fb:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Ad:CCC, 232Bb:CCP, 232Bc:CCP, 232Bd:CCP, 232Br:CCC, 232Bx:CCC, 232Bz:CCC, 232Cb:CCC, 232Ce:CCC, 232Ch:CCC, 232Ci:CCC, 232Cj:CCC, 232Db:CCP, 232Dc:CCC, 232Dd:CCC, 232De:CCP, 232Eb:CCC, 232Ed:CCC, 232Ee:CCC, 232Gb:CCP, 255Da:CCP, 255Dc:CCC, 315F:CC

Federal Lands: NPS (Acadia, Assateague Island, Boston Harbor Islands, Cape Cod, Cape Hatteras, Cape Lookout, Chincoteague, Fire Island, Fort Pulaski, Gateway, Muskeget Island?, Sagamore Hill, Timucuan); USFWS (Anahuac, Back Bay?, Big Boggy, Brazoria, Chesapeake Marshlands, Matagorda Island, McFaddin, Moosehorn, Parker River?, Prime Hook, Rachel Carson, San Bernard, Texas Point)

(CEGL004197) Saltmeadow Cordgrass - Saltgrass - (Black Needlerush) Herbaceous Vegetation
***Spartina patens - Distichlis spicata - (Juncus roemerianus)* Herbaceous Vegetation**
Mid-Atlantic High Salt Marsh

NVC Classification

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Tidal temperate or subpolar grassland (V.A.5.N.n.)
Alliance	*Spartina patens - (Distichlis spicata)* Tidal Herbaceous Alliance (A.1481)
Alliance (English name)	Saltmeadow Cordgrass - (Saltgrass) Tidal Herbaceous Alliance
Association	*Spartina patens - Distichlis spicata - (Juncus roemerianus)* Herbaceous Vegetation
Association (English name)	Saltmeadow Cordgrass - Saltgrass - (Black Needlerush) Herbaceous Vegetation
Association (Common name)	Mid-Atlantic High Salt Marsh
Ecological System(s):	Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260) Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519) Central Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270)

Element Concept

Global Summary: This coastal community is an irregularly tidally flooded high salt marsh of the mid- and southern Atlantic Coast from Delaware south to Florida. It is dominated by *Spartina patens* (saltmeadow cordgrass), which forms meadows with a distinct "cowlicked" appearance. These meadows occur at slightly higher elevations than adjacent, regularly flooded low salt marsh occupying the zone extending from mean high tide landward approximately to the limit of high spring tides. The substrate is peat of variable depths overlying sand. *Distichlis spicata* (inland saltgrass) can be codominant. Additional associated species that generally occur in low abundance can include *Limonium carolinianum* (Carolina sealavender), *Agalinis maritima* (saltmarsh false foxglove), *Salicornia virginica* (Virginia glasswort), *Juncus roemerianus* (needlegrass rush), *Sabatia stellaris* (rose of Plymouth), *Borrichia frutescens* (bushy seaside tansy), *Lythrum lineare* (wand lythrum), *Solidago sempervirens* (seaside goldenrod), *Pluchea odorata* (sweetscent), *Hibiscus moscheutos ssp. moscheutos* (crimsoneyed rosemallow), or *Atriplex prostrata* (triangle orache). Shrub seedlings of *Baccharis halimifolia* (eastern baccharis), *Iva frutescens* (Jesuit's bark), and/or *Morella cerifera* (wax myrtle) may occur sporadically. Diagnostic species are *Spartina patens* (saltmeadow cordgrass), *Distichlis spicata*, *Borrichia frutescens* (bushy seaside tansy), *Kosteletzkya*

virginica (Virginia saltmarsh mallow), and *Pluchea odorata* (sweetscent). One unusual Virginia occurrence is dominated by *Plantago maritima var. juncoides* (goose tongue).

Environmental Description

USFWS Wetland System: Estuarine

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This irregularly tidally flooded high salt marsh is common on both Cape Hatteras National Seashore and Cape Lookout National Seashore on tidal flats and seasonally flooded depressions. Soils are either very poorly drained muck or well-drained sand. The unvegetated surface is variable with leaf litter (0-60% cover), standing water (0-100%) and bare sand/soil (0-90%). Evidence of disturbance includes trails/roads, saltwater overwash, wrack deposition, and damage from storm surge, strong winds, and salt spray.

Global Environment: This high salt marsh association generally occurs behind barrier beaches, but also in the outer reaches of estuaries, occupying the zone extending from mean high tide landward approximately to the limit of high spring tides. They are often adjacent to low salt marshes dominated by *Spartina alterniflora* (tall form), which are regularly flooded by diurnal tides. *Spartina patens*-dominated high marshes form very dense peat with high organic matter content. Peat forms over sand, silt or bedrock.

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: The moderate to very dense (70-90% cover) herbaceous layer is codominated by *Distichlis spicata* (inland saltgrass) and *Spartina alterniflora* (smooth cordgrass). Additional species that may occur in lesser amounts include *Borrichia frutescens* (bushy seaside tansy), *Fimbristylis castanea* (marsh fimbry), *Hydrocotyle bonariensis* (largeleaf pennywort), *Juncus roemerianus* (needlegrass rush), *Limonium carolinianum* (Carolina sealavender), *Sarcocornia pacifica* (Pacific swampfire), *Schoenoplectus pungens* (common threesquare), *Solidago sempervirens* (seaside goldenrod), *Spartina patens* (saltmeadow cordgrass), and state-vulnerable *Symphyotrichum tenuifolium* (perennial saltmarsh aster). A very sparse (0-10%) shrub layer may include *Baccharis halimifolia* (eastern baccharis), *Borrichia frutescens* (bushy seaside tansy), *Iva frutescens* (Jesuit's bark), *Iva imbricata* (seacoast marshelder), *Morella cerifera* (wax myrtle), and *Toxicodendron radicans ssp. radicans* (eastern poison ivy). This community supports many state-rare species, including the state-critically imperiled *Eleocharis parvula* (dwarf spikerush); a total of 11 species were recorded from 8 plots.

Global Vegetation: This high salt marsh is dominated by *Spartina patens* (saltmeadow cordgrass) with *Distichlis spicata* (inland saltgrass) occurring as a common associate or a codominant species. Associated species that generally occur in low abundance can include *Limonium carolinianum* (Carolina sealavender), *Agalinis maritima* (saltmarsh false foxglove), *Salicornia virginica* (Virginia glasswort), *Sabatia stellaris* (rose of Plymouth), *Borrichia frutescens* (bushy seaside tansy), *Lythrum lineare* (wand lythrum), *Juncus roemerianus* (needlegrass rush), *Solidago sempervirens* (seaside goldenrod), *Pluchea odorata* (sweetscent), *Hibiscus moscheutos ssp. moscheutos* (crimsoneyed rosemallow), and/or *Atriplex prostrata* (triangle orache). Shrub seedlings of *Baccharis halimifolia* (eastern baccharis), *Iva frutescens* (Jesuit's bark), and/or *Morella cerifera* (wax myrtle) may occur sporadically.

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved evergreen shrub	*Morella cerifera* (wax myrtle)
Short shrub/sapling	Broad-leaved deciduous shrub	*Iva imbricata* (seacoast marshelder)
Short shrub/sapling	Vine/Liana	*Toxicodendron radicans* ssp. *radicans* (eastern poison ivy)

Herb (field)	Graminoid	*Distichlis spicata* (inland saltgrass), *Fimbristylis castanea* (marsh fimbry), *Juncus roemerianus* (needlegrass rush)

Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Distichlis spicata* (inland saltgrass), *Spartina patens* (saltmeadow cordgrass)

Characteristic Species

Cape Hatteras National Seashore and Cape Lookout National Seashore:

Global: *Distichlis spicata* (inland saltgrass), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Pluchea odorata* (sweetscent), *Spartina patens* (saltmeadow cordgrass)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Baccharis angustifolia* (saltwater false willow), *Bacopa monnieri* (herb of grace), *Cenchrus tribuloides* (sanddune sandbur), *Cynanchum angustifolium* (Gulf Coast swallow-wort), *Eleocharis parvula* (dwarf spikerush), *Iva imbricata* (seacoast marshelder), *Phyla nodiflora* (turkey tangle fogfruit), *Schoenoplectus robustus* (sturdy bulrush), *Symphyotrichum tenuifolium* (perennial saltmarsh aster), *Triglochin striata* (threerib arrowgrass)

Global:

Conservation Status Rank

Global Rank & Reasons: G4G5 (13-May-2002). Although widespread on the eastern seaboard, examples of this community that have not been impacted by ditching, dredging and filling, mosquito spraying, and other activities are relatively uncommon.

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: Although *Juncus roemerianus* may not be present or have minor cover in some stands, it is a differential species and was chosen as a nominal of this association to distinguish it from *Spartina patens - Distichlis spicata - (Juncus gerardii)* Herbaceous Vegetation (CEGL006006), which occurs to the north. *Spartina patens - Distichlis spicata - (Juncus roemerianus)* Herbaceous Vegetation (CEGL004197) is differentiated by the absence or relative infrequent occurrence of *Juncus gerardii, Plantago maritima,* and *Triglochin maritima* (in pannes), and by the importance of species of southern distribution, such as *Borrichia frutescens*, *Kosteletzkya virginica*, *Fimbristylis castanea*, and *Lythrum lineare*. If discrete patches of *Juncus roemerianus* occur in substantial size (several acres), the community is considered to be *Juncus roemerianus* Herbaceous Vegetation (CEGL004186). Currently, some unusually diverse variants exist in Virginia that may warrant recognition as a separate association.

Global Similar Associations:

- *Juncus roemerianus* Herbaceous Vegetation (CEGL004186)
- *Spartina alterniflora - Distichlis spicata* Tidal Herbaceous Vegetation [Provisional] (CEGL006586)
- *Spartina patens - Distichlis spicata - (Juncus gerardii)* Herbaceous Vegetation (CEGL006006)

Global Related Concepts:

- *Aster tenuifolius - Distichlis spicata - Fimbristylis castanea - Borrichia frutescens - Spartina patens* association (Adams 1963) =
- *Spartina - Distichlis - Juncus* associes (Penfound 1952) =
- *Spartina patens - Distichlis spicata - Sarcocornia perennis - Limonium carolinianum* Herbaceous Vegetation (Coulling 2002) F
- *Spartina patens - Distichlis spicata* Herbaceous Vegetation (Harrison 2001) I
- *Spartina patens - Distichlis spicata* Herbaceous Vegetation (Coulling 2002) F
- *Spartina patens - Distichlis spicata* high marsh (Clancy 1993b) =
- *Spartina patens* type (Cooper and Waits 1973) =
- Brackish Marsh (Salt Meadow Cordgrass Subtype) (Schafale 2000) ?
- High marsh (Cooper 1974) =
- Salt marsh (Higgins et al. 1971) B
- Salt marsh community (Hill 1986) B

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found near Haulover Day Use Area on Hatteras Island, at various locations on North Core Banks, and on Shackleford Banks.

Global Range: This association occurs along the Atlantic coast from Delaware to Florida.

Nations: US

States/Provinces: DE:S4, FL, GA, MD, NC, NJ, SC, VA

TNC Ecoregions:

USFS Ecoregions: 232Br:CCC, 232Bx:CCC, 232Bz:CCC, 232Ch:CCC, 232Ci:CCC

Federal Lands: NPS (Assateague Island, Cape Hatteras, Cape Lookout, Fort Pulaski, Timucuan); USFWS (Back Bay?, Chesapeake Marshlands, Chincoteague, Prime Hook)

Element Sources

Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.7, CALO.13, CALO.14, CALO.6, CALO.7, CALO.73.

Local Description Authors: M.J. Russo

Global Description Authors: L.A. Sneddon, mod. S.L. Neid

References: Adams 1963, Bowman 2000, Clancy 1993b, Clancy 1996, Cooper 1974, Cooper and Waits 1973, Coulling 2002, Eastern Ecology Working Group n.d., Fleming 2001, Fleming et al. 2001, Harrison 2001, Harrison 2004, Higgins et al. 1971, Hill 1986, Nelson 1986, Peet et al. unpubl. data 2002, Penfound 1952, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990]

Tidal Temperate Perennial Forb Vegetation (V.B.2.N.g)

Sarcocornia perennis – (Distichlis spicata, Salicornia spp.) Tidal Herbaceous Alliance (A.1704)

Alliance Concept

Summary:

Classification Comments: This alliance is reported from two very disjunct areas, California and New Hampshire. In California it is very poorly known, and documented only by Sawyer and Keeler-Wolf (1995). Not enough information was available to complete a description of this alliance at this time, and the two associations (one from New Hampshire and one from California) need to be reviewed to determine if they belong to the same alliance.

Similar Alliances:

- *Triglochin maritima* Semipermanently Flooded Herbaceous Alliance (A.1681)

Similar Alliance Comments:

Related Concepts:

- Estuarine Intertidal: Salt Marsh (Swain and Kearsley 2001) ?

Alliance Distribution

Range: This alliance is found throughout the northeastern coastal United States and Canada and possibly in the Pacific Northwest from California to Washington.

Nations: CA, US

Subnations: CA?, CT, DE, MA, MD, ME, NB, NC, NH, NJ, NS, NY, OR?, RI, SC?, VA, WA?

TNC Ecoregions: 1:C, 14:C, 15:C, 16:C, 57:P, 58:C, 62:C, 63:C

USFS Ecoregions: 212C:PP, 212D:PP, 221Aa:CCC, 221Ab:CCC, 221Ac:CCC, 221Ad:CCC, 221Ak:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Ad:CC?, 232Bx:CCC, 232Bz:CCC, 232Ci:CCC, 261A:CC, 261B:CC, 263A:CC, M242A:CC

Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Cape Lookout, Fire Island, Gateway); USFWS (Parker River, Prime Hook, Rachel Carson)

(CEGL004308) (Virginia Glasswort, Dwarf Glasswort, Sea Saltwort) - Saltmarsh Cordgrass Herbaceous Vegetation

***Salicornia (virginica, bigelovii, maritima) - Spartina alterniflora* Herbaceous Vegetation**
Salt Panne (Salicornia Type)

NVC Classification

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial forb vegetation (V.B.)
Physiognomic Group	Temperate or subpolar perennial forb vegetation (V.B.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar perennial forb vegetation (V.B.2.N.)
Formation	Tidal temperate perennial forb vegetation (V.B.2.N.g.)
Alliance	*Sarcocornia perennis - (Distichlis spicata, Salicornia* spp.) Tidal Herbaceous Alliance (A.1704)
Alliance (English name)	Woody Glasswort - (Saltgrass, Saltwort species) Tidal Herbaceous Alliance
Association	*Salicornia (virginica, bigelovii, maritima) - Spartina alterniflora* Herbaceous Vegetation
Association (English name)	(Virginia Glasswort, Dwarf Glasswort, Sea Saltwort) - Saltmarsh Cordgrass Herbaceous Vegetation
Association (Common name)	Salt Panne (Salicornia Type)
Ecological System(s):	Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260) Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519) Central Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270) Acadian Coastal Salt Marsh (CES201.578)

Element Concept

Global Summary: This association represents tidally flooded hypersaline flats or very shallow depressions (pannes) dominated by halophytic herbs, including *Salicornia virginica* (Virginia glasswort), *Salicornia bigelovii* (dwarf saltwort), *Salicornia maritima* (slender grasswort), and stunted *Spartina alterniflora* (smooth cordgrass), that occur in salt marshes of the Atlantic Coast. Vegetation of this association tends to develop in shallow depressions within high or salt marshes where drainage is poor. The depressions are regularly to irregularly flooded by high tides, but as the water evaporates during low tide, the salinity concentration increases forming "salt pannes." Formation of the pannes may result from ice-scouring, rafting flotsam, peat compaction, mosquito ditch levees, or erosion of tidal creek banks, which create small, sparsely vegetated to unvegetated impoundments. Bare peat and/or mucky soils are prevalent (up to 85% bare soils). Total vegetative cover is variable in pannes, from near total absence of vascular plants to a dense cover of *Salicornia virginica* (Virginia glasswort), *Salicornia bigelovii* (dwarf saltwort), *Salicornia maritima* (slender grasswort), *Sarcocornia perennis* (chickenclaws), or *Spartina alterniflora* (smooth cordgrass) (short form). Common associates include *Limonium carolinianum* (Carolina sealavender), *Plantago maritima var. juncoides* (goose tongue), *Triglochin maritima* (seaside arrowgrass), *Spartina patens* (saltmeadow cordgrass), *Suaeda maritima* (herbaceous seepweed), and *Atriplex* (saltbush) spp. Algal mats are characteristically present, visible even in densely vegetated pannes. Blue-green algae are an important component of these mats, in some cases contributing significantly more biomass to the community than do vascular species. Diagnostic species include *Salicornia bigelovii* (dwarf saltwort) and *Salicornia virginica* (Virginia glasswort).

Environmental Description

USFWS Wetland System: Estuarine

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This salt panne community was sampled once on the Core Banks at Cape Lookout National Seashore. The site is a wind-tidally flooded flat with poorly drained sand soil. Evidence of disturbance includes washed up human trash.

Global Environment: Vegetation of this association tends to develop in shallow depressions in salt marshes where drainage is poor. They tend to occur more frequently on the high marsh but occur within low marsh as well. Pannes

form in depressions that range from 2-30 cm lower than the elevation of the marsh. The depressions are regularly to irregularly flooded by tides, and as the water evaporates during low tide, the salinity concentration increases forming "salt pannes." Substrate is soft, silty muck or peat of variable density.

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: The sparse (35% cover) vegetation is dominated by *Juncus roemerianus* (needlegrass rush), *Borrichia frutescens* (bushy seaside tansy), and *Sarcocornia pacifica* (Pacific swampfire). Additional species include *Iva frutescens* (Jesuit's bark), *Spartina alterniflora* (smooth cordgrass), and *Suaeda linearis* (annual seepweed). This community also supports state-vulnerable *Cynanchum angustifolium* (Gulf Coast swallow-wort).

Global Vegetation: This association includes tidally flooded hypersaline flats or very shallow depressions (pannes) dominated by halophytic herbs. Total vegetative cover is quite variable in pannes, from near total absence of vascular plants to a dense cover of *Salicornia virginica* (Virginia glasswort), *Salicornia bigelovii* (dwarf saltwort), *Salicornia maritima* (slender grasswort), *Sarcocornia perennis* (chickenclaws), or *Spartina alterniflora* (smooth cordgrass) (short form). Common associates include *Limonium carolinianum* (Carolina sealavender), *Plantago maritima var. juncoides* (goose tongue), *Triglochin maritima* (seaside arrowgrass), *Spartina patens* (saltmeadow cordgrass), *Suaeda maritima* (herbaceous seepweed), and *Atriplex* (saltbush) spp. Algal mats are characteristically present, visible even in densely vegetated pannes. Blue-green algae are an important component of these mats, in some cases contributing significantly more biomass to the community than do vascular species. The following algae were noted to occur in association with *Spartina alterniflora* (smooth cordgrass) in the littoral zone of a Massachusetts salt marsh: *Oscillatoria subuliformis*, *Oscillatoria amphibia*, *Lyngbea* spp., *Microcoleus chthonoplastes*, *Nodularia harveyana*, *Hydrocoleum lyngbyaceum*, and *Symploca* spp. (Webber 1967).

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Iva frutescens* (Jesuit's bark)
Herb (field)	Forb	*Borrichia frutescens* (bushy seaside tansy), *Cynanchum angustifolium* (Gulf Coast swallow-wort), *Sarcocornia pacifica* (Pacific swampfire), *Suaeda linearis* (annual seepweed)
Herb (field)	Graminoid	*Distichlis spicata* (inland saltgrass), *Juncus roemerianus* (needlegrass rush), *Spartina alterniflora* (smooth cordgrass)

Global

Stratum	Lifeform	Species
Herb (field)	Semi-shrub	*Salicornia virginica* (Virginia glasswort), *Sarcocornia perennis* (chickenclaws)
Herb (field)	Forb	*Salicornia bigelovii* (dwarf saltwort)
Herb (field)	Graminoid	*Spartina alterniflora* (smooth cordgrass)

Characteristic Species

Cape Hatteras National Seashore and Cape Lookout National Seashore:

Global: *Salicornia bigelovii* (dwarf saltwort), *Salicornia virginica* (Virginia glasswort), *Sarcocornia perennis* (chickenclaws)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Cynanchum angustifolium* (Gulf Coast swallow-wort)

Global:

Conservation Status Rank

Global Rank & Reasons: G5 (1-Dec-1997).

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: This community occurs in coastal salt marshes from Nova Scotia to the Carolinas, north of the range of *Batis maritima*. Salt pannes can potentially be classified based on morphology, salinity gradients, or substrate (Godfrey et al. 1978), which may elucidate further variation.

Global Similar Associations:

- *Batis maritima - Sarcocornia perennis* Dwarf-shrubland (CEGL003956)
- *Sarcocornia perennis - (Batis maritima, Distichlis spicata)* Dwarf-shrubland (CEGL002278)
- *Spartina alterniflora - Distichlis spicata* Tidal Herbaceous Vegetation [Provisional] (CEGL006586)

Global Related Concepts:

- *Salicornia - Bassia* salt flat (Harvill 1965) =
- *Salicornia europaea - Spartina alterniflora* community (Metzler and Barrett 1992) =
- *Salicornia virginica* Tidal Dwarf Shrubland (VDNH 2003) =
- *Salicornia* tidal flat (Clovis 1968) =
- *Salicornietum ambiguae* (Conard 1935) =
- *Sarcocornia perennis - (Distichlis spicata, Spartina alterniflora)* Dwarf-shrubland (Bartgis 1986) =
- *Spartina alterniflora / Salicornia europaea* community (Clancy 1993b) =
- Pan (Nichols 1920) =
- Panne (Good 1965) =
- Panne marsh (Baumann 1978b) =
- Pans (Higgins et al. 1971) =
- Pans (Hill 1986) =
- Salt Flat (Schafale 2000) =
- Salt Marsh (Rawinski 1984) ?
- Salt marsh complex, pannes (Breden 1989) =
- Salt pan (Klotz 1986) =
- Salt panne (Miller and Egler 1950) =
- Salt panne (Clancy 1993b) =
- Salt panne (Reschke 1990) =
- Stunted *Spartina alterniflora* community (Miller and Egler 1950) =

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found on South Core Banks.

Global Range: This association occurs along the Mid- and North Atlantic Coast from the Canadian maritime provinces south to North Carolina.

Nations: CA, US

States/Provinces: CT, DE:S3, MA, MD, ME, NB, NC, NH, NJ:S3S4, NS, NY, RI, SC?, VA

TNC Ecoregions:

USFS Ecoregions: 212C:PP, 212D:PP, 221Aa:CCC, 221Ab:CCC, 221Ac:CCC, 221Ad:CCC, 221Ak:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Ad:CC?, 232Bx:CCC, 232Bz:CCC, 232Ci:CCC

Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Cape Lookout, Fire Island, Gateway); USFWS (Parker River, Prime Hook)

Element Sources
Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CALO.54.

Local Description Authors: M.J. Russo

Global Description Authors: S.L. Neid

References: Bartgis 1986, Baumann 1978b, Bell et al. 2002, Berdine 1998, Bertness et al. 1992, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1993b, Clancy 1996, Clovis 1968, Conard 1935, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming 2001, Fleming et al. 2001, Gawler 2001, Gawler 2002, Godfrey et al. 1978, Good 1965, Harrison 2004, Harvill 1965, Higgins et al. 1971, Hill 1986, Klotz 1986, Metzler and Barrett 1992, Metzler and Barrett 2001, Miller and Egler 1950, NRCS 2001b, Nichols 1920, Niering and Warren 1980, Peet et al. unpubl. data 2002, Rawinski 1984, Redfield 1972, Reschke 1990, Schafale 2000, Schafale and Weakley 1990, Sperduto 2000b, Swain and Kearsley 2001, VDNH 2003, Webber 1967

Sparse Vegetation (VII.)

Sand Flats (VII.C.2.N.a)

Cakile edentula Sparsely Vegetated Alliance (A.1861)

Alliance Concept

Summary: Annual-dominated sand flats on island end flats and upper ocean beaches, within the reach of storm tides and extreme lunar tides. This alliance has less perennial species than the related *Cakile constricta* (Gulf Coast searocket) Sparsely Vegetated Alliance (A.1860), since the Atlantic coast shoreline is a higher-energy system, and the alliance is more dynamic and more frequently disturbed. Vegetative cover is variable, depending on the amount of exposure to wave and wind action, but on average is sparse; no species can be considered dominant. Annual or biennial species more-or-less restricted to beach habitats are characteristic of this alliance, including *Cakile edentula ssp. edentula* (American searocket), as well as *Salsola kali ssp. kali* (Russian thistle), *Chamaesyce polygonifolia* (seaside sandmat), *Honckenya peploides* (seaside sandplant), *Cenchrus tribuloides* (sanddune sandbur), *Amaranthus retroflexus* (redroot amaranth), *Chenopodium album* (lambsquarters), *Erechtites hieraciifolia* (American burnweed), and *Atriplex cristata* (crested saltbush). Associated species include *Ammophila breviligulata* (American beachgrass), *Chamaesyce polygonifolia* (seaside sandmat), *Salsola kali ssp. kali* (Russian thistle), and *Triplasis purpurea* (purple sandgrass). At Assateague Island National Seashore, this alliance is sparsely vegetated with *Cakile edentula ssp. edentula* (American searocket), covering approximately 1% of the area. Other associated species in this alliance are just as sparse and generally adapted to a low growth form, given the exposed windy conditions of their environment. The South Atlantic Coast phase of this alliance occupies the upper portion of ocean beaches in the southern part (Cape Hatteras, North Carolina, to Cape Romain, South Carolina) of the microtidal region (barrier islands with coastal geomorphology dominated by hurricane overwash rather than tidal energy). Other characteristic species include mostly annual herbs, such as *Chamaesyce polygonifolia* (seaside sandmat), *Chamaesyce bombensis* (dixie sandmat), *Sesuvium portulacastrum* (shoreline seapurslane), *Salsola kali ssp. kali* (Russian thistle), and the rare *Amaranthus pumilus* (seaside amaranth). In addition to the two associations in the Southeast, there is also an association in the Great Lakes; in this association the dominant plant is *Cakile edentula var. lacustris* (American searocket).

Classification Comments:

Similar Alliances:

- *Ammophila breviligulata* Herbaceous Alliance (A.1207)
- *Cakile constricta* Sparsely Vegetated Alliance (A.1860)
- *Ipomoea pes-caprae* Herbaceous Alliance (A.1581)

Similar Alliance Comments: This alliance (A.1861) has less perennial species than the related *Cakile constricta* Sparsely Vegetated Alliance (A.1860).

Related Concepts:

- *Cakile edentula-Chenopodium album* community (Metzler and Barrett 1992) ?
- *Cakiletum edentula* (Conard 1935) ?
- Beach community (Johnson 1985b) ?
- Beach community (Hill 1986) ?
- Beach strand community (MENHP 1991) ?
- Eastern Great Lakes Beach (Smith 1991) ?
- Great Lakes Region sparsely vegetated beach (Fike 1999) ?
- Marine intertidal gravel/sand beach community (Breden 1989) ?
- Maritime Beach Strand Community (Swain and Kearsley 2001) ?
- Maritime Grassland (Nelson 1986) I
- Upper Beach (Schafale and Weakley 1990) I
- Beach (Fender 1937) ?
- Beach (Higgins et al. 1971) ?
- Beach (McDonnell 1979) ?
- Beach community (Baumann 1978b) ?
- Beach vegetation (Moul 1973) ?
- Coastal beach strand (Sperduto 1994) ?
- Dune and swale community (Stalter 1990) I
- Dune community (Jenkins 1974) ?
- Dune-strand area (Clovis 1968) ?
- Embryo dune (Klotz 1986) ?
- Marine sandy beach (Clancy 1993b) ?
- Maritime beach (Reschke 1990) ?
- Middle beach (Nichols 1920) ?
- Middle beach (Shreve et al. 1910) ?
- Pioneer beach community (Boule 1979) ?
- Sea-strand vegetation, beach formation (Harshberger 1900) ?

Alliance Description

Environment: Annual-dominated sand flats on island end flats and upper ocean beaches, within the reach of storm tides and extreme lunar tides. The South Atlantic Coast phase of this alliance occupies the upper portion of ocean beaches in the southern part (Cape Hatteras, North Carolina, to Cape Romain, South Carolina) of the microtidal region (barrier islands with coastal geomorphology dominated by hurricane overwash rather than tidal energy).

Vegetation: Annual-dominated sand flats on island end flats and upper ocean beaches, within the reach of storm tides and extreme lunar tides. This alliance has less perennial species than the related *Cakile constricta* (Gulf Coast searocket) Sparsely Vegetated Alliance (A.1860), since the Atlantic coast shoreline is a higher-energy system, and the alliance is more dynamic and more

frequently disturbed. Vegetative cover is variable, depending on the amount of exposure to wave and wind action, but on average is sparse; no species can be considered dominant. Annual or biennial species more-or-less restricted to beach habitats are characteristic of this alliance, including *Cakile edentula ssp. edentula* (American searocket), as well as *Salsola kali ssp. kali* (Russian thistle), *Chamaesyce polygonifolia* (seaside sandmat), *Honckenya peploides* (seaside sandplant), *Cenchrus tribuloides* (sanddune sandbur), *Amaranthus retroflexus* (redroot amaranth), *Chenopodium album* (lambsquarters), *Erechtites hieraciifolia* (American burnweed), and *Atriplex cristata* (crested saltbush). Associated species include *Ammophila breviligulata* (American beachgrass), *Chamaesyce polygonifolia* (seaside sandmat), *Salsola kali ssp. kali* (Russian thistle), and *Triplasis purpurea* (purple sandgrass). At Assateague Island National Seashore, this alliance is sparsely vegetated with *Cakile edentula ssp. edentula* (American searocket), covering approximately 1% of the area. Other associated species in this alliance are just as sparse and generally adapted to a low growth form, given the exposed windy conditions of their environment. The South Atlantic Coast phase of this alliance occupies the upper portion of ocean beaches in the southern part (Cape Hatteras, North Carolina, to Cape Romain, South Carolina) of the microtidal region (barrier islands with coastal geomorphology dominated by hurricane overwash rather than tidal energy). Other characteristic species include mostly annual herbs, such as *Chamaesyce polygonifolia* (seaside sandmat), *Chamaesyce bombensis* (dixie sandmat), *Sesuvium portulacastrum* (shoreline seapurslane), *Salsola kali ssp. kali* (Russian thistle), and the rare *Amaranthus pumilus* (seaside amaranth). In addition to the two associations in the Southeast, there is also an association in the Great Lakes; in this association the dominant plant is *Cakile edentula var. lacustris* (American searocket).

Dynamics:

Alliance Distribution

Range: This alliance is found in coastal areas from Maine to South Carolina, as well as along the Great Lakes; and in Canada in Ontario. It may also be found in Florida and Georgia.

Nations: CA, US

Subnations: CT, DE, FL?, GA?, IL, IN, LB?, MA, MD, ME, MI, NB?, NC, NF?, NH, NJ, NS?, NY, OH, ON, PA, PE?, RI, SC, VA, VT, WI

TNC Ecoregions: 48:C, 56:C, 57:C, 58:C, 62:C, 63:C, 64:C

USFS Ecoregions: 212Cb:CCC, 212Db:CCC, 212Dc:CCC, 212Ec:CPP, 212Hd:CCC, 212He:CCC, 212Hi:CCP, 212Hj:CCC, 212Hw:CCP, 212Ia:CPP, 212Ja:CPP, 212Oa:CCC, 212Ob:CCC, 221Aa:CCP, 221Ab:CCC, 221Ac:CCC, 221Ad:CCP, 221Ak:CCC, 222Ia:CCC, 222If:CCC, 222Jj:CCC, 222Kg:CCC, 222Qa:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Bb:CCP, 232Bc:CCP, 232Bd:CCP, 232Bx:CCC, 232Bz:CCC, 232Cb:CCP, 232Ce:CCC, 232Ch:CCC, 232Ci:CCC, M411A:CC

Federal Lands: NPS (Acadia, Assateague Island, Boston Harbor Islands, Cape Cod, Cape Hatteras, Cape Lookout, Cumberland Island, Fire Island, Gateway, Muskeget Island, Sagamore Hill); USFS (Hiawatha, Huron-Manistee, Huron?, Manistee); USFWS (Back Bay, Cape Romain, Chesapeake Marshlands, Monomoy, Parker River, Rachel Carson)

(CEGL004400) Sea-rocket - Northern Seaside Spurge Sparse Vegetation
***Cakile edentula* ssp. *edentula* - *Chamaesyce polygonifolia* Sparse Vegetation**
North Atlantic Upper Ocean Beach

NVC Classification

Physiognomic Class	Sparse Vegetation (VII)
Physiognomic Subclass	Unconsolidated material sparse vegetation (VII.C.)
Physiognomic Group	Sparsely vegetated sand flats (VII.C.2.)
Physiognomic Subgroup	Natural/Semi-natural sparsely vegetated sand flats (VII.C.2.N.)
Formation	Sand flats (VII.C.2.N.a.)
Alliance	*Cakile edentula* Sparsely Vegetated Alliance (A.1861)
Alliance (English name)	Sea-rocket Sparsely Vegetated Alliance
Association	*Cakile edentula* ssp. *edentula* - *Chamaesyce polygonifolia* Sparse Vegetation
Association (English name)	Sea-rocket - Northern Seaside Spurge Sparse Vegetation
Association (Common name)	North Atlantic Upper Ocean Beach
Ecological System(s):	Northern Atlantic Coastal Plain Sandy Beach (CES203.301)
	Central Atlantic Coastal Plain Sandy Beach (CES203.064)

Element Concept

Global Summary: This is a sparsely vegetated upper beach community occurring on unstable sands and often gravels and cobbles just above mean high tide on maritime beaches and foredunes along the middle and northern Atlantic coast. This association occurs at the wrack line; there is regular deposition of wave-deposited flotsam. They are irregularly flooded by spring or storm tides. Vegetation cover is variable, depending on the amount of exposure to wave and wind action, but is generally sparse and characterized by annuals and biennials. Species composition can change dramatically from year to year but frequently includes *Cakile edentula ssp. edentula* (American searocket), as well as *Salsola kali ssp. kali* (Russian thistle), *Chamaesyce polygonifolia* (seaside sandmat), *Honckenya peploides* (seaside sandplant), *Cenchrus tribuloides* (sanddune sandbur), *Amaranthus retroflexus* (redroot amaranth), *Chenopodium album* (lambsquarters), *Erechtites hieraciifolia* (American burnweed), *Xanthium strumarium* (rough cockleburr), and *Atriplex cristata* (crested saltbush). Globally rare species such as *Polygonum glaucum* (seaside knotweed) and *Amaranthus pumilus* (seaside amaranth) occur in this habitat. Sparse *Ammophila breviligulata* (American beachgrass) can occur sporadically as a common associate, colonizing from the adjacent beachgrass community. Diagnostic species are *Cakile edentula ssp. edentula* (American searocket), *Salsola kali ssp. kali* (Russian thistle), *Atriplex cristata* (crested saltbush), and *Chamaesyce polygonifolia* (seaside sandmat). This community occurs in maritime coastal areas from southern Maine to Cape Hatteras, North Carolina.

Environmental Description

USFWS Wetland System:

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This sparsely vegetated upper beach community was sampled only on Cape Hatteras National Seashore. The site is a gently sloping dune with rapidly drained sand soil. The unvegetated surface is made up almost entirely of bare sand (99% cover) with some leaf litter (1%). Evidence of disturbance includes wind damage and storm overwash.

Global Environment: This association occurs on unstable sands and often gravels and cobbles just above mean high tide on beaches and foredunes washed over by spring and storm tides and impacted by wind erosion.

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: The vegetation is a sparse (20% cover) monoculture of *Cakile edentula ssp. edentula* (American searocket).

Global Vegetation: This is a sparsely vegetated association characterized by annuals and biennials. Species composition is variable, but frequently includes *Cakile edentula ssp. edentula* (American searocket), *Honckenya peploides* (seaside sandplant), *Salsola kali* (Russian thistle), *Atriplex patula* (spear saltbush), *Cenchrus tribuloides* (sanddune sandbur), *Chamaesyce polygonifolia* (seaside sandmat), *Atriplex cristata* (crested saltbush), *Xanthium strumarium* (rough cockleburr), and *Chenopodium* (goosefoot) spp. Globally rare species such as *Polygonum glaucum* (seaside knotweed) and *Amaranthus pumilus* (seaside amaranth) occur in this habitat. *Ammophila breviligulata* (American beachgrass) can occur sporadically, colonizing from the adjacent beachgrass community. Additional infrequent species can include *Chenopodium rubrum* (red goosefoot), *Chenopodium album* (lambsquarters), *Chenopodium berlandieri var. macrocalycium* (pitseed goosefoot), *Cyperus filicinus* (fern flatsedge), *Triplasis purpurea* (purple sandgrass), and *Sesuvium maritimum* (slender seapurslane). Bare substrate can comprise greater than 95% cover in this association.

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Herb (field)	Forb	*Cakile edentula* ssp. *edentula* (American searocket)

Global

Stratum	Lifeform	Species
Herb (field)	Forb	*Atriplex cristata* (crested saltbush), *Cakile edentula* ssp. *edentula* (American searocket), *Chamaesyce polygonifolia* (seaside sandmat), *Salsola kali* ssp. *kali* (Russian thistle)

Characteristic Species

Cape Hatteras National Seashore and Cape Lookout National Seashore:

Global: *Atriplex cristata* (crested saltbush), *Cakile edentula* ssp. *edentula* (American searocket), *Chamaesyce polygonifolia* (seaside sandmat), *Salsola kali* ssp. *kali* (Russian thistle)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore:

Global: *Amaranthus pumilus* (seaside amaranth), *Polygonum glaucum* (seaside knotweed)

Conservation Status Rank

Global Rank & Reasons: G4G5 (1-Dec-1997).

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments: This community is common on maritime dunes of the Northeast but is vulnerable to development and shifting wave action due to jetties. J. Harrison (pers. comm. 2006): "In the Chesapeake

Marshlands, in Maryland, a small patch of this vegetation was observed on South Marsh Island [see Observation Point CM-15]. Please note many of the associated "maritime" species are not present in the refuge. Although not as well-developed in estuarine environments, consider expanding concept to include narrow sandy shorelines on bay islands."

Global Similar Associations:

- *Cakile edentula* Great Lakes Shore Sparse Vegetation (CEGL005162)
- *Cakile edentula* ssp. *edentula* - *Mertensia maritima* Sparse Vegetation (CEGL006106)
- *Cakile edentula* ssp. *harperi* Sparse Vegetation (CEGL004401)

Global Related Concepts:

- *Cakile edentula* - *Chenopodium album* community (Metzler and Barrett 1992) =
- *Cakile edentula* ssp. *edentula* - *Salsola caroliniana* Sparse Vegetation (Bartgis 1986) =
- *Cakiletum edentula* (Conard 1935) =
- Beach (Fender 1937) =
- Beach (McDonnell 1979) =
- Beach (Higgins et al. 1971) =
- Beach community (Johnson 1985b) ?
- Beach community (Hill 1986) =
- Beach community (Baumann 1978b) =
- Beach strand community (MENHP 1991) =
- Beach vegetation (Moul 1973) =
- Coastal beach strand (Sperduto 1994) =
- Coastal beach strand community (Rawinski 1984) ?
- Dune and swale community (Stalter 1990) B
- Dune community (Jenkins 1974) =
- Dune-strand area (Clovis 1968) =
- Embryo dune (Klotz 1986) =
- Marine intertidal gravel/sand beach community (Breden 1989) =
- Marine sandy beach (Clancy 1993b) =
- Maritime beach (Reschke 1990) =
- Middle beach (Nichols 1920) =
- Middle beach (Shreve et al. 1910) =
- Pioneer beach community (Boule 1979) =
- Sea-strand vegetation, beach formation (Harshberger 1900) =

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found on Ocracoke Island.

Global Range: This association ranges from southern Maine to North Carolina.

Nations: US

States/Provinces: CT, DE, MA:S3, MD, ME, NC, NH, NJ:S1S2, NY:S5, RI, VA

TNC Ecoregions:

USFS Ecoregions: 221Ab:CCC, 221Ac:CCC, 221Ak:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Bz:CCC, 232Ch:CCC, 232Ci:CCC

Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Cape Hatteras, Fire Island, Gateway, Muskeget Island, Sagamore Hill); USFWS (Back Bay, Chesapeake Marshlands, Monomoy, Parker River)

Element Sources

Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CAHA.54.

Local Description Authors: M.J. Russo

Global Description Authors: S.L. Neid

References: Bartgis 1986, Baumann 1978b, Berdine 1998, Boule 1979, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1993b, Clovis 1968, Conard 1935, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fender 1937, Fleming et al. 2001, Gawler 2001, Gawler 2002, Godfrey et al. 1978, Harrison 2004, Harshberger 1900, Higgins et al. 1971, Hill 1986, J. Harrison pers. comm., Jenkins 1974, Johnson 1985b, Klotz 1986, MENHP 1991, McDonnell 1979, Metzler and Barrett 1992, Metzler and Barrett 2001, Moul 1973, Nichols 1920, Rawinski 1984, Reschke 1990, Schafale and Weakley 1990, Shreve et al. 1910, Sperduto 1994, Sperduto 2000a, Sperduto 2000b, Stalter 1990, Swain and Kearsley 2001

(CEGL004401) Southern Sea-rocket Sparse Vegetation

***Cakile edentula* ssp. *harperi* Sparse Vegetation**
South Atlantic Upper Ocean Beach

NVC Classification

Physiognomic Class	Sparse Vegetation (VII)
Physiognomic Subclass	Unconsolidated material sparse vegetation (VII.C.)
Physiognomic Group	Sparsely vegetated sand flats (VII.C.2.)
Physiognomic Subgroup	Natural/Semi-natural sparsely vegetated sand flats (VII.C.2.N.)
Formation	Sand flats (VII.C.2.N.a.)
Alliance	*Cakile edentula* Sparsely Vegetated Alliance (A.1861)
Alliance (English name)	Sea-rocket Sparsely Vegetated Alliance
Association	*Cakile edentula* ssp. *harperi* Sparse Vegetation
Association (English name)	Southern Sea-rocket Sparse Vegetation
Association (Common name)	South Atlantic Upper Ocean Beach
Ecological System(s):	Southern Atlantic Coastal Plain Beach (CES203.535)
	Atlantic Coastal Plain Sea Island Beach (CES203.383)

Element Concept

Global Summary: This association is a southern Atlantic Coast upper ocean beach community. It occupies the upper portion of ocean beaches in the southern part (Cape Hatteras, North Carolina, to Cape Romain, South Carolina) of the microtidal region (barrier islands with coastal geomorphology dominated by hurricane overwash rather than tidal energy), as well as vegetation further south to Volusia County, Florida. Characteristic species include mostly annual herbs, such as *Cakile edentula ssp. harperi* (Harper's searocket), *Chamaesyce polygonifolia* (seaside sandmat), *Chamaesyce bombensis* (dixie sandmat), *Sesuvium portulacastrum* (shoreline seapurslane), *Salsola kali ssp. kali* (Russian thistle), and *Amaranthus pumilus* (seaside amaranth).

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species

Global

Stratum	Lifeform	Species
Herb (field)	Forb	*Cakile edentula* ssp. *harperi* (Harper's searocket)

Characteristic Species

Cape Hatteras National Seashore and Cape Lookout National Seashore:

Global: *Cakile edentula* ssp. *harperi* (Harper's searocket)

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore:

Global: *Amaranthus pumilus* (seaside amaranth), *Cakile edentula* ssp. *harperi* (Harper's searocket), *Caretta caretta* (loggerhead), *Charadrius melodus* (piping plover), *Dermochelys coriacea* (leatherback)

Conservation Status Rank

Global Rank & Reasons: G3 (23-Jan-2000). This community occurs in narrow linear bands along the oceanward side of barrier islands and barrier spits. It is a very dynamic community, altered by regular and catastrophic storm events. Total areal extent is small; a rough calculation of potential extent (20 m wide by 200 kilometers long) suggests maximum total area as about 400 hectares (1000 acres), much of which is degraded. Community composition, structure, and function are affected detrimentally by development, beach vehicular traffic, and heavy recreational use that occur at most sites. Beach "replenishment" also alters this community extensively, and may improve or maintain some functions, while destroying or degrading others.

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments:

Global Similar Associations:

- *Cakile edentula* ssp. *edentula* - *Chamaesyce polygonifolia* Sparse Vegetation (CEGL004400)

Global Related Concepts:

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Presumably found on Cape Lookout National Seashore.

Global Range: This association occupies the upper portion of ocean beaches in the southern part (Cape Hatteras, North Carolina to Cape Romain, South Carolina) of the microtidal region (barrier islands with coastal geomorphology dominated by hurricane overwash rather than tidal energy). It may extend south to Volusia County, Florida

Nations: US

States/Provinces: FL?, GA?, NC, SC

TNC Ecoregions:

USFS Ecoregions: 232Cb:CCP, 232Ce:CCC, 232Ci:CCC

Federal Lands: NPS (Cape Lookout, Cumberland Island); USFWS (Cape Romain)

Element Sources
Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: None.

Local Description Authors:

Global Description Authors: A.S. Weakley

References: Nelson 1986, Peet et al. unpubl. data 2002, Schafale and Weakley 1990, Southeastern Ecology Working Group n.d.

Tidal Sand Flats (VII.C.2.N.d)

Sesuvium ssp. – Atriplex spp. – Suaeda spp. Tidal Sparsely Vegetated Alliance (A.1868)

Alliance Concept
Summary: This alliance tends to occur on the backside of the ends of barrier islands and is irregularly flooded but does not accumulate salt like *Salicornia* (pickleweed) or *Distichlis* (saltgrass) (maybe should be in separate formation). Physiognomy tends to be of scattered mound-like clumps of vegetation (mostly *Sesuvium portulacastrum* (shoreline seapurslane)) in a wet sand flat.

Classification Comments: This alliance will need revision, and possibly splitting, when more information is available.

Similar Alliances:

Similar Alliance Comments:

Related Concepts:

- Salt Flat (Nelson 1986) I
- Upper Beach (Schafale and Weakley 1990) I

Alliance Description
Environment: This alliance tends to occur on the backside of the ends of barrier islands and is irregularly flooded but does not accumulate salt like *Salicornia* or *Distichlis*.

Vegetation:

Dynamics:

Alliance Distribution

Range: This alliance is probably found on coastal barrier islands from Delaware to Mississippi, but it is not verified from all states in this potential range.

Nations: US

Subnations: AL, DE, FL, GA?, MD, MS?, NC, SC, VA

TNC Ecoregions: 53:C, 55:C, 56:P, 57:C, 58:C, 62:C

USFS Ecoregions: 232Ac:CCC, 232Ci:CCC, 232Dd:CCC, 232Gb:CCC

Federal Lands: NPS (Assateague Island, Canaveral, Cape Lookout); USFWS (Back Bay?, Bon Secour, Prime Hook)

(CEGL004406) Shoreline Sea-purslane - Saltbush species - Sea-blite species Sparse Vegetation
***Sesuvium portulacastrum* - *Atriplex* spp. - *Suaeda* spp. Sparse Vegetation**
Coastal Bay Shore / Succulent Beach

NVC Classification

Physiognomic Class	Sparse Vegetation (VII)
Physiognomic Subclass	Unconsolidated material sparse vegetation (VII.C.)
Physiognomic Group	Sparsely vegetated sand flats (VII.C.2.)
Physiognomic Subgroup	Natural/Semi-natural sparsely vegetated sand flats (VII.C.2.N.)
Formation	Tidal sand flats (VII.C.2.N.d.)
Alliance	*Sesuvium* spp. - *Atriplex* spp. - *Suaeda* spp. Tidal Sparsely Vegetated Alliance (A.1868)
Alliance (English name)	Sea-purslane species - Saltbush species - Sea-blite species Tidal Sparsely Vegetated Alliance
Association	*Sesuvium portulacastrum* - *Atriplex* spp. - *Suaeda* spp. Sparse Vegetation
Association (English name)	Shoreline Sea-purslane - Saltbush species - Sea-blite species Sparse Vegetation
Association (Common name)	Coastal Bay Shore / Succulent Beach
Ecological System(s):	Florida Panhandle Beach Vegetation (CES203.266)
	Northern Atlantic Coastal Plain Sandy Beach (CES203.301)
	Central Atlantic Coastal Plain Sandy Beach (CES203.064)

Element Concept

Global Summary: This association represents irregularly flooded beach vegetation along the Atlantic and northern Gulf of Mexico coasts. Examples tend to occur on the back side of the ends of barrier islands; where they are only irregularly flooded. In contrast to *Salicornia* (pickleweed)- or *Distichlis* (saltgrass)-dominated areas they apparently accumulate less salt. Its physiognomy tends to be of scattered mound-like clumps of vegetation (mostly *Sesuvium portulacastrum* (shoreline seapurslane)) in a wet sand flat.

Environmental Description

USFWS Wetland System: Estuarine

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This sparsely vegetated beach community was sampled only on Cape Lookout National Seashore. Soil is well-drained sand. The unvegetated surface is made up entirely of bare sand (100% cover). Evidence of disturbance includes wind and wave processes and horse grazing.

Global Environment: This vegetation tends to occur on the back side of the ends of barrier islands; it is irregularly flooded by wind and storm tides, but does not accumulate salt like *Salicornia*- or *Distichlis*-dominated areas. It is especially prevalent on low-energy, protected shorelines.

Vegetation Description

Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: The very sparse vegetation (10% cover) consists of state-vulnerable *Sesuvium portulacastrum* (shoreline seapurslane) and *Spartina patens* (saltmeadow cordgrass).

Global Vegetation: Vegetation consists of widely scattered to fairly continuous mats of various succulent species, including most characteristically *Sesuvium portulacastrum* (shoreline seapurslane), *Sesuvium maritimum* (slender seapurslane), *Atriplex patula* (spear saltbush), and *Suaeda linearis* (annual seepweed). Other species which may occur are *Spartina patens* (saltmeadow cordgrass), *Panicum amarum* (bitter panicgrass), *Vigna luteola* (hairypod cowpea), *Ipomoea imperati* (beach morning-glory), *Ipomoea sagittata* (saltmarsh morning-glory), *Sporobolus virginicus* (seashore dropseed), and *Cyperus* (flatsedge) sp.

Most Abundant Species

Cape Hatteras National Seashore and Cape Lookout National Seashore

Stratum	Lifeform	Species
Herb (field)	Forb	*Sesuvium portulacastrum* (shoreline seapurslane)
Herb (field)	Graminoid	*Spartina patens* (saltmeadow cordgrass)

Global

Stratum	Lifeform	Species

Other Noteworthy Species

Cape Hatteras National Seashore and Cape Lookout National Seashore: *Sesuvium portulacastrum* (shoreline seapurslane)

Global: *Amaranthus pumilus* (seaside amaranth)

Element Distribution

Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found on the southeastern side of Shackleford Banks.

Global Range: This community occurs along the Atlantic coast and portions of the northern Gulf of Mexico, from Delaware to Mississippi, but it is not verified from all states in this potential range.

Nations: US

States/Provinces: AL, DE, FL, GA?, MD, MS?, NC, SC, VA

TNC Ecoregions:

USFS Ecoregions: 232Ac:CCC, 232Ci:CCC, 232Dd:CCC, 232Gb:CCC

Federal Lands: NPS (Assateague Island, Canaveral, Cape Lookout); USFWS (Back Bay?, Bon Secour, Prime Hook)

Element Sources
Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: CALO.38.

Local Description Authors: M.J. Russo

Global Description Authors: Southeastern Ecology Group

References: Fleming et al. 2001, Harrison 2004, Harrison and Stango 2003, Lea 2002b, Nelson 1986, Schafale and Weakley 1990, Schotz pers. comm., Southeastern Ecology Working Group n.d.

No Alliance Placement

(CEGL006615) Japanese Sedge Herbaceous Vegetation
***Carex kobomugi* Herbaceous Vegetation**
Japanese Sedge Maritime Dunes

NVC Classification

Association	*Carex kobomugi* Herbaceous Vegetation
Association (English name)	Japanese Sedge Herbaceous Vegetation
Association (Common name)	Japanese Sedge Maritime Dunes

Ecological System(s):

Element Concept
Global Summary: This semi-natural community is dominated by the non-native sedge *Carex kobomugi* (Japanese sedge) that invades and overtakes coastal sand dunes dominated by *Ammophila breviligulata* (American beachgrass) and/or *Panicum amarum var. amarum* (bitter panicgrass). It is reported along the central New Jersey coast and at First Landing/Seashore State Park in Virginia.

Environmental Description
USFWS Wetland System:

Cape Hatteras National Seashore and Cape Lookout National Seashore Environment: This semi-natural community is found on coastal dunes and swales at the campground north of Oregon Inlet (Stalter and Lamont 1997).

Global Environment: This association occurs on coastal sand dunes with sandy, unstable, droughty substrates with no soil profile development. Eolian processes cause active sand deposition and erosion. The sand substrate is usually visible, and litter accumulation from plant debris is nearly absent. This community generally occurs on foredunes that receive the force of wind and salt spray, but it is beyond the influence of most storm tides.

Vegetation Description
Cape Hatteras National Seashore and Cape Lookout National Seashore Vegetation: Coastal dunes and swales (Stalter and Lamont 1997).

Global Vegetation: *Carex kobomugi* (Japanese sedge), a non-native invasive sedge that spreads by rhizome growth, dominates the vegetation. This sedge overtakes maritime dune grasslands dominated by *Ammophila breviligulata* (American beachgrass) or *Panicum amarum var. amarum* (bitter panicgrass). Associated species in New Jersey

include *Solidago sempervirens* (seaside goldenrod), *Artemisia campestris* (field sagewort), and scattered shrubs such as *Prunus maritima* (beach plum) and/or *Morella pensylvanica* (northern bayberry).

Conservation Status Rank
Global Rank & Reasons: GNA (invasive) (15-Mar-2007). Non-native invasive association not of conservation concern.

Classification
Status: Nonstandard

Classification Confidence: 3 - Weak

Cape Hatteras National Seashore and Cape Lookout National Seashore Comments:

Global Comments:

Global Similar Associations:

- *Ammophila breviligulata - Panicum amarum* var. *amarum* Herbaceous Vegetation (CEGL004043)--is the community *Carex kobomugi* successfully invades and overtakes in New Jersey.

Global Related Concepts:

Element Distribution
Cape Hatteras National Seashore and Cape Lookout National Seashore Range: Found on coastal dunes and swales at the campground north of Oregon Inlet (Stalter and Lamont 1997), on Bodie Island.

Global Range: Relatively large (>0.5 ha) occurrences of this invasive association are reported in coastal sand dunes in central New Jersey, and one mappable occurrence is reported in Virginia. *Carex kobomugi* is also reported to the north and south along the Atlantic Coast in Massachusetts, Rhode Island, Delaware, Maryland, Virginia and North Carolina.

Nations: US

States/Provinces: NC, NJ, VA

TNC Ecoregions:

USFS Ecoregions: 232Ab:CCC, 232Ac:CCC, 232Ci:CCC

Federal Lands: NPS (Cape Hatteras, Gateway)

Element Sources
Cape Hatteras National Seashore and Cape Lookout National Seashore Inventory Notes:

Cape Hatteras National Seashore and Cape Lookout National Seashore Plots: None.

Local Description Authors: C.W. Nordman

Global Description Authors: E. Largay

References: Eastern Ecology Working Group n.d., Martin 1959a, Small 1954, Stalter 1980, Stalter and Lamont 1997, Wootton et al. 2005

Bibliography

Adams, D. A. 1963. Factors influencing vascular plant zonation in North Carolina salt marshes. Ecology 44:445-456.

Allard, D. J. 1990. Southeastern United States ecological community classification. Interim report, Version 1.2. The Nature Conservancy, Southeast Regional Office, Chapel Hill, NC. 96 pp.

Ambrose, J. 1990a. Georgia's natural communities--A preliminary list. Unpublished document. Georgia Natural Heritage Inventory. 5 pp.

Au, S. 1974. Vegetation and ecological processes on Shackleford Bank, North Carolina. USDI National Park Service, Scientific Monograph No. 6.

Barry, J. F. 1980. Natural vegetation of South Carolina. University of South Carolina Press, Columbia. 214 pp.

Bartgis, R. 1986. Natural community descriptions. Unpublished draft. Maryland Natural Heritage Program, Maryland Department of Natural Resources, Annapolis.

Baumann, C. 1978b. The effects of overwash on the vegetation of a Virginia barrier island. M.A. thesis. College of William and Mary, Williamsburg, VA. 104 pp.

Bell, R., M. Chandler, R. Buchsbaum, and C. Roman. 2002. Inventory of intertidal habitats: Boston Harbor Islands, a National Park area. Technical Report NPS/NERBOST/NRTR-2004/1. USDI National Park Service, Northeast Region, Boston, MA. 13 pp.

Bellis, V. J. 1992. Floristic continuity among the maritime forests of the Atlantic Coast of the United States. Pages 21-29 in: C. A. Cole and F. K. Turner, editors. Barrier island ecology of the mid-Atlantic Coast: A symposium. Technical Report NPS/SERCAHA/NRTR-93/04.

Berdine, M. A. 1998. Maryland vegetation classification. Maryland Department of Natural Resources, Annapolis, MD.

Bertness, M. D., L. Gough, and S. W. Shumway. 1992. Salt tolerances and the distribution of fugitive salt marsh plants. Ecology 73(5):1842-1851.

Boule, M. E. 1979. The vegetation of Fisherman Island, Virginia. Castanea 44:98-108.

Bourdeau, P. F., and H. J. Oosting. 1959. The maritime live oak forest in North Carolina. Ecology 40:148-152.

Bowman, P. 2000. Draft classification for Delaware. Unpublished draft. Delaware Natural Heritage Program.

Bratton, S. P., and K. Davison. 1987. Disturbance and succession in Buxton Woods, Cape Hatteras, North Carolina. Castanea 52:166-179.

Breden, T. F. 1989. A preliminary natural community classification for New Jersey. Pages 157-191 in: E. F. Karlin, editor. New Jersey's rare and endangered plants and animals. Institute for Environmental Studies, Ramapo College, Mahwah, NJ. 280 pp.

Breden, T. F., Y. R. Alger, K. S. Walz, and A. G. Windisch. 2001. Classification of vegetation communities of New Jersey: Second iteration. Association for Biodiversity Information and New Jersey Natural Heritage Program, Office of Natural Lands Management, Division of Parks and Forestry, New Jersey Department of Environmental Protection, Trenton.

Brown, C. A. 1959. Vegetation of the Outer Banks of North Carolina. Louisiana State University Studies, Coastal Studies Series No. 4. Louisiana State University Press, Baton Rouge. 179 pp.

Brush, G. S., C. Lenk, and J. Smith. 1980. The natural forests of Maryland: An explanation of the vegetation map of Maryland. Ecological Monographs 50:77-92.

Clampitt, C. A. 1991. The upland plant communities of Seashore State Park, Virginia Beach, Virginia. Virginia Journal of Science 42:419-435.

Clancy, K. 1993a. Selected rare and historical vascular plants of Delaware. Bartonia 57:75-92.

Clancy, K. 1993b. A preliminary classification of the natural communities of Delaware. Unpublished draft, Delaware Natural Heritage Inventory, Division of Parks and Recreation, Dover. 30 pp.

Clancy, K. 1996. Natural communities of Delaware. Unpublished review draft. Delaware Natural Heritage Program, Division of Fish and Wildlife, Delaware Division of Natural Resources and Environmental Control, Smyrna, DE. 52 pp.

Clovis, J. F. 1968. The vegetation of Smith Island, Virginia. Castanea 33:115-121.

Conard, H. S. 1935. The plant associations of central Long Island. The American Midland Naturalist 16:433-516.

Cooper, A. S. 1974. Salt marshes. In: H. T. Odum and B. J. Copeland, editors. Coastal Ecological Systems of the United States. II. The Conservation Foundation, Washington, DC.

Cooper, A. W., and E. D. Waits. 1973. Vegetation types in an irregularly flooded salt marsh on the North Carolina Outer Banks. Journal of the Elisha Mitchell Scientific Society 89:78-91.

Coulling, P. P. 2002. A preliminary classification of tidal marsh, shrub swamp, and hardwood swamp vegetation and assorted non-tidal, chiefly non-maritime, herbaceous wetland communities of the Virginia Coastal Plain. October 2002. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Natural Heritage Technical Report 02-18. 30 pp.

Coulling, Phil. Personal communication. Vegetation Ecologist. Department of Conservation & Recreation, 217 Governor St., Richmond, VA 23219.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, Biological Service Program. FWS/OBS-79/31. Washington, DC. 103 pp.

Daiber, F. C., L. L. Thornton, K. A. Bolster, T. G. Campbell, O. W. Crichton, G. L. Esposito, D. R. Jones, and J. M. Tyrawski. 1976. An atlas of Delaware's wetlands and estuarine resources. College of Marine Studies, University of Delaware, Newark. 528 pp.

Diamond, D. D. 1993. Classification of the plant communities of Texas (series level). Unpublished document. Texas Natural Heritage Program, Austin. 25 pp.

Dowhan, J. J., and R. Rozsa. 1989. Flora of Fire Island, Suffolk Country, New York. Bulletin of the Torrey Botanical Club 116:265-282.

Eastern Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe, Boston, MA.

Edinger, G. J., D. J. Evans, S. Gebauer, T. G. Howard, D. M. Hunt, and A. M. Olivero, editors. 2002. Ecological communities of New York state. Second edition. A revised and expanded edition of Carol Reschke's ecological communities of New York state. (Draft for review). New York Natural Heritage Program, New York State Department of Environmental Conservation, Albany, NY.

Eleuterius, L. N., and C. K. Eleuterius. 1979. Tide levels and salt marsh zonation. Bulletin of Marine Science 29:394-400.

Eleuterius, L. N., and J. D. Caldwell. 1984. Flowering phenology of tidal marsh plants in Mississippi. Castanea 49:172-179.

Enser, R. 1999. Natural communities of Rhode Island. Unpublished draft, December 1999. 22 pp.

Eyre, F. H., editor. 1980. Forest cover types of the United States and Canada. Society of American Foresters, Washington, DC. 148 pp.

FNAI [Florida Natural Areas Inventory]. 1990. Guide to the natural communities of Florida. Florida Natural Areas Inventory and Florida Department of Natural Resources, Tallahassee. 111 pp.

FNAI [Florida Natural Areas Inventory]. 1992a. Natural communities. Unpublished document. The Nature Conservancy, Florida Natural Areas Inventory, Tallahassee. 6 pp.

FNAI [Florida Natural Areas Inventory]. 1992b. Natural community classification. Unpublished document. The Nature Conservancy, Florida Natural Areas Inventory, Tallahassee. 16 pp.

Fender, F. S. 1937. The flora of Seven Mile Beach, New Jersey. Bartonia 19:23-41.

Fleming, G. P. 1998. Virginia natural community framework, version January 30, 1998. Unpublished document. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond. 6 pp.

Fleming, G. P. 2001. Community types of Coastal Plain calcareous ravines in Virginia. Preliminary analysis and classification. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. 4 pp.

Fleming, G. P., P. P. Coulling, D. P. Walton, K. M. McCoy, and M. R. Parrish. 2001. The natural communities of Virginia: Classification of ecological community groups. First approximation. Natural Heritage Technical Report 01-1. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. Unpublished report. January 2001. 76 pp.

Fleming, Gary P. Personal communication. Ecologist, Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

Fleming, L. M. 1978. Delaware's outstanding natural areas and their preservation. Delaware Nature Education Society, Inc., Hockessin, DE. 422 pp.

Gawler, S. C. 2001. Natural landscapes of Maine: Natural community profiles. Open (non-forested) types. Final review draft, July 2001. Maine Natural Areas Program. Department of Conservation. Augusta, ME.

Gawler, S. C. 2002. Natural landscapes of Maine: A guide to vegetated natural communities and ecosystems. Maine Natural Areas Program, Department of Conservation, Augusta, ME. [in press]

Godfrey, P. J., M. Benedict, and M. Soukup. 1978. A guide to the ecology of Cape Cod National Seashore (Mary 1978 draft). National Park Service Cooperative Research Unit, Institute for Man and Environment, University of Massachusetts, Amherst, MA .

Good, R. E. 1965. Salt marsh vegetation, Cape May, New Jersey. Bulletin of the New Jersey Academy of Science 10:1-11.

Graetz, K. E. 1973. Seacoast plants of the Carolinas for conservation and beautification. U.S. Department of Agriculture and Soil Conservation Service, Raleigh, NC, and Columbia, SC.

Hackney, C. T., and A. A. de la Cruz. 1981. Effects of fire on brackish marsh communities: Management implications. Wetlands (81-09):75-86.

Hackney, C. T., and A. A. de la Cruz. 1982. The structure and function of brackish marshes in the north central Gulf of Mexico: A ten year case study. Pages 89-107 in: B. Gopal et al., editors. Wetlands ecology and management. National Institute of Ecology. International Science Publication, Jaipur, India.

Harrison, J. W. 2001. Herbaceous tidal wetland communities of Maryland's eastern shore: Identification, assessment and monitoring. Report submitted to the U.S. EPA (Clean Water

Act 1998 State Wetlands Protection Development Grant Program). Biodiversity Program, Maryland Department of Natural Resources, Wildlife and Heritage Division. 30 June 2001. [U.S. EPA Reference Wetland Natural communities of Maryland's Herbaceous Tidal Wetlands Grant #CD993724].

Harrison, J. W., and P. Stango, III. 2003. Shrubland tidal wetland communities of Maryland's Eastern Shore: Identification, assessment and monitoring. Maryland Natural Heritage Program, Maryland Department of Natural Resources, Annapolis. 118 pp.

Harrison, J. W., compiler. 2004. Classification of vegetation communities of Maryland: First iteration. A subset of the International Classification of Ecological Communities: Terrestrial Vegetation of the United States, NatureServe. Maryland Natural Heritage Program, Maryland Department of Natural Resources, Annapolis. 243 pp.

Harrison, Jason W. Personal communication. State Community Ecologist, Maryland Wildlife and Heritage Division, Department of Natural Resources, Tawes State Office Building, E-1, Annapolis, MD 21401.

Harshberger, J. W. 1900. An ecological study of the New Jersey strand flora. Proceedings of the Academy of Natural Science Philadelphia 52:623-671.

Harvill, A. M., Jr. 1965. The vegetation of Parramore Island, Virginia. Castanea 30:226-228.

Harvill, A. M., Jr. 1967. The vegetation of Assateague Island, Virginia. Castanea 32:105-108.

Higgins, E. A. T., R. D. Rappleye, and R. G. Brown. 1971. The flora and ecology of Assateague Island. University of Maryland Experiment Station Bulletin A-172. 70 pp.

Hill, S. R. 1986. An annotated checklist of the vascular flora of Assateague Island (Maryland and Virginia). Castanea 5:265-305.

Jenkins, D. 1974. Natural areas of the Chesapeake Bay region: Ecological priorities. Smithsonian Institute, Ecology Program, Center for Natural Areas Ecology.

Johnson, A. F. 1985b. A guide to the plant communities of the Napeague Dunes, Long Island, New York. Mad Printers, Mattituck, NY. 58 pp. plus plates.

Johnson, A. F. 1997. Rates of vegetation succession on a coastal dune system in northwest Florida. Journal of Coastal Research 13:373-384.

Johnson, A. F., J. W. Muller, and K. A. Bettinger. 1992a. An assessment of Florida's remaining coastal upland natural communities: Panhandle. The Nature Conservancy, Florida Natural Areas Inventory, Tallahassee. 12 pp. plus appendices.

Johnson, Ann F. Personal communication. Florida Natural Areas Inventory, Tallahassee.

Klemas, V., F. C. Daiber, D. S. Bartlett, O. W. Crichton, and A. O. Fornes. 1973. Coastal vegetation of Delaware. University of Delaware, College of Marine Studies. 27 pp.

Klotz, L. H. 1986. The vascular flora of Wallops Island and Wallops Mainland, Virginia. Castanea 51:306-326.

Kruczynski, W. L., C. B. Subrahmanyam, and S. H. Drake. 1978. Studies on the plant community of a north Florida salt marsh. Bulletin of Marine Science 28:707-715.

LeGrand, H. E., Jr., C. C. Frost, and J. O. Fussell, III. 1992. Regional inventory for critical natural areas, wetland ecosystems, and endangered species habitats of the Albemarle-Pamlico estuarine region: Phase 2. North Carolina Department of Environment, Health, and Natural Resources, Division of Parks and Recreation, Natural Heritage Program, Raleigh. 506 pp.

Lea, C. 2002b. Vegetation classification of Assateague Island National Seashore, Addendum (version 2) - March 1, 2002. Unpublished draft. National Park Service. 31 pp.

Lonard, R. I., and F. W. Judd. 1980. Phytogeography of South Padre Island, Texas. Southwestern Naturalist 25:313-322.

Lynch, J. J. 1941. The place of burning in management of Gulf Coast wildlife refuges. Journal of Wildlife Management 5:454-457.

MENHP [Maine Natural Heritage Program]. 1991. Natural landscapes of Maine: A classification of ecosystems and natural communities. Unpublished document. Office of Comprehensive Planning, Maine Natural Heritage Program, Augusta. 77 pp.

Martin, N. D. 1959a. An analysis of forest succession in Algonquin Park, Ontario. Ecological Monographs 29(3):187-218.

Martin, W. E. 1959b. The vegetation of Island Beach State Park, New Jersey. Ecological Monographs 29:1-46.

McAlister, W. H., and M. K. McAlister. 1993. A naturalist's guide: Matagorda Island. University of Texas Press, Austin. 354 pp.

McAlister, W. H., and M. K. McAlister. 1995. A naturalist's guide: Aransas. University of Texas Press, Austin. 354 pp.

McDonnell, M. J. 1979. The flora of Plum Island, Essex County, Massachusetts. University of New Hampshire, Agricultural Experiment Station. Station Bulletin No. 513. Durham, NH. 110 pp.

Metzler, K. J., and J. Barrett. 1992. Connecticut community classification. Unpublished draft. Connecticut Department of Environmental Protection, Natural Resources Center, Natural Diversity Database, Hartford.

Metzler, K. J., and J. P. Barrett. 2001. Vegetation classification for Connecticut. Draft 5/21/2001. Connecticut Department of Environmental Protection, Natural Resources Center, Natural Diversity Database, Hartford.

Metzler, K., and J. Barrett. 1996. Vegetation classification for Connecticut organized into the modified UNESCO hierarchy. Unpublished review draft. Connecticut Natural Diversity Database. Hartford, CT. 48 pp.

Miller, W. R., and F. E. Egler. 1950. Vegetation of the Wequetequock-Pawcatuck tidal-marshes, Connecticut. Ecological Monographs 20:143-172.

Montague, C. L., and R. G. Wiegert. 1990. Salt marshes. Pages 481-516 in: R. L. Myers and J. J. Ewel, editors. Ecosystems of Florida. University of Central Florida Press, Orlando.

Moul, E. T. 1973. Marine flora and fauna of the northeastern United States: Higher plants of the marine fringe. USDC National Oceanographic and Atmospheric Administration. Technical Report NMFS CIRC-384. Seattle, WA. 61 pp.

NRCS [Natural Resources Conservation Service]. 2001b. Soil survey of Gateway National Recreation Area, New York and New Jersey. USDA Natural Resources Conservation Service and USDI National Park Service, Gateway National Recreation Area in partnership with Cornell University Agricultural Experiment Station and New York City Soil and Water Conservation District.

Nelson, J. B. 1986. The natural communities of South Carolina: Initial classification and description. South Carolina Wildlife and Marine Resources Department, Division of Wildlife and Freshwater Fisheries, Columbia, SC. 55 pp.

Nichols, G. E. 1920. The vegetation of Connecticut: III. The associations of depositing areas along the seacoast. Bulletin of the Torrey Botanical Club 47:511-548.

Nicholson, W. R., and R. D. Van Deusen. 1954. Marshes of Maryland. Maryland Game and Inland Fish Commission. Resource Study Report No. 6. Baltimore, MD.

Niering, W. A., and R. S. Warren. 1977. Our dynamic tidal marshes: Vegetation changes as revealed by peat analysis. The Connecticut Arboretum Bulletin 22.

Niering, W. A., and R. S. Warren. 1980. Vegetation patterns and processes in New England salt marshes. Bioscience 30:301-307.

Odum, W. E., T. J. Smith, III, J. K. Hoover, and C. C. McIvor. 1984. The ecology of tidal freshwater marshes of the United States east coast: A community profile. USDI Fish & Wildlife Service. FWS/OBS-83/17. 176 pp.

Peet, R. K., T. R. Wentworth, M. P. Schafale, and A.S. Weakley. 2002. Unpublished data of the North Carolina Vegetation Survey. University of North Carolina, Chapel Hill.

Penfound, W. T. 1952. Southern swamps and marshes. Botanical Review 7:413-446.

Rawinski, T. 1984. Natural community description abstract - southern New England calcareous seepage swamp. Unpublished report. The Nature Conservancy, Boston, MA. 6 pp.

Redfield, A. C. 1972. Development of a New England salt marsh. Ecological Monographs 42(2):201-237.

Reschke, C. 1990. Ecological communities of New York State. New York Natural Heritage Program. New York State Department of Environmental Conservation. Latham, NY. 96 pp.

Saltonstall, K. 2002. Cryptic invasion by a non-native genotype of the common reed, Phragmites australis, into North America. Proceedings of the National Academy of Science 99:2445-2449.

Sauer, J. D. 1967. Geographic reconnaissance of seashore vegetation along the Mexican Gulf Coast. Louisiana State University Press, Coastal Studies Series No. 21, Baton Rouge.

Schafale, M. 2000. Fourth approximation guide. Coastal Plain. January 2000 draft. North Carolina Natural Heritage Program, Raleigh.

Schafale, M. 2003b. Fourth approximation guide. Coastal Plain communities. March 2003 draft. North Carolina Natural Heritage Program, Raleigh.

Schafale, M. P., and A. S. Weakley. 1990. Classification of the natural communities of North Carolina. Third approximation. North Carolina Department of Environment, Health, and Natural Resources, Division of Parks and Recreation, Natural Heritage Program, Raleigh. 325 pp.

Schafale, Mike P. Personal communication. Ecologist, North Carolina Department of Environment, Health, and Natural Resources, Division of Parks and Recreation, Natural Heritage Program, Raleigh.

Schotz, Al. Personal communication. Community Ecologist. Alabama Natural Heritage Program. Huntingdon College, Massey Hall, 1500 East Fairview Avenue, Montgomery, AL 36106-2148.

Sharitz, R. R. 1975. Forest communities of Kiawah Island. Pages F1-F39 in: W. M. Campbell, J. M. Dean, and W. D. Chamberlain, editors. Environmental inventory of Kiawah Island. Environmental Research Center, Inc., Columbia, SC.

Shreve, F., M. A. Chrysler, F. H. Blodgett, and F. W. Besley. 1910. The plant life of Maryland. Maryland Weather Service. Special Publication, Volume III. Johns Hopkins Press. Baltimore, MD.

Small, J. A. 1954. Carex kobomugi at Island Beach, New Jersey. Ecology 35:289-291.

Smith, L. M., compiler. 1996a. Natural plant communities in Louisiana currently recognized by the Louisiana Natural Heritage Program. Unpublished document. Louisiana Department of Wildlife and Fisheries, Natural Heritage Program, Baton Rouge. 2 pp.

Sneddon, L. A., K. J. Metzler, and M. Anderson. 1995. A classification and description of natural community alliances and selected community elements of the Delaware Estuary. In:

L. E. Dove and R. M. Nyman, editors. Living resources of the Delaware Estuary. The Delaware Estuary Program. 530 pp. plus appendices.

Southeastern Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe, Durham, NC.

Sperduto, D. 1994. A classification of the natural communities of New Hampshire. April 1994 approximation. Unpublished document. New Hampshire Natural Heritage Inventory, Department of Resources and Economic Development, Concord, NH. 45 pp. plus appendices.

Sperduto, D. D. 2000a. Natural communities of New Hampshire: A guide and classification. Near final unformatted draft without pictures and illustrations; includes upland classification. New Hampshire Natural Heritage Inventory, DRED Division of Forests and Lands, Concord, NH. 127 pp.

Sperduto, D. D. 2000b. A classification of wetland natural communities in New Hampshire. New Hampshire Natural Heritage Inventory, Department of Resources and Economic Development, Division of Forests and Lands. Concord, NH. 156 pp.

Stalter, R. 1973a. The flora of Turtle Island, Jasper Co., South Carolina. Castanea 38:35-37.

Stalter, R. 1973b. Factors influencing the distribution of vegetation of the Cooper River Estuary. Castanea 38:18-24.

Stalter, R. 1980. Carex kobomugi Ohwi at Sandy Hook, New Jersey. Bulletin of the Torrey Botanical Club 107:431-432.

Stalter, R. 1990. The vascular flora of Assateague Island, Virginia. Bulletin of the Torrey Botanical Club 117:48-56.

Stalter, R., and E. E. Lamont. 1990. The vascular flora of Assateague Island, Virginia. Bulletin of the Torrey Botanical Club 117:48-56.

Stalter, R., and E. E. Lamont. 1997. Flora of North Carolina's Outer Banks, Ocracoke Island to Virginia. Journal of the Torrey Botanical Society 124(1):71-88.

Stout, J. P. 1984. The ecology of irregularly flooded salt marshes of the northeastern Gulf of Mexico: A community profile. USDI Fish and Wildlife Service, Minerals Management Service. Biological Report 85 (7.1). 98 pp.

Swain, P. C., and J. B. Kearsley. 2001. Classification of natural communities of Massachusetts. September 2001 draft. Natural Heritage and Endangered Species Program, Massachusetts Division of Fisheries and Wildlife. Westborough, MA.

TNC [The Nature Conservancy]. 1995c. NBS/NPS Vegetation Mapping Program: Vegetation classification of Assateague Island National Seashore. Unpublished report. The Nature Conservancy, Eastern Regional Office, Boston, MA.

Tiner, R. W., Jr. 1984. Wetlands of the United States: Current status and recent trends. USDI Fish and Wildlife Service, National Wetlands Inventory 59 pp.

Tiner, R. W., Jr. 1985a. Wetlands of Delaware. Cooperative publication of USDI Fish & Wildlife Service, National Wetlands Inventory, Newton Corner, MA, and Delaware Department of Natural Resources and Environmental Control, Dover, DE. 77 pp.

Tiner, R. W., Jr. 1985b. Wetlands of New Jersey. USDI Fish & Wildlife Service, National Wetlands Inventory, Newton Corner, MA. 117 pp.

Travis, R. W., and P. J. Godfrey. 1976. Interactions of plant communities and oceanic overwash on the manipulated barrier islands of Cape Hatteras National Seashore, North Carolina. Pages 777-780 in: Proceedings of the First Conference on Scientific Research in the National Parks, Volume II.

VDNH [Virginia Division of Natural Heritage]. 2003. The natural communities of Virginia: Hierarchical classification of community types. Unpublished document, working list of November 2003. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Ecology Group, Richmond.

Weakley, A. S., compiler. 1993. Natural Heritage Program list of the rare plant species of North Carolina. North Carolina Department of Environment, Health, and Natural Resources, Division of Parks and Recreation, Natural Heritage Program. Raleigh. 79 pp.

Webber, E. E. 1967. Bluegreen algae from a Massachusetts salt marsh. Bulletin of the Torrey Botanical Club 94:99-106.

Wells, B. W. 1939. A new forest climax: The salt spray climax of Smith Island, N.C. Bulletin of the Torrey Botanical Club 66:629-634.

Wells, B. W., and I. V. Shunk. 1938. Salt spray: An important factor in coastal ecology. Bulletin of the Torrey Botanical Club 65:485-492.

Wentworth, T. R., M. P. Schafale, A. S. Weakley, R. K. Peet, P. S. White, and C. C. Frost. 1993. A preliminary classification of North Carolina barrier island forests. Pages 31-46 in: C. A. Cole and F. K. Turner, editors. Barrier island ecology of the mid-Atlantic coast: A symposium. USDI National Park Service. Technical Report NPS/SERCAHA/NRTR-93/04. Atlanta, GA.

Wieland, R. G. 1994a. Marine and estuarine habitat types and associated ecological communities of the Mississippi Coast. Mississippi Department of Wildlife, Fisheries, and Parks. Museum of Natural Science. Museum Technical Report 25. Jackson, MS. 270 pp.

Wieland, R. G. 1994b. Mississippi Natural Heritage Program: Ecological communities. Unpublished document. Mississippi Department of Wildlife, Fisheries, and Parks, Museum of Natural Science, Natural Heritage Program, Jackson, MS. 7 pp.

Wieland, R. G. 2000b. Ecological communities of Mississippi: Mississippi Natural Heritage Program. Unpublished document. Mississippi Department of Wildlife, Fisheries, and Parks, Museum of Natural Science, Natural Heritage Program, Jackson, MS. 8 pp.

Wolfe, S. H., editor. 1990. An ecological characterization of the Florida Springs Coast: Pithlachascotee to Waccasassa rivers. USDI Fish & Wildlife Service, Biological Report 90(21). Slidell, LA. 323 pp.

Wootton, L., S. Halsey, K. Bevaart, A. McGough, J. Ondreika, and P. Patel. 2005. When invasive species have benefits as well as costs: Managing Carex kobomugi (Asiatic sand sedge) in New Jersey's Coastal Dunes. Biological Invasions 7:1017-27.

Zaremba, R. E., and S. P. Leatherman. 1984. Overwash processes and foredune ecology, Nauset Spit, Massachusetts. Miscellaneous Paper EL-84-8. Prepared by Massachusetts Audubon Society and University of Massachusetts under cooperative agreement between USDI National Park Service, North Atlantic Region, Boston, MA, and the U.S. Army Corps of Engineering Research Center. Published by U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. 232 pp.

Appendix C: Key to the National Vegetation Classification (NVC) Associations That Occur or Potentially Occur at Cape Hatteras and Cape Lookout National Seashores

The following was modified in 2012 by SECN staff based on draft classification keys developed by NatureServe in November 2007.

Associations which are documented from Cape Hatteras and/or Cape Lookout National Seashores are in **bold type**. Associations which may potentially occur, but that were not documented from Cape Hatteras or Cape Lookout National Seashores as part of this project, are in normal type. For each association, the common name is given, with the Element Code in parentheses (CEGL00####) and the Alliance Code in brackets [A.###].

KEY TO KEYS

1. Vegetation dominated by trees, forests or woodlands .....**KEY A – FORESTS**

1. Vegetation not dominated by trees, trees absent or very sparse..... **2**

2. Shrub-dominated and vine dominated areas, with few or no trees. If located in tidally-influence high marsh or marsh fringe, may be as little as 20% shrub coverage and a mixture of herbaceous groundcover . .....**KEY B –SHRUBLANDS**

2. Vegetation dominated by herbaceous plants, including sparse vegetation of herbaceous plants, such as may occur between the foredunes and the beach..... **KEY C – GRAMINOID VEGETATION**

KEY A –FORESTS

1. Forest dominated by Pine (*Pinus spp.*), canopy having low amounts of broadleaf evergreen trees..... **2**

1. Forest dominated by broad leaf evergreen or deciduous trees, Loblolly Pine (*Pinus taeda*) may be an important component of the canopy, but it has less than 50% cover..... **5**

2. Forest dominated by Loblolly Pine (*Pinus taeda*) **3**

2. Forest dominated by other Pines (*Pinus spp.*), not native to the Outer Banks, such as Slash Pine (*Pinus elliottii var. elliottii*) or Maritime Pine (*Pinus pinaster*) **4**

3. Upland forest with closed canopy dominated by Loblolly Pine (*Pinus taeda*), which can be the sole canopy component or can be associated with Slash Pine (*Pinus elliottii*) Southern Red Oak (*Quercus falcata),* Red Maple (*Acer rubrum),* Black Cherry (*Prunus serotina var. serotina),* and Sassafras (*Sassafras albidum).* The tall-shrub layer is comprised of Wax Myrtle (*Morella cerifera)* and Southern Highbush Blueberry (*Vaccinium corymbosum*). Vines and lianas are always present in abundance; Muscadine (*Vitis rotundifolia)* is most common..... ..... **Mid-Atlantic Coastal Loblolly Pine Forest (CEGL006040) [A.406]**

3. Wetland Forest with closed to partially open canopy dominated by Loblolly Pine (*Pinus taeda).* Other canopy associates may be absent, or may include Red Maple (*Acer rubrum),* Swamp Red-bay (*Persea palustris),* or Sweetgum (*Liquidambar styraciflua).* The understory is made up of vines, strongly dominated by Catbrier (*Smilax rotundifolia),* with lesser amounts of Poison-ivy (*Toxicodendron radicans)* and Virginia Creeper (*Parthenocissus quinquefolia).* Wax-myrtle (*Morella cerifera)* is a common shrub… .....**Coastal Loblolly Pine Wetland Forest (CEGL006137) [A.3009]**

4. Forest dominated by Maritime Pine (*Pinus pinaster*), not native to the Outer Banks .... **Maritime Pine Plantation (CEGL007945) [A.1991]**

4. Forest dominated by Slash Pine (*Pinus elliottii var. elliottii*), not native to the Outer Banks..... ..... **Slash Pine Plantation (CEGL007170) [A.95]**

5. Deciduous forest or tall shrubland in semipermanently flooded depression with very poorly drained muck soil. Dominated or codominated by moderately dense (70% cover) tall-shrub layer (2-5 m tall) of *Cornus foemina*. In addition, there may be a sparse (10%) emergent tree layer (5-10 m) of Swamp Red Bay (*Persea palustris)* and Sand Laurel Oak (*Quercus hemisphaerica)*..... .....**Atlantic Coast Stiff Dogwood Dune Swale (CEGL007384) [A.319]**

5. Broadleaf evergreen forest..... **6**

6. Saturated wetland broadleaf evergreen forest, dominated by Swamp Red Bay (*Persea palustris)*..... ..... **Magnolia virginiana-Persea palustris Saturated Forest Alliance**

6. Upland broadleaf evergreen forest, dominated or codominated by Live Oak (*Quercus virginiana*), Sand Laurel Oak (*Quercus hemisphaerica*), or Loblolly Pine (*Pinus taeda*)..... ..... **Live Oak – (Cabbage palmetto) Forest Alliance [A. 55**]

KEY B –SHRUBLANDS

1. Deciduous wetland forest or tall shrubland in semipermanently flooded depression with very poorly drained muck soil. Dominated or codominated by moderately dense (70% cover) tall-shrub layer (2-5 m tall) of Stiff Dogwood (*Cornus foemina)*. In addition, there may be a sparse (10%) emergent tree layer (5-10 m) of Swamp Red Bay (*Persea palustris)* and Sand Laurel Oak (*Quercus hemisphaerica)*..... ..... **Atlantic Coast Stiff Dogwood Dune Swale (CEGL007384) [A.319]**

1. Upland or wetland shrubland not dominated by Stiff Dogwood (*Cornus foemina*) **2**

2. Evergreen shrubland, dominated or codominated by Live Oak (*Quercus virginiana*). Other species that may occur are Coastal Red-cedar (*Juniperus virginiana var. silicicola*) and Wax-myrtle (*Morella cerifera)* ..... **Quercus virginiana - Ilex vomitoria - (Morella cerifera) Shrubland Alliance**

2. Shrubland, not dominated or codominated by Live Oak (*Quercus virginiana*)..... **3**

3. Shrubland, Wax-myrtle (*Morella cerifera)* dominates the shrub layers; additional shrubs may include Groundsel-tree *(Baccharis halimifolia),*Yaupon *(Ilex vomitoria)*, and Coastal Red-cedar (*Juniperus virginiana var. silicicola)*. Saltmeadow Cordgrass *(Spartina patens)* is the dominant herb. Sites are swales, depressions, and tidal flats, typically located in dune areas (backdunes and interdunal swales) ..... **Atlantic Coast Interdune Swale (CEGL003839) [A.1906]**

3. Shrubland, not dominated or codominated by Wax-myrtle (*Morella cerifera)* **4**

4. Vegetation is dominated by a dense (80% cover) layer of vines, 0.5-1.5 m tall, including Seaside Greenbrier (*Smilax auriculata),* Peppervine *(Ampelopsis arborea)*, Greenbrier *(Smilax bona-nox)*, and Eastern Poison-ivy (*Toxicodendron radicans ssp. radicans)* .... **Mid-Atlantic Coastal Plain Vine Dune (CEGL003885) [A.909]**

4. Vegetation is not dominated by vines **5**

5. Vegetation is tidal shrubland is dominated by a sparse to very dense (20-100% cover) shrub layer (0.5-2 m tall) of Seaside Oxeye (*Borrichia frutescens)*; additional shrubs include False-willow (*Baccharis angustifolia)* and Maritime Marsh-elder (*Iva frutescens)*. The moderate to dense (40-80%) herbaceous layer is dominated by Black Needlerush (*Juncus roemerianus)* and Saltmeadow Cordgrass (*Spartina patens)*..... **Seaside Oxeye Tidal Shrub Flat (CEGL003924) [A.1026]**

5. Vegetation is not dominated by Seaside Oxeye (*Borrichia frutescens),* but characterized by some combination of Groundsel-tree *(Baccharis halimifolia),* Maritime Marsh-elder (*Iva frutescens)*, and Wax-myrtle (*Morella cerifera)*, and Yaupon (*Ilex vomitoria)* .... **Groundsel-tree – Maritime Marsh-elder Tidal Shrubland Alliance [A. 1023]**

KEY C – GRAMINOID VEGETATION

1. Graminoid vegetation dominated by grasses, sedges, Rushes (*Juncus spp.*), or Cattails (*Typha spp.*), Fimbry (*Fimbristylis spp.*), Sawgrass (*Cladium mariscus ssp. jamaicense*) **2**

1. Sparse forb-dominated vegetation (including succulents found on upper beach, foredunes and hypersaline flats)..... **13**

2. Grassland vegetation, dominated by grasses, includes uplands and wetlands..... **3**

2. Vegetation dominated by sedges, Rushes (*Juncus spp.*), Fimbry (*Fimbristylis spp.*), Sawgrass (*Cladium mariscus ssp. jamaicense*), or Cattails (*Typha spp.*)..... **9**

3. Grassland vegetation, dominated by the exotic turf grass called Centipede Grass (*Eremochloa ophiuroides*)..... **Centipede Grass Planted Herbaceous Vegetation (CEGL004204)**

3. Vegetation dominated by grasses other than Centipede Grass (*Eremochloa ophiuroides*) **4**

4. Grassland vegetation, dominated by the Common Reed (*Phragmites australis*), generally in brackish marshes ..... **Reed Tidal Marsh (CEGL004187)**

4. Vegetation dominated by grasses other than Common Reed (*Phragmites australis*)..... **5**

5. Tidal saltmarsh vegetation, dominated by Saltmarsh Cordgrass (*Spartina alterniflora*) .... **Southern Atlantic Coast Salt Marsh (CEGL004191)**

5. Vegetation dominated by grasses other than Saltmarsh Cordgrass (*Spartina alterniflora*)..... **6**

6. Vegetation dominated or codominated by Sea Oats (*Uniola paniculata)* ....***Uniola paniculata*** **Temperate Herbaceous Alliance**

6. Vegetation not dominated or codominated by Sea Oats (*Uniola paniculata)* **7**

7. Vegetation with a sparse to very dense (20-100% cover) herbaceous layer (typically 0.5-1 m tall) dominated by Southern Hairgrass (*Muhlenbergia filipes),* Saltmeadow Cordgrass (*Spartina patens*), and Dune Fingergrass (*Eustachys petraea*) in flat to gently sloping interdunal flats and swales that are intermittently flooded or seasonally saturated .... **Southern Hairgrass – Saltmeadow Cordgrass - Dune Fingergrass Herbaceous Vegetation** .....**(CEGL004051) [A.1217]**

7. Vegetation not dominated by Southern Hairgrass (*Muhlenbergia filipes),* Saltmeadow Cordgrass (*Spartina patens*), and Dune Fingergrass (*Eustachys petraea*) 8

8. Interdunal flats and swales and gently sloping barrier beaches that are intermittently wind-tidally flooded. Vegetation is a sparse to very dense (20-90% cover) herbaceous layer (typically 0.5-1 m tall) dominated by Saltmeadow Cordgrass (*Spartina patens)*. Additional graminoids may include Purple Lovegrass (*Eragrostis spectabilis),* Chestnut Fimbry *(Fimbristylis castanea),* Bitter Panicgrass *(Panicum amarum),* Seashore Crowngrass (*Paspalum vaginatum),* St. Augustine Grass (*Stenotaphrum secundatum),* and Purple Sandgrass (*Triplasis purpurea)*. Forbs may include the ubiquitous Beach Pennywort (*Hydrocotyle bonariensis*) and shrubs may include Seaside Oxeye (*Borrichia frutescens),* Maritime Marsh-elder *(Iva frutescens),* and Seaside Greenbrier *(Smilax auriculata)* ..... **Overwash Dune Grassland (CEGL004097) [A.1274]**

8. Tidal flats and seasonally flooded depressions, codominated by codominated by Saltgrass (*Distichlis spicata)* and Saltmarsh Cordgrass *(Spartina alterniflora)*. Additional species that may occur in lesser amounts include Seaside Oxeye (*Borrichia frutescens),* Chestnut Fimbry *(Fimbristylis castanea),* Beach Pennywort (*Hydrocotyle bonariensis),*Black Needlerush (*Juncus roemerianus),*Sea-lavender *(Limonium carolinianum),* Glasswort (*Sarcocornia pacifica),*Common Threesquare *(Schoenoplectus pungens),* Seaside Goldenrod (*Solidago sempervirens),* Saltmeadow Cordgrass *(Spartina patens),* and Saline Aster (*Symphyotrichum tenuifolium)* ..... **Mid-Atlantic High Salt Marsh (CEGL004197) [A.1481]**

9. Vegetation dominated by Southern Cattail (*Typha domingensis*), sometimes with Giant Foxtail Grass (*Setaria magna)* in interdune ponds and lagoon areas..... **Southern Cattail - Giant Foxtail Grass Herbaceous Vegetation (CEGL004138) [A.1392]**

9. Vegetation dominated by sedges , Rushes (*Juncus spp.*), Fimbry (*Fimbristylis spp.*), or Sawgrass (*Cladium mariscus ssp. jamaicense*)..... **10**

10. Tidal flats, with vegetation dominated by Sawgrass (*Cladium mariscus ssp. jamaicense*)..... **Tidal Sawgrass Marsh (CEGL004178) [A.1473]**

10. Vegetation dominated by sedges , Rushes (*Juncus spp.*), or Fimbry (*Fimbristylis spp.*) **11**

11. High salt marsh, with vegetation dominated by Black Needlerush (*Juncus roemerianus*) ..... **Needlerush High Marsh (CEGL004186) [A.1475]**

11. Vegetation dominated by sedges or by Fimbry (*Fimbristylis spp.*)..... **12**

12. Dunes with vegetation dominated by the exotic Japanese Sedge (*Carex kobomugi)* ..... **Japanese Sedge Maritime Dunes (CEGL006615) [No Alliance assigned]**

12. Interdune pond, wet swale, or temporarily flooded interdune flats. Vegetation dominated by Fimbry (*Fimbristylis spp.*), especially Chestnut Fimbry (*Fimbristylis castanea*) and Common Threesquare (*Schoenoplectus pungens)*..... **Chestnut Fimbry - Common Threesquare Seasonally Flooded Herbaceous Vegetation (CEGL003790) [A.1372]**

13. Tidally flooded hypersaline flats or very shallow depressions (pannes) dominated by halophytic herbs, including Glasswort (*Sarcocornia pacifica),* Virginia Glasswort (*Salicornia virginica),*Dwarf Glasswort *(Salicornia bigelovii),* Sea Saltwort (*Salicornia maritima*), and stunted Saltmarsh Cordgrass *(Spartina alterniflora)* ..... **Salt Panne (Salicornia Type) (CEGL004308) [A.1704]**

13. Vegetation sparse, on the upper beach or lower part of foredune..... **14**

14. Vegetation sparse, on the upper beach, dominated by Shoreline Sea-purslane (*Sesuvium portulacastrum)* ..... **Coastal Bay Shore / Succulent Beach (CEGL004406) [A.1868]**

14. Vegetation sparse, on the upper beach or lower part of foredune, dominated by Sea-rocket (*Cakile edentula ssp. edentula*) or Southern Sea-rocket (*Cakile edentula ssp. harperi*) .... ***Cakile edentula* Sparsely Vegetated Alliance**

Appendix D: Photo-Interpretation Guide to the Vegetated Map Classes of Cape Hatteras National Seashore

Page

MAP CLASS 1. Live Oak – (Cabbage Palmetto) Forest Alliance / Live Oak – (Yaupon) Shrubland 208

MAP CLASS 2. Maritime Red Bay Shrub Swamp / Atlantic Coast Stiff Dogwood Dune Swale 210

MAP CLASS 3. Mid-Atlantic Coastal Loblolly Pine Forest / Slash Pine Plantation 212

MAP CLASS 4. Atlantic Coast Interdune Swale 214

MAP CLASS 5. Maritime Marsh Elder Tidal Shrubland Alliance / Seaside Oxeye Tidal Shrub Flat 216

MAP CLASS 6. Overwash Dune Grassland / Sea-oats Temperate Herbaceous Alliance / Centipede Grass Planted Herbaceous Vegetation. 219

MAP CLASS 7. Reed Tidal Marsh 222

MAP CLASS 8. Needlerush High Marsh. 224

MAP CLASS 9. Mid-Atlantic High Salt Marsh / Chestnut Fimbry – Common Threesquare Seasonally Flooded Herbaceous Vegetation / Southern Cattail – Giant Foxtail Herbaceous Vegetation. 226

MAP CLASS 10. Southern Atlantic Coast Salt Marsh: 229

MAP CLASS 11. Southern Hairgrass – Saltmeadow Cordgrass – Dune Fingergrass Herbaceous Vegetation. 231

MAP CLASS 12. Tidal Sawgrass Marsh: 233

MAP CLASS 13. Coastal Loblolly Pine Wetland Forest 235

MAP CLASS 1. Live Oak – (Cabbage Palmetto) Forest Alliance / Live Oak – (Yaupon) Shrubland





Abundant Species for Live Oak – (Cabbage Palmetto) Forest Alliance:

- *Quercus virginiana* (Live oak)
- *Sabal palmetto* (Sabal palm)
- *Juniperus virginiana var. silicicola* (southern redcedar)

Abundant Species for Live Oak – (Yaupon) Shrubland:

- *Juniperus virginiana var. silicicola* (southern redcedar)
- *Diospyros virginiana* (common persimmon)
- *Morella cerifera* (wax myrtle)
- *Ilex vomitoria* (yaupon)
- *Quercus virginiana* (live oak)

Map Class Statistics (for combined map class):
Frequency: 67
Total area: 625.5 ha
Average polygon size: 9.33 ha
Producer's accuracy: 61%
User's accuracy: 42%

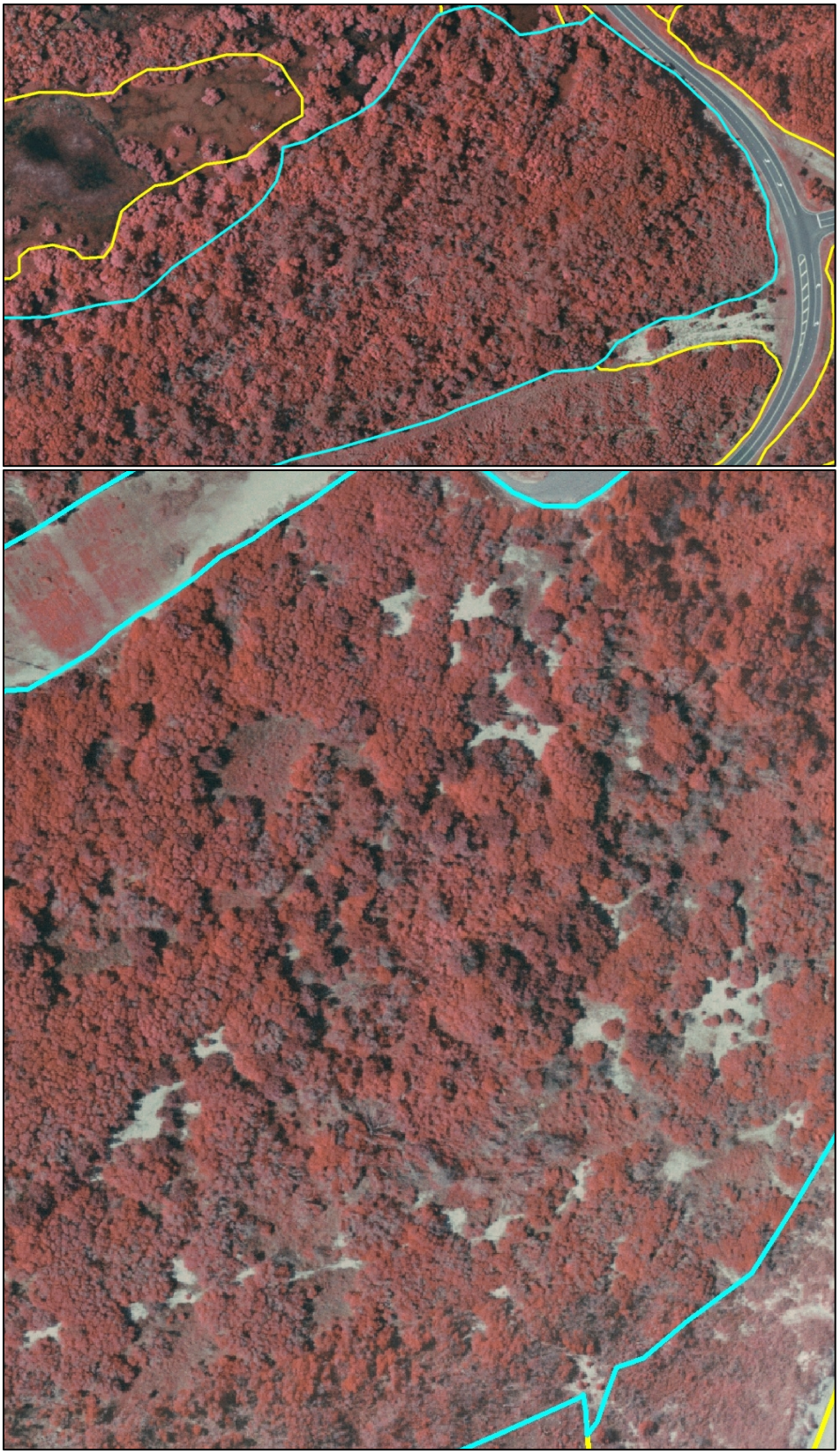


Figure C-1. Examples of photo signature for Live Oak – (Sabal palmetto) Forest Alliance ***/*** Live Oak – (Yaupon) Shrubland (inside blue polygon).

MAP CLASS 2. Maritime Red Bay Shrub Swamp / Atlantic Coast Stiff Dogwood Dune Swale



Abundant Species for Maritime Red Bay Shrub Swamp:

- *Persea palustris* (swamp bay)
- *Quercus virginiana* (live oak)
- *Ilex vomitoria* (yaupon)
- *Morella cerifera* (wax myrtle)
- *Juniperus virginiana var. silicicola* (southern redcedar)

Abundant Species Atlantic Coast Stiff Dogwood Dune Swale:

- *Cornus foemina* (stiff dogwood)
- *Persea palustris* (swamp bay)
- *Boehmeria cylindrical* (smallspike false nettle)
- *Ampelopsis arborea* (peppervine)
- *Leersia oryzoides* (rice cutgrass)
- *Mikania scandens* (climbing hempvine)
- *Zizania aquatic* (annual wildrice)

Map Class Statistics (for combined groups):
Frequency: 31
Total area: 139 ha
Average polygon size: 4.5 ha
Producer's accuracy: 66%
User's accuracy: 59%

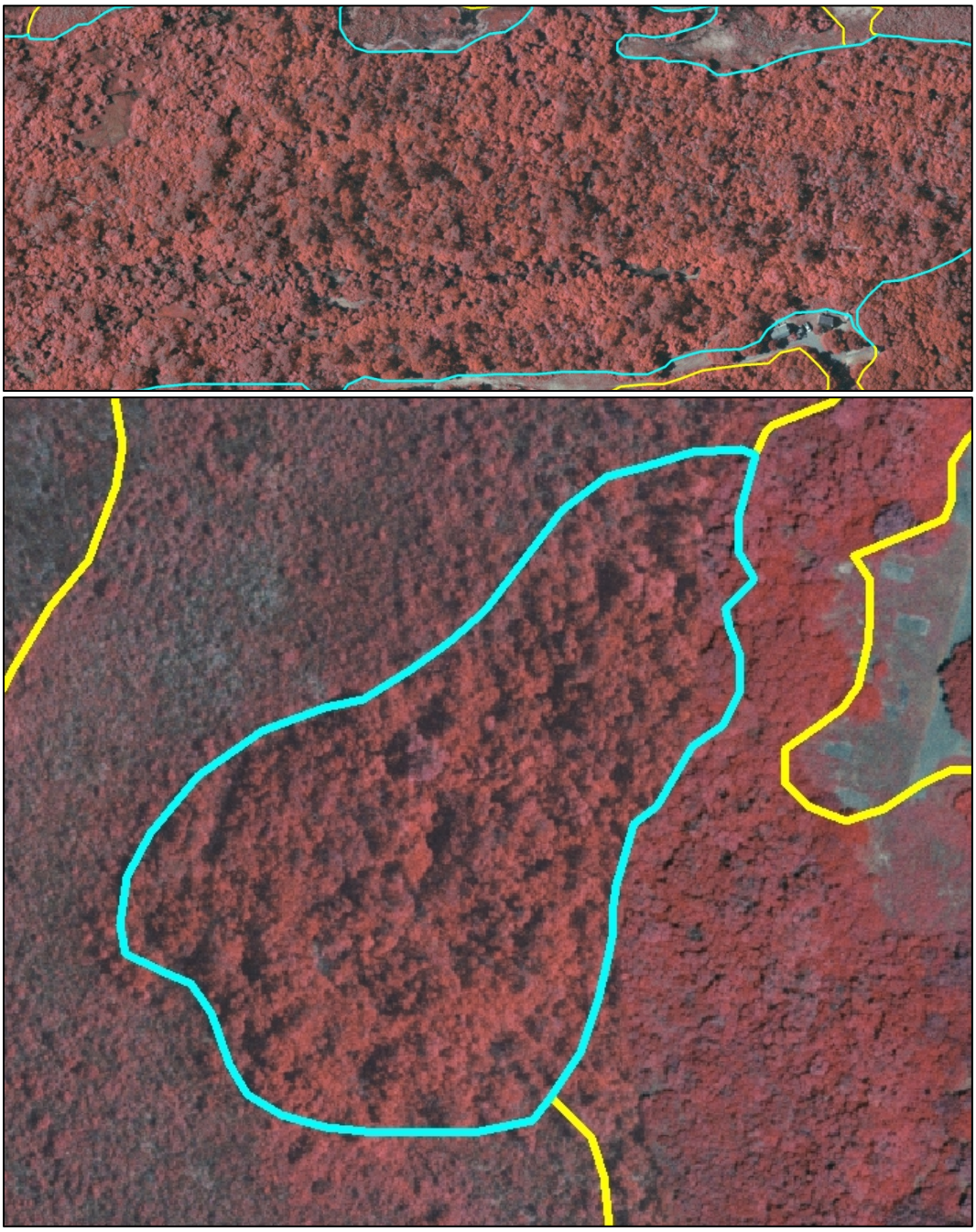


Figure C-2. Example of photo signature for Maritime Red Bay Shrub Swamp / Atlantic Coast Stiff Dogwood Dune Swale

MAP CLASS 3. Mid-Atlantic Coastal Loblolly Pine Forest / Slash Pine Plantation





Abundant Species for Slash Pine Plantation:

- *Pinus elliottii var. elliottii* (Slash pine)
- *Juniperus virginiana var. silicicola* (southern redcedar)
- *Ilex vomitoria* (yaupon)
- *Morella cerifera* (wax myrtle)
- *Persea palustris* (swamp bay)

Abundant Species for Mid-Atlantic Coastal Loblolly Pine Forest:

- *Pinus taeda* (loblolly pine)
- *Morella cerifera* (wax myrtle)
- *Persea palustris* (swamp bay)
- *Ilex vomitoria* (yaupon)

Map Class Statistics (for combined group):
Frequency: 41
Total area: 327.9 ha
Average polygon size: 8.0 ha
Producer's accuracy: 55%
User's accuracy: 77%

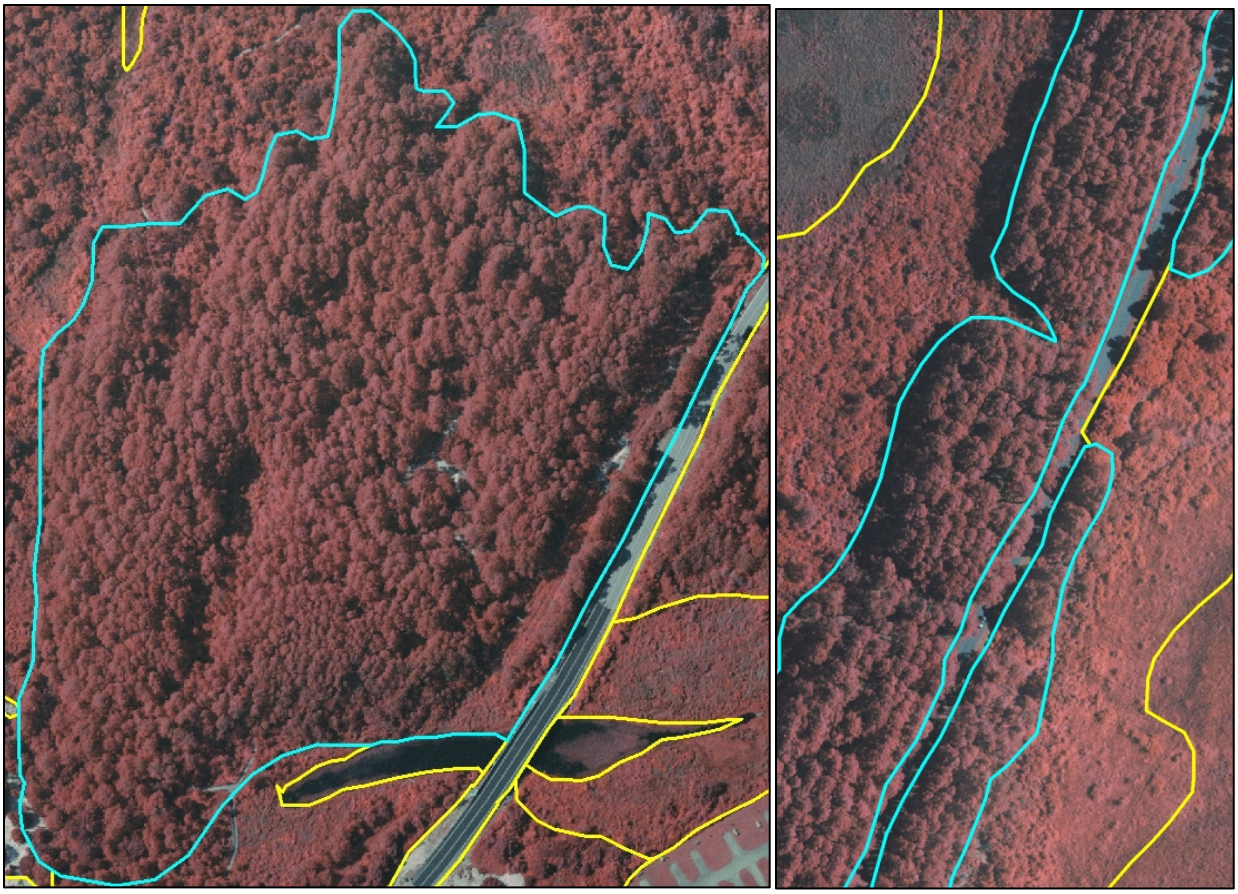


Figure C-3. Examples of photo signature for Slash Pine Plantation / Mid-Atlantic Coastal Loblolly Pine Forest (inside blue polygons).

MAP CLASS 4. Atlantic Coast Interdune Swale



Abundant Species:

- *Juniperus virginiana var. silicicola* (southern redcedar)
- *Baccharis angustifolia* (saltwater false willow)
- *Ilex vomitoria* (yaupon)
- *Morella cerifera* (wax myrtle)
- *Hydrocotyle bonariensis* (largeleaf pennywort)

Map Class Statistics:
Frequency: 488
Total area: 2,050 ha
Average polygon size: 4.2 ha
Producer's accuracy: 58%
User's accuracy: 83%

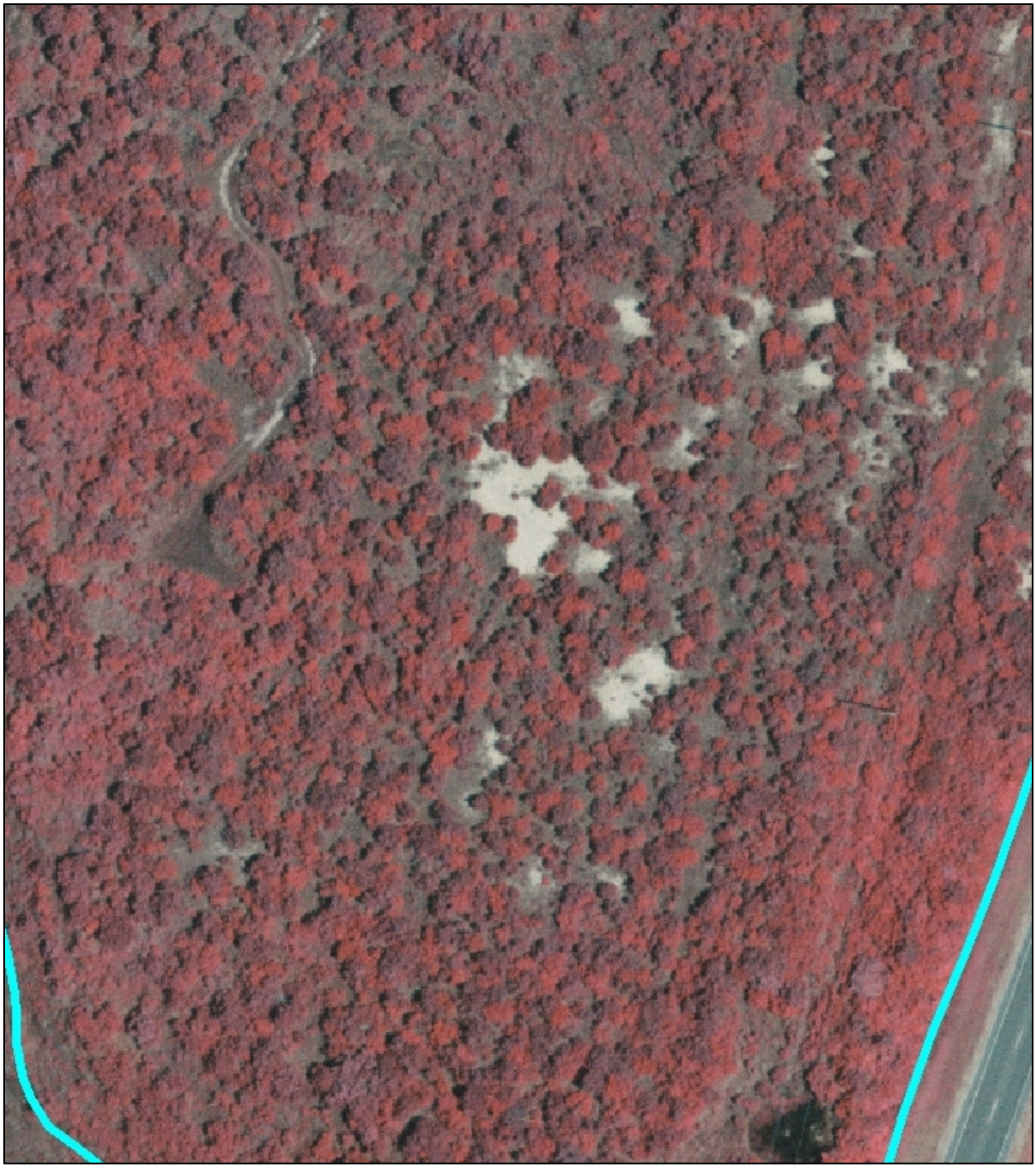


Figure C-4. Example of photo signature for Atlantic Coast Interdune Swale.

MAP CLASS 5. Maritime Marsh Elder Tidal Shrubland Alliance / Seaside Oxeye Tidal Shrub Flat





Abundant Species for Maritime Marsh Elder Tidal Shrubland Alliance:

- *Juniperus virginiana var. silicicola* (southern redcedar)
- *Baccharis angustifolia* (saltwater false willow)
- *Ilex vomitoria* (yaupon)
- *Morella cerifera* (wax myrtle)
- *Hydrocotyle bonariensis* (largeleaf pennywort)

Abundant Species for Seaside Oxeye Tidal Shrub Flat:

- *Borrichia frutescens* (bushy seaside tansy)
- *Baccharis angustifolia* (saltwater false willow)
- *Iva frutescens* (Jesuit's bark)
- *Juncus roemerianus* (needlegrass rush)
- *Spartina patens* (saltmeadow cordgrass)

Map Class Statistics (for combined group):
Frequency: 120
Total area: 100.8 ha
Average polygon size: 0.84 ha
Producer's accuracy: 74%
User's accuracy: 65%



Figure C-5. Example of photo signature for Maritime Marsh Elder Tidal Shrubland Alliance and Seaside Oxeye Tidal Shrub Flat (inside blue polygon).

MAP CLASS 6. Overwash Dune Grassland / Sea-oats Temperate Herbaceous Alliance / Centipede Grass Planted Herbaceous Vegetation.







Abundant Species for Overwash Dune Grassland:

- *Spartina patens* (saltmeadow cordgrass)
- *Solidago sempervirens* (seaside goldenrod)
- *Hydrocotyle bonariensis* (largeleaf pennywort)

Abundant Species for Sea-oats Temperate Herbaceous Alliance:

- *Uniola paniculata* (sea-oats)
- *Panicum amarum* (bitter panicgrass)
- *Panicum virgatum* (switchgrass)
- *Heterotheca subaxillaris* (camphorweed)
- *Hydrocotyle bonariensis* (largeleaf pennywort)
- *Smilax auriculata* (earleaf greenbrier)

Abundant Species for Centipede Grass Herbaceous Vegetation:

- *Phyla nodiflora* (turkey tangle fogfruit)
- *Eremochloa ophiuroides* (centipede grass)
- *Spartina patens* (saltmeadow cordgrass)

Map Class Statistics:
Frequency: 220
Total area: 1,438.7 ha
Average polygon size: 6.54 ha
Producer's accuracy: 94%
User's accuracy: 90%

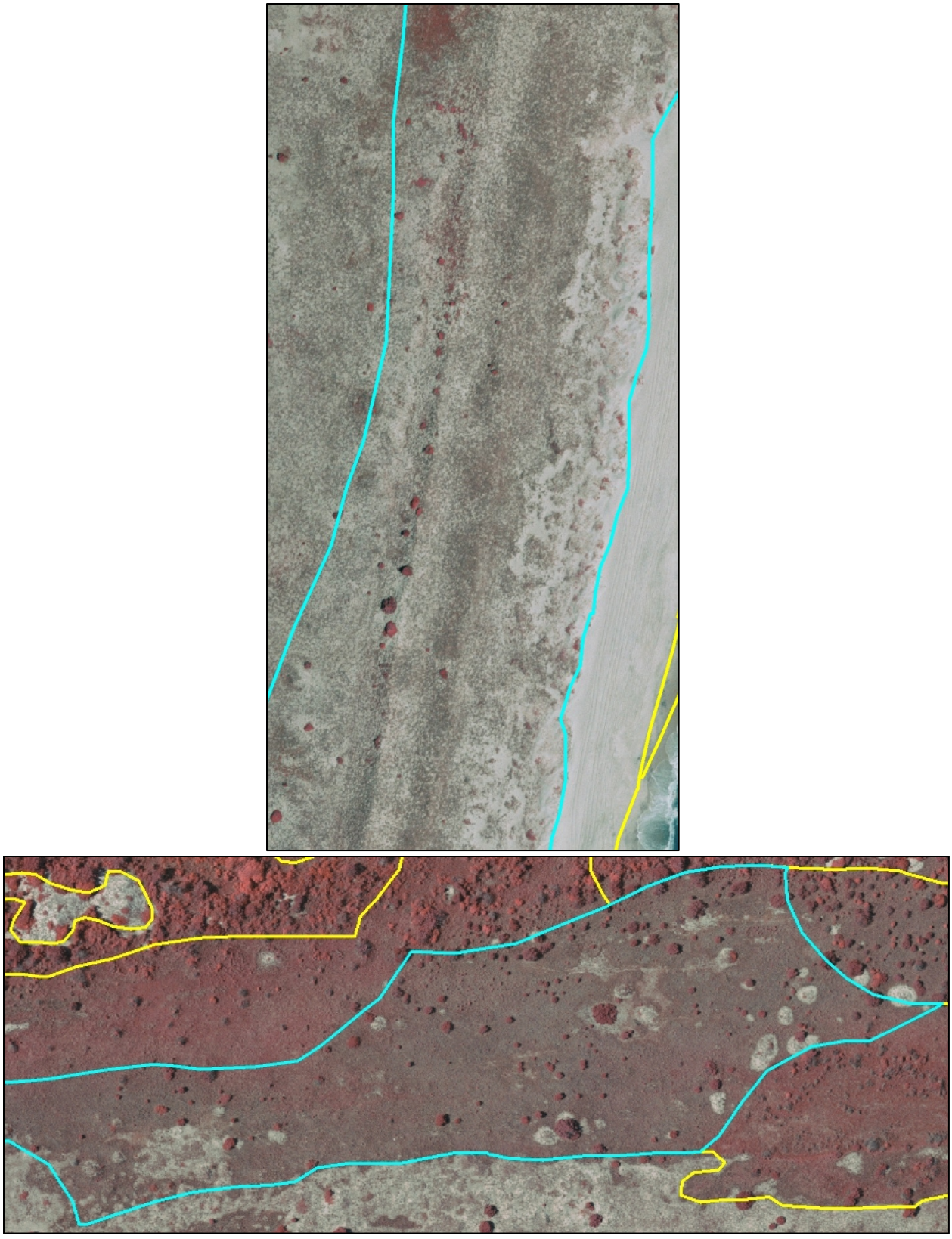


Figure C-6. Example of photo-signatures for Overwash Dune Grassland / Sea-oats Temperate Herbaceous Alliance / Centipede Grass Planted Herbaceous Vegetation (inside blue polygons).

MAP CLASS 7. Reed Tidal Marsh



Abundant Species:

- *Phragmites australis* (common reed)

Map Class Statistics:
Frequency: 33
Total area: 41.2 ha
Average polygon size: 1.25 ha
Producer's accuracy: 73%
User's accuracy: 86%

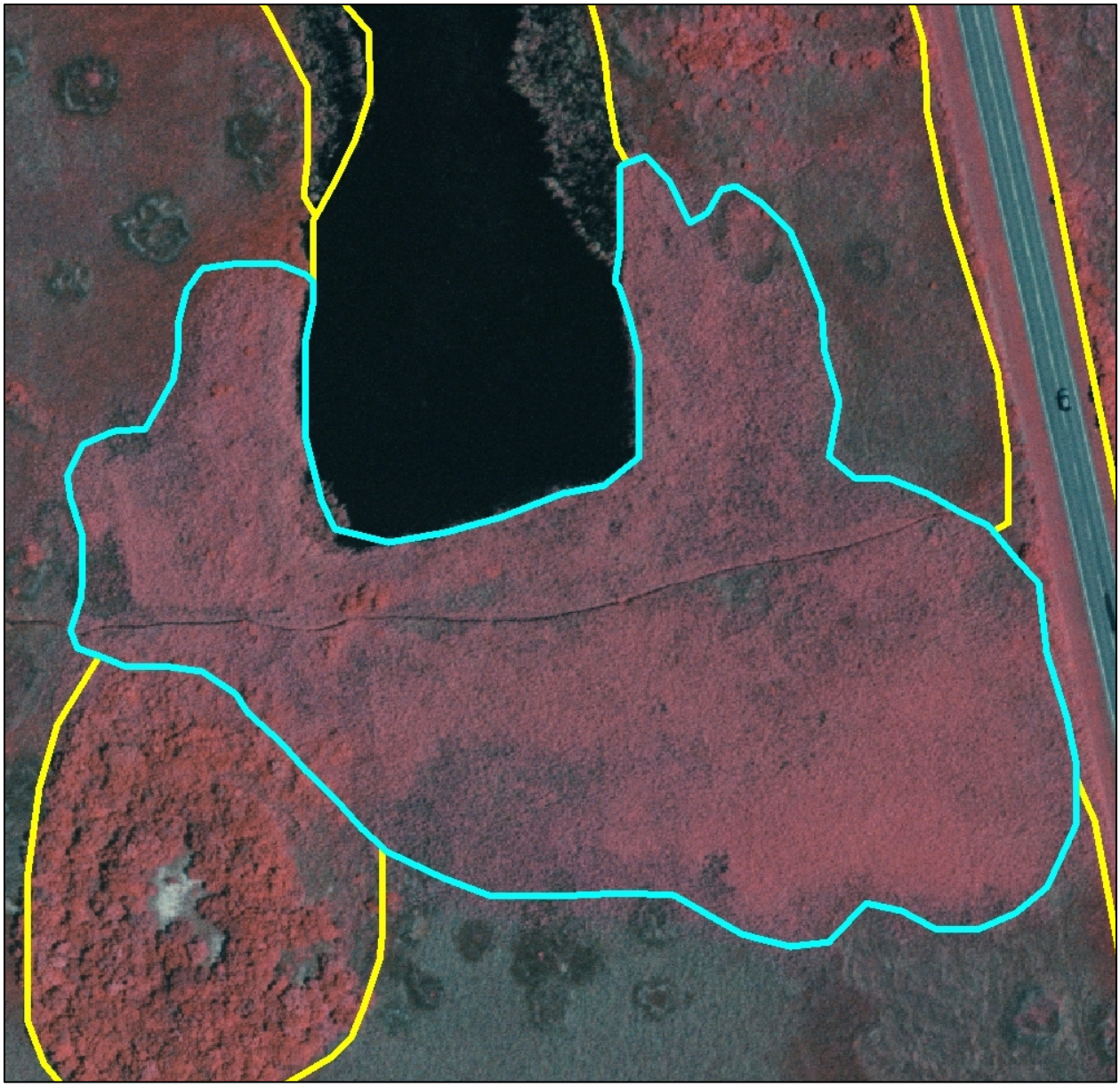


Figure C-7. Example of photo signature for Reed Tidal Marsh

MAP CLASS 8. Needlerush High Marsh.



Abundant Species:

- *Juncus roemerianus* (needlerush rush)
- *Iva frutescens* (Jesuit's bark)
- *Baccharis angustifolia* (saltwater false willow)
- *Borrichia frutescens* (bushy seaside tansy)

Map Class Statistics:
Frequency: 408
Total area: 1,272.9 ha
Average polygon size: 3.10 ha
Producer's accuracy: 82%
User's accuracy: 93%



Figure C-8. Example of photo signature for Needlerush High Marsh

MAP CLASS 9. Mid-Atlantic High Salt Marsh / Chestnut Fimbry – Common Threesquare Seasonally Flooded Herbaceous Vegetation / Southern Cattail – Giant Foxtail Herbaceous Vegetation.







Abundant Species for Mid-Atlantic High Salt Marsh:

- *Spartina patens* (saltmeadow cordgrass)
- *Distichlis spicata* (inland saltgrass)
- *Fimbristylis castanea* (marsh fimbry)
- *Juncus roemerianus* (black needlerush)

Abundant Species for Chestnut Fimbry – Common Threesquare Seasonally Flooded Herbaceous Vegetation:

- *Spartina patens* (saltmeadow cordgrass)
- *Schoenoplectus pungens* (common threesquare)
- *Fimbristylis castanea* (Marsh fimbry)
- *Erectites hieraciifolia* (American burnweed)
- *Galium obtusum* (bluntleaf bedstraw)
- *Mikania scandens* (climbing hempvine)

Abundant Species for Southern Cattail – Giant Foxtail Herbaceous Vegetation :

- *Typha domingensis* (southern cattail)
- *Setaria parviflora* (marsh bristlegrass)
- *Spartina patens* (saltmeadow cordgrass)
- *Mikania scandens* (climbing hempvine)

Map Class Statistics:
Frequency: 354
Total area: 1,139.4 ha
Average polygon size: 3.25 ha
Producer's accuracy: 74%
User's accuracy: 85%

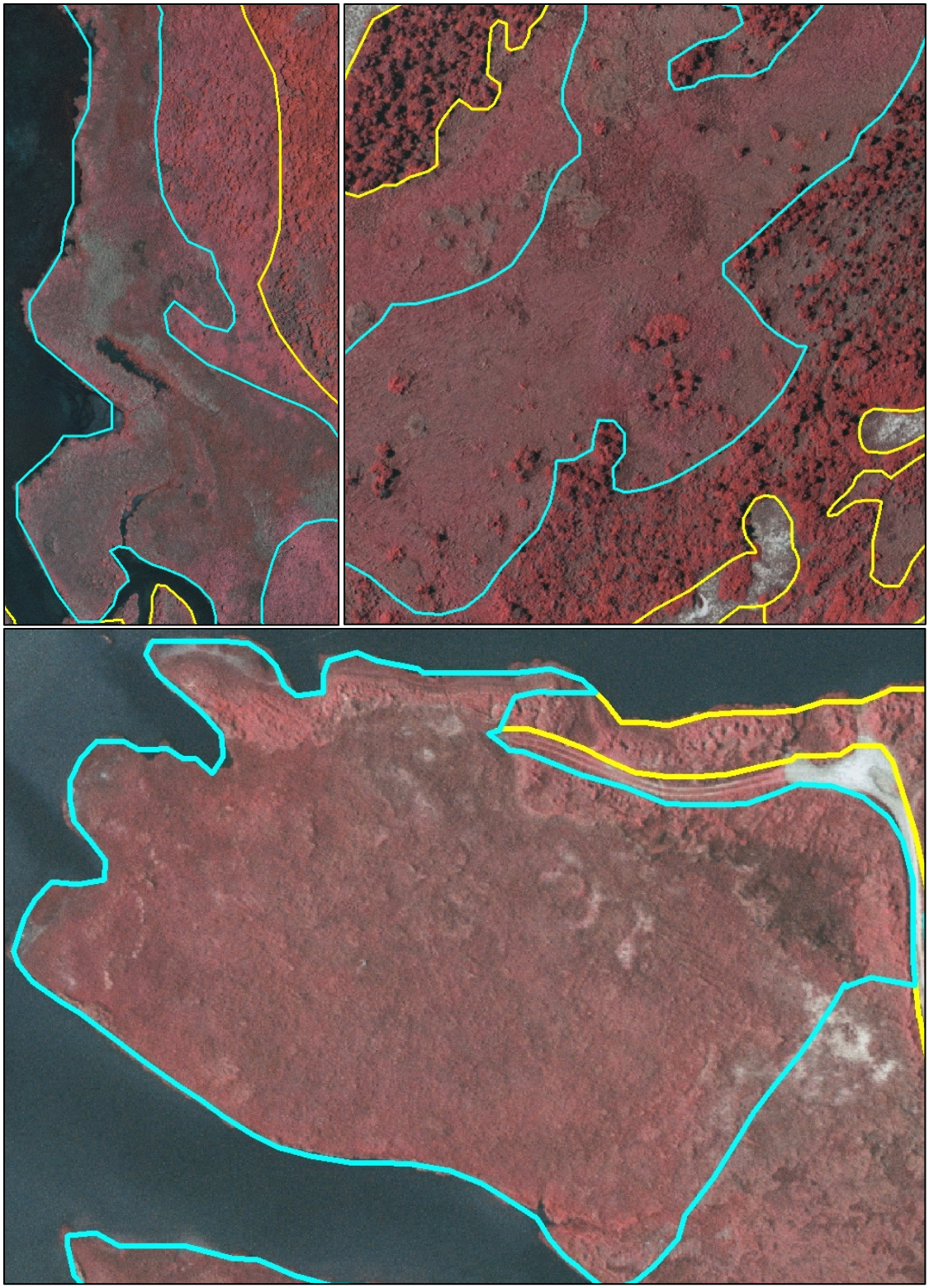


Figure C-9. Examples of photo signature for Mid-Atlantic High Salt Marsh / Chestnut Fimbry – Common Threesquare Seasonally Flooded Herbaceous Vegetation / Southern Cattail – Giant Foxtail Herbaceous Vegetation.

MAP CLASS 10. Southern Atlantic Coast Salt Marsh



Abundant Species:

- *Spartina alterniflora* (smooth cordgrass)

Map Class Statistics:
Frequency: 113
Total area: 239.1 ha
Average polygon size: 2.12 ha
Producer's accuracy: 92%
User's accuracy: 77%

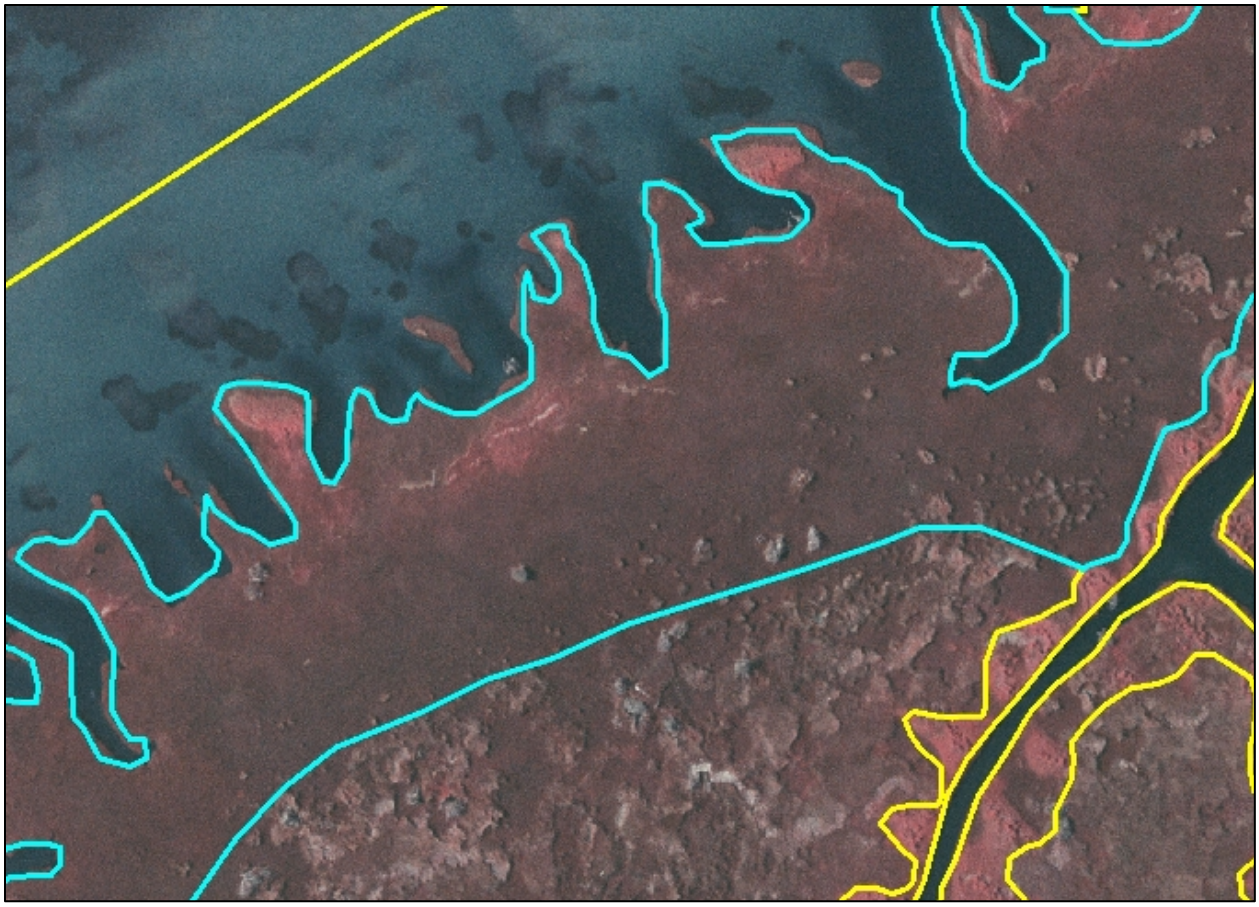


Figure C-10. Example of photo signature for Southern Atlantic Coast Salt Marsh

MAP CLASS 11. Southern Hairgrass – Saltmeadow Cordgrass – Dune Fingergrass Herbaceous Vegetation



Abundant Species:

- *Baccharis halimifolia* (eastern baccharis)
- *Morella cerifera* (wax myrtle)
- *Eustachys petraea* (dune fingergrass)
- *Hydrocotyle bonariensis* (largeleaf pennywort)
- *Solidago sempervirens* (seaside goldenrod)
- *Muhlenbergia filipes* (southern hairgrass)
- *Andropogon glomeratus* (bushy bluestem)
- *Eragrostis spectabilis* (purple lovegrass)
- *Spartina patens* (saltmeadow cordgrass)

Map Class Statistics:
Frequency: 38
Total area: 12.6 ha
Average polygon size: 0.33 ha
Producer's accuracy: 88%
User's accuracy: 50%

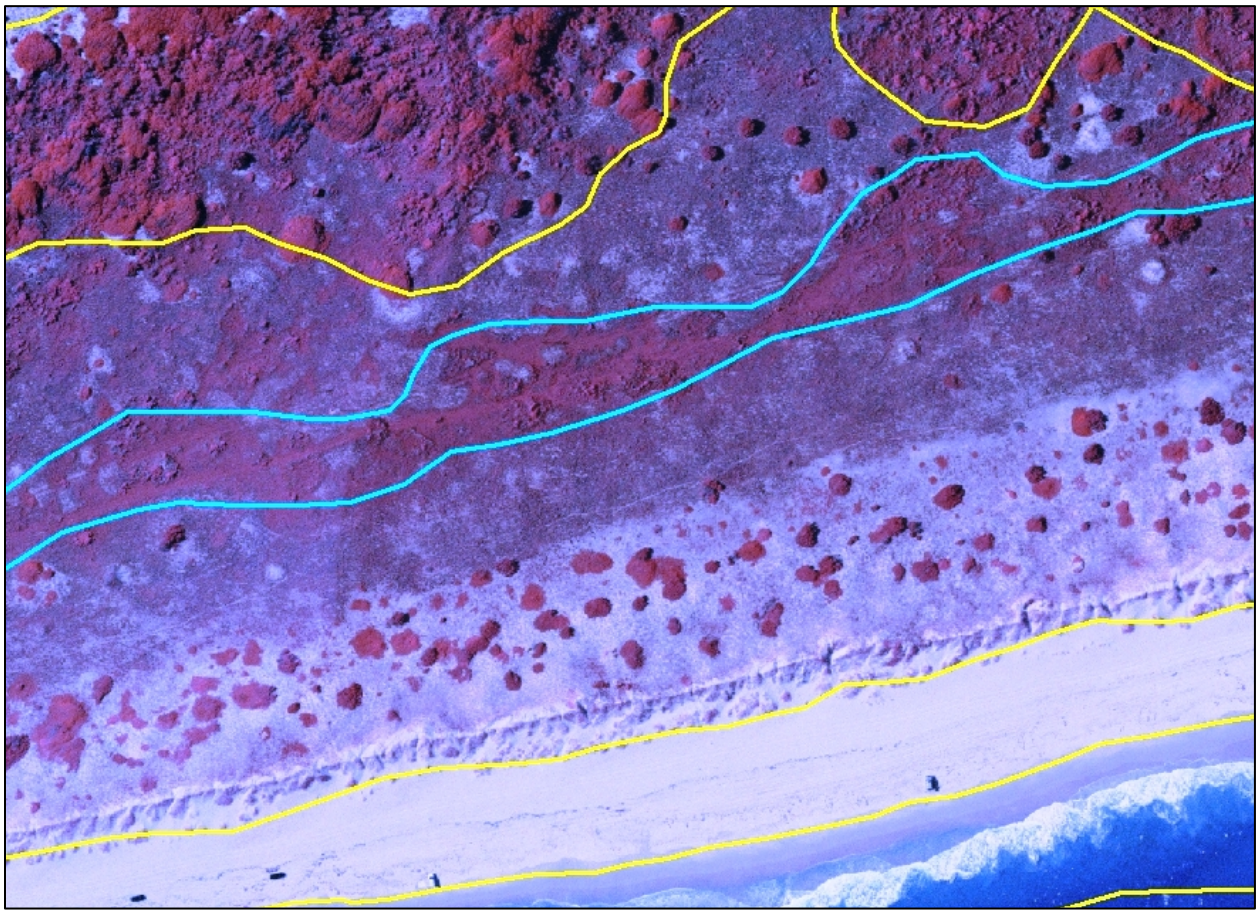


Figure C-11. Example of photo signature for Southern Hairgrass – Saltmeadow Cordgrass – Dune Fingergrass Herbaceous Vegetation

MAP CLASS 12. Tidal Sawgrass Marsh:



Abundant Species:

- *Cladium mariscus ssp. jamaicense* Tidal Herbaceous Vegetation
- *Centella erecta* (erect centella)
- *Hydrocotyle bonariensis* (largeleaf pennywort)
- *Spartina patens* (saltmeadow cordgrass)
- *Rhynchospora colorata* (starrush whitetop)
- *Morella cerifera* (wax myrtle)
- *Persea borbonia* (redbay)

Map Class Statistics:
Frequency: 10
Total area: 12.8 ha
Average polygon size: 1.28 ha
Producer's accuracy: 50%
User's accuracy: 40%

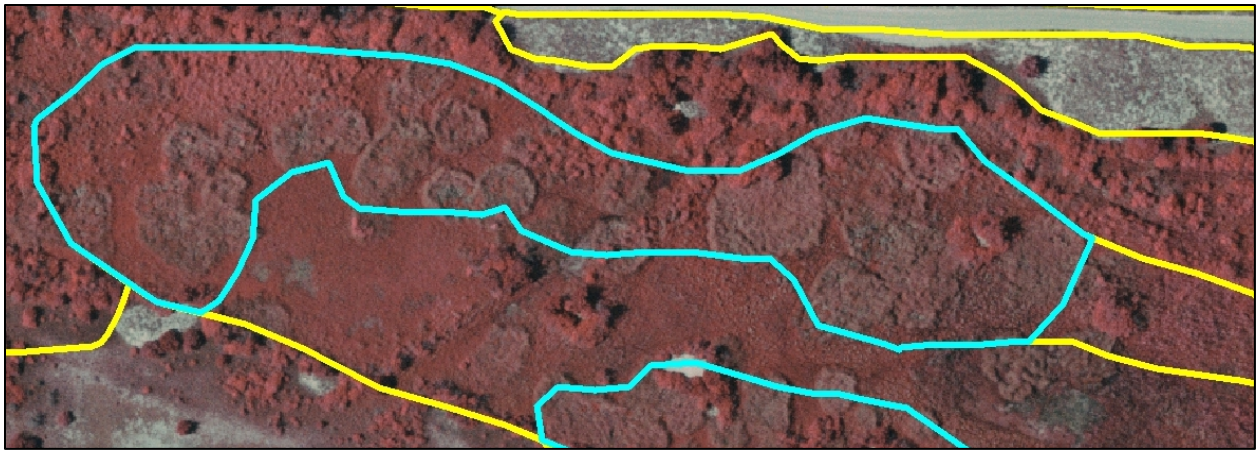


Figure C-12. Example of photo signature for Tidal Sawgrass Marsh

MAP CLASS 13. Coastal Loblolly Pine Wetland Forest



Abundant Species:

- *Pinus taeda* (loblolly pine)
- *Juniperus virginiana var. virginiana* (southern redcedar)
- *Hibiscus moscheutos* (crimsoneyed rosemallow)
- *Morella cerifera* (wax myrtle)
- *Persea borbonia* (redbay)
- *Toxicodendron radicans ssp. Radicans* (eastern poison ivy)
- *Ampelopsis arborea* (peppervine)
- *Mikania scandens* (climbing hempvine)
- *Eleocharis rostellata* (beaked spikerush)

Map Class Statistics:
Frequency: 1
Total area: 1.67 ha
Average polygon size: 1.67 ha
Producer's accuracy: 0%
User's accuracy: 0%

Appendix E: Field Reconnaissance Form

Cape Hatteras National Seashore Observation Point Data Sheet:



II. ENVIRONMENTAL/ SITE DESCRIPTION

1. Environmental Comments *(site-specific information (if applicable) such as hydrology, topographic position, unvegetated surfaces, recent disturbances, etc.)*

Soil Texture-

Soil Drainage-

Topo/Landscape Position-

Disturbance-

III. VEGETATION DESCRIPTION



IV. VEGETATION COMPOSITION *(list **dominant species only** and indicate which stratum it occurs in by checking the appropriate stratum next to the species name)*

Species	Canopy	Sub-canopy	Shrub	Herb



Appendix F: Accuracy Assessment Form

ACCURACY ASSESSMENT (AA) FORM FOR VEGETATION MAPPING IN SECN PARKS

I. LOCATION DATA:

1. AA Point Code: _________ 2. Park: ___________ 3. Date: _______

4. Observers: ____

5. Photo (s) #: _______________________________________

6. Coordinates: X: ________________ Y: ____________________

7. Estimated Accuracy (m): _______ 8. Number of Satellites: _________

II. ENVIRONMENTAL/ SITE DESCRIPTION:

1. Environmental Comments *(site specific information such as hydrology, topographic position, unvegetated surfaces, recent disturbances, etc.*

III. VEGETATION DESCRIPTION:

Leaf phenology (of dominant stratum)

Trees and Shrubs:
___Evergreen
___Cold-deciduous
___Drought-deciduous
___Mixed evergreen - cold-deciduous
___Mixed evergreen - drought-deciduous

Herbs: ___Annual ___Perennial

Leaf Type (of dominant stratum)

___Broad-leaved
___Needle-leaved
___Mixed broad-leaved/Needle leaved
___Microphyllous
___Graminoid
___Forb
___Pteridophyte

Physiognomic class

___Forest
___Woodland
___Shrubland
___Dwarf Shrubland
___Herbaceous
___Nonvascular
___Sparsely Vegetated

IV. VEGETATION COMPOSITION: *(list dominant species only and indicate which stratum it occurs in by checking the appropriate stratum next to the species name)*

Species	Canopy layer	Sub-canopy layer	Shrub layer	Herb layer

V. VEGETATION ASSOCIATION:

1. Primary and secondary (if there is a close call or multiple associations within the same polygon) vegetation classification(s) within radius of observation point, based on field key:

2. Are there other vegetation associations present within the radius observation area in addition to what was listed above?

3. Representativeness: Does the assigned association represent the vegetation well? If not, why? Please rank the fit as "Good" "Fair" or "Poor."

V. SOIL CHARACTERISTICS:

O-horizon depth:_____ A-horizon depth:_____

Soil texture (from key below):_____

Soil Notes:

_____

_____

_____

VI. CLASSIFICATION COMMENTS *(use this space to provide additional comments about problems or ease in applying the vegetation key at this site, rationale for choice of association if there was doubt, etc.)*



*__Soil Texture__- Using the key below, assess average soil texture.

(Simplified Key to Soil Texture (Brewer and McCann, 1982)

A1 Soil does not remain in a ball when squeezed ..... **sand**
A2 Soil remains in a ball when squeezed..... **B**
B1 Squeeze the ball between your thumb and forefinger, attempting to make a ribbon that you push up over your finger. Soil makes no ribbon..... **loamy sand**
B2 Soil makes a ribbon, may be very short..... **C**
C1 Ribbon extends less than 1 inch before breaking..... **D**
C2 Ribbon extends 1 inch or more before breaking..... **E**
D1 Add excess water to small amount of soil; soil feels at least slightly gritty ..... **loam or sandy loam**
D2 Soil feels smooth..... **silt loam**
E1 Soil makes a ribbon that breaks when 1-2 inches long; cracks if bent into a ring..... **G**
E2 Soil makes a ribbon 2+ inches long; doesn't crack when bent into a ring.... **F**
F1 Add excess water to a small amount of soil; soil feels at least slightly gritty... ..... **sandy clay loam or clay loam**
F2 Soil feels smooth..... **silty clay loam or silt**
G1 Add excess water to a small amount of soil; soil feels at least slightly gritty..... ..... **sandy clay or clay**
G2 Soil feels smooth..... **silty clay**

Appendix G: Accuracy Assessment Contingency Table

Explanation of the Contingency Matrices

The accuracy assessment contingency matrix for the Cape Hatteras National Seashore vegetation map layer is designed in a row and column format so as to compare the results of the vegetation types represented on the map layer to the vegetation types as verified on the ground. Map-class codes are used to identify vegetation types for ease of comparison during the analysis. (A crosswalk between map classes and vegetation types is provided.)

The sample contingency table provides an initial summary of the AA data by displaying counts of observations, with sample data values (vegetation map classes) as rows and reference data values (vegetation types as identified on the ground) as columns. The values in the shaded cells along the diagonal represent counts for correctly classified observations, where the reference data (column) matches the mapped vegetation type (row). User's accuracy was calculated by dividing the number of samples that agreed with their corresponding map class by the total number of samples in that class. Producer's accuracy was calculated by dividing the number of samples that agreed with their corresponding map class by the total number of samples whose field call belonged to that category.

Measures of accuracy for the AA are defined on the population contingency table. Similar to the sample contingency table, rows in the population contingency table are defined by the sample data values, and the columns are defined by the by the reference data values. Unlike the sample contingency table, the values in each cell are the proportion of the target area in the corresponding true and mapped vegetation classes, rather than the raw counts of observations. The population and sample contingency tables are reported together as a summary of between-class error relationships and class accuracy statistics (Lea and Curtis 2010).

Reference Data (Observations Classified as Vegetation Type on Ground)																		
Sample Data (Observations Selected Within the Map Class)	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**Row Total**	**Map Class Area (Ha)**	**Estimate (Users' Accuracy)**	**Limit, 90% Conf Int.**	**Limit, 90% Conf. Int.**
A	0.2200	0.0000	0.0000	0.0089	0.0266	0.0089	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2644	1975.8	83.3%	70.5%	96.2%
B	0.0000	0.0118	0.0000	0.0079	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0197	146.3	60.0%	43.6%	76.4%
C	0.0060	0.0000	0.1354	0.0000	0.0000	0.0000	0.0000	0.0000	0.0181	0.0000	0.0000	0.0000	0.0000	0.1595	1184.0	84.9%	75.9%	93.9%
D	0.0138	0.0099	0.0000	0.0494	0.0000	0.0415	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0040	0.1186	880.9	41.7%	30.4%	53.0%
E	0.0000	0.0025	0.0013	0.0000	0.0108	0.0000	0.0019	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0165	122.4	65.4%	48.1%	82.7%
F	0.0014	0.0005	0.0000	0.0010	0.0000	0.0129	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0010	0.0168	124.0	77.1%	64.0%	90.2%
G	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1468	0.0000	0.0000	0.0109	0.0000	0.0000	0.0000	0.1577	1170.5	93.1%	83.6%	100.0%
H	0.0110	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1732	0.0000	0.0055	0.0027	0.0000	0.0000	0.1924	1428.3	90.0%	83.6%	100.0%
I	0.0000	0.0000	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0044	0.0000	0.0000	0.0002	0.0000	0.0051	37.7	86.4%	72.1%	100.0%
J	0.0000	0.0000	0.0026	0.0000	0.0026	0.0000	0.0039	0.0000	0.0000	0.0301	0.0000	0.0000	0.0000	0.0392	291.4	76.7%	62.3%	91.0%
K	0.0005	0.0000	0.0023	0.0000	0.0000	0.0000	0.0000	0.0008	0.0000	0.0000	0.0039	0.0000	0.0000	0.0075	57.6	50.0%	33.3%	66.7%
L	0.0000	0.0000	0.0001	0.0000	0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0002	0.0000	0.0005	4.2	40.0%	0%	86.0%
M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0%	0%	0%
Column Total	0.2527	0.0247	0.1422	0.0672	0.0401	0.0633	0.1526	0.1741	0.0225	0.0465	0.0066	0.0004	0	**1.0**				
Estimated True Map Class Area (Ha)	1890.0	183.6	1055.7	498.5	297.9	469.8	1133.0	1292.1	168.5	304.13	69.6	23.8	36.5					
Point Estimate, Mean Producers' Accuracy	87.1%	47.8%	95.2%	73.6%	26.9%	20.4%	96.2%	99.5%	19.3%	73.5%	41.4%	7.1%	0%					
Lower Limit, 90% Conf. Int.	84.5%	47.2%	94.1%	72.0%	25.9%	19.3%	95.1%	98.5%	19.0%	72.8%	41.1%	6.8%	0%					
Upper Limit, 90% Conf. Int.	89.7%	48.4%	96.4%	75.2%	27.8%	21.4%	97.3%	100.4%	19.7%	74.1%	41.7%	7.3%	0%					

Point Estimate, Overall Accuracy (with 90% Confidence Interval): **80.1% (76.2% - 84.0%)**

Point Estimate, Overall Accuracy Kappa Statistic (with 90% Confidence Interval): **69.9% (65.9% - 73.8%)**

Key to Map Class Codes

A= Atlantic Coast Interdune Swale
B= Atlantic Coast Stiff Dogwood Dune Swale / Maritime Red Bay Shrub Swamp
C= Mid-Atlantic High Salt Marsh / Chestnut Fimbry-Common Threesquare Seasonally Flooded Alliance/ Southern Cattail-Giant Foxtail Herbaceous Vegetation
D= Live Oak - (Cabbage Palmetto) Forest Alliance / Live Oak - (Yaupon) Shrubland
E= Maritime Marsh Elder Tidal Shrub Alliance / Seaside Oxeye Tidal Shrub Flat
F= Mid-Atlantic Coastal Loblolly Pine Forest / Slash Pine Plantation
G= Needlerush High Marsh
H= Overwash Dune Grassland / Sea-oats Temperate Herbaceous Alliance / Centipede Grass Planted Herbaceous Vegetation
I=Reed Tidal Marsh
J=Southern Atlantic Coast Salt Marsh
K=Southern Hairgrass - Saltmeadow Cordgrass - Dune Fingergrass Herbaceous Vegetation
L=Tidal Sawgrass Marsh
M=Coastal Loblolly Pine Wetland Forest

			Field Determination																
	Map Units		**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**Totals**	**User's Accuracy**	**90% Confidence**	
																		-	**+**
Photointerpreter's Determination	**A**		25			1	3	1								30	83%	0%	94%
	B			19		13										32	59%	44%	75%
	C		2		45						6					53	85%	0%	100%
	D		7	5		25		21							2	60	42%	0%	100%
	E			4	2		17		3							26	65%	0%	83%
	F		3	1		2		27							2	35	77%	64%	90%
	G								27			2				29	93%	84%	100%
	H		4							63			2	1		70	90%	0%	100%
	I				2						19			1		22	86%	72%	100%
	J				2		2		3			23				30	77%	62%	100%
	K		2		9					3	1		15			30	50%	33%	100%
	L				1		1			1				2		5	40%	0%	100%
	M														0	0	0%	0%	100%
	Totals		43	29	61	41	23	49	33	67	26	25	17	4	4				
	Producer's Accuracy		58%	66%	74%	2%	74%	55%	82%	94%	73%	92%	88%	50%	0%		**306 Total Correct Points**		
	90% Confidence Interval	**-**	23%	49%	0%	0%	57%	42%	69%	0%	57%	81%	72%	0%	0%		**450 Total Points**		
		+	72%	100%	100%	8%	91%	100%	100%	100%	89%	100%	100%	100%	13%				

Key to Map Class Codes

A= Atlantic Coast Interdune Swale

B= Atlantic Coast Stiff Dogwood Dune Swale / Maritime Red Bay Shrub Swamp

C= Mid-Atlantic High Salt Marsh / Chestnut Fimbry-Common Threesquare Seasonally Flooded Alliance/ Southern Cattail-Giant Foxtail Herbaceous Vegetation

D= Live Oak - (Cabbage Palmetto) Forest Alliance / Live Oak - (Yaupon) Shrubland

E= Maritime Marsh Elder Tidal Shrub Alliance / Seaside Oxeye Tidal Shrub Flat

F= Mid-Atlantic Coastal Loblolly Pine Forest / Slash Pine Plantation

G= Needlerush High Marsh

H= Overwash Dune Grassland / Sea-oats Temperate Herbaceous Alliance / Centipede Grass Planted Herbaceous Vegetation

I=Reed Tidal Marsh

J=Southern Atlantic Coast Salt Marsh

K=Southern Hairgrass - Saltmeadow Cordgrass - Dune Fingergrass Herbaceous Vegetation

L=Tidal Sawgrass Marsh

M=Coastal Loblolly Pine Wetland Forest

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

NPS 603/126787, October 2014

National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov