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Vegetation Mapping at Fort Sumter National Monument

Natural Resource Data Series NPS/SECN/NRR—2012/320

ON THE COVER
Fort Sumter (upper left) and Fort Moultrie (lower right)
Photographs courtesy NPS.gov

Vegetation Mapping at Fort Sumter National Monument

Natural Resource Data Series NPS/SECN/NRR—2012/320

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Executive Summary

The Southeast Coast Network worked with the support of the National Park Service Vegetation Mapping Inventory Program to describe and map vegetation at Fort Sumter National Monument (FOSU). This mapping effort was accomplished through collaboration with the Southeast regional office of NatureServe (Raleigh/Durham, NC).

The mapping area is 137.6 hectares (~340 ac), encompassing the entire boundary of FOSU and an additional area of adjacent private lands. NatureServe ecologists identified plant associations for FOSU and a remote sensing specialist from the Southeast Coast Network completed the vegetation mapping using 1:12,000-scale, color infrared aerial photography and digital orthophotography. NatureServe collected vegetation and environmental data from three vegetation classification plots, and the remote sensing specialist assessed 25 observation points. Assessment of map accuracy entailed sampling 20 additional points. Fieldwork and mapping were completed between 2006 and 2011.

A total of 14 map classes were developed to map the vegetation and general land cover of FOSU and environs, including the following: five map classes representing natural/semi-natural vegetation at the association level in the National Vegetation Classification System (NVCS), one map class representing cultural vegetation (e.g., developed) in the NVCS, and eight 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 dated 31 May 2009 through heads-up-digitizing in ArcGIS (Version 9.3, © 2008 Environmental Systems Research Institute, Redlands, California). Polygons were mapped to a 0.5-ha minimum mapping unit.

A geodatabase containing various feature class layers and tables show the locations of vegetation types and general land cover (vegetation map), vegetation plot samples, accuracy assessment (AA) sites, project boundary extent, and aerial photographic centers. The feature class layer for the FOSU vegetation map provides 43 polygons of detailed attribute data covering 137.6 hectares (340 ac), with an average polygon size of 3.20 hectares (7.93 ac). Of the area mapped, 10 polygons (23.3% of all polygons) represent natural/semi-natural vegetation types in the NVCS, encompassing 17.0 hectares (42.1 ac, 12.4%) of the total map extent.

Summary reports generated from the vegetation map layer indicate that the Wax-myrtle-Carolina Laurel Cherry-Toothache tree Shrubland dominates the vegetated landscape (four polygons covering 8.9 ha), with the Sea-oats Temperate Herbaceous Alliance also covering a considerable portion of the park (two polygons totaling 5.8 ha). The Wax-myrtle-Carolina Laurel Cherry-Toothache tree Shrubland is found on a flat interdunal swale between the fort and primary dunes. The Sea-oats Temperate Herbaceous Alliance is found primarily on dune and foreshore regions.

A thematic accuracy assessment study was conducted on the five map classes within the boundary of FOSU representing floristic types within the NVCS. Results present an overall accuracy of 92.2% (Kappa statistic = 92.6%) based on data from 20 AA sites.

Products resulting from the FOSU 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 a Microsoft Access 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 websites
http://irma.nps.gov/Reference.mvc/Profile?Code=209727
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 accuracy assessment. Special thanks to the staff of Fort Sumter National Monument for their cooperation with this project.

Introduction

Fort Sumter National Monument Vegetation Mapping Project

The Fort Sumter National Monument (FOSU) Vegetation Mapping project was organized and coordinated by the Southeast Coast Network (SECN) between 2006 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 map existing plant associations on approximately 94 hectares (232 ac) of FOSU 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 useful 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 (e.g., 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, and map vegetation communities in more than 270 national park units across the United States. The primary objective of the Vegetation Inventory 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 Inventory and Monitoring (I&M) Program 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 (TNC and ESRI 1994)
- 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
- 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 because the vegetation mapping inventory discussed herein was completed before the revised NVCS hierarchy was available.

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	Shrubland
Subclass	Growth form characteristics including leaf type (evergreen, deciduous) for woody plants and persistent (perennial, annual) herbaceous species	Evergreen shrubland
Group	Leaf morphology (broad leaf, microphyllous, xeromorphic), leaf phenology, and climatic conditions	Temperate broad-leaved evergreen shrubland
Subgroup	Relative degree of human disturbance	Natural/Semi-natural temperate broad-leaved evergreen shrubland
Formation	Additional physiognomic characteristics, general environmental conditions, relative landscape position, and hydrologic regimes	Sclerophyllous temperate broad-leaved evergreen shrubland
Alliance	Dominant or diagnostic species of uppermost or dominant stratum	*Quercus virginiana – Ilex vomitoria – (Morella cerifera)* Shrubland Alliance
Association	Other dominant or diagnostic species from any stratum	*Morella cerifera – Prunus caroliniana – Zanthoxylum clava-herculis* Shrubland

Federal Geographic Data Committee Standards

In addition to vegetation classification, the Federal Geographic Data Committee (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 hectares (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

Fort Sumter National Monument (FOSU) is in Charleston County, South Carolina within the Atlantic Coastal Plain physiographic province (Figure 1). FOSU is comprised of two administrative units: Fort Sumter National Monument, which is on an island at the outer edge of Charleston Harbor, and Fort Moultrie, which is on Sullivan's Island north of Charleston Harbor. Liberty Square, which is in downtown Charleston, is also part of the park administrative boundaries. Liberty Square serves as the park's Visitor Center and departure point for the passenger ferry that transports visitors to Fort Sumter but does not contain significant amounts of natural or semi-natural vegetation relevant to the mapping project.

History

Fort Moultrie was first constructed for the Revolutionary War and was not yet complete when it was attacked on June 28, 1776. After a nine hour battle, the ships were forced to retire, and the fort was named in honor of its commander, Colonel William Moultrie. After the Revolution, Fort Moultrie was neglected and little of it remained by 1791. In 1793, when war broke out between England and France, Congress authorized the first national system of nationwide coastal fortifications. A second Fort Moultrie was completed in 1798, only to be later destroyed by a hurricane in 1804. In 1809 a third Fort Moultrie, one made of brick, stood on Sullivan's Island. Between 1809 and 1860, Fort Moultrie changed very little. During this same time period, Fort Sumter was constructed at the entrance to the Charleston Harbor. The forts ringing Charleston Harbor (Moultrie, Sumter, Johnson, and Castle Pickney) were meant to complement each other, but they actually ended up being opponents. In December 1860 South Carolina seceded from the Union, and the Federal garrison abandoned Fort Moultrie for the stronger Fort Sumter. Three and a half months later, Confederate troops shelled Sumter into submission. In April 1863, Federals bombarded both Fort Moultrie and Fort Sumter, yet Charleston's defenses held. When the Confederate army evacuated Charleston in February 1865, Fort Sumter was little more than a pile of rubble and Fort Moultrie lay hidden under the band of sand that protected its walls from Federal shells. Fort Moultrie was modernized in the 1870s. Then the world wars brought new threats of aerial and submarine attack and required new means of defense at the forts. Today, Fort Moultrie and Fort Sumter have been restored to portray the major periods of their history (Figures 2 and 3). At Fort Moultrie, a visitor can move back through time from the World War II Harbor Entrance Control Post to the site of the first Palmetto-log fort in 1776. (Taken from http://www.nps.gov/fosu/historyculture/fort_moultrie.htm).

Vegetation

Natural/semi-natural vegetation (as defined by the NCVS) is limited in extent at both Fort Moultrie and Fort Sumter. At Fort Sumter, Southern Atlantic Coast Salt Marsh is located south of the fort (Figure 4). At Fort Moultrie, the largest vegetation community is the Wax-myrtle-Carolina Laurel Cherry-Toothache-tree Shrubland, which is located between the fort and the primary dunes (Figure 5).

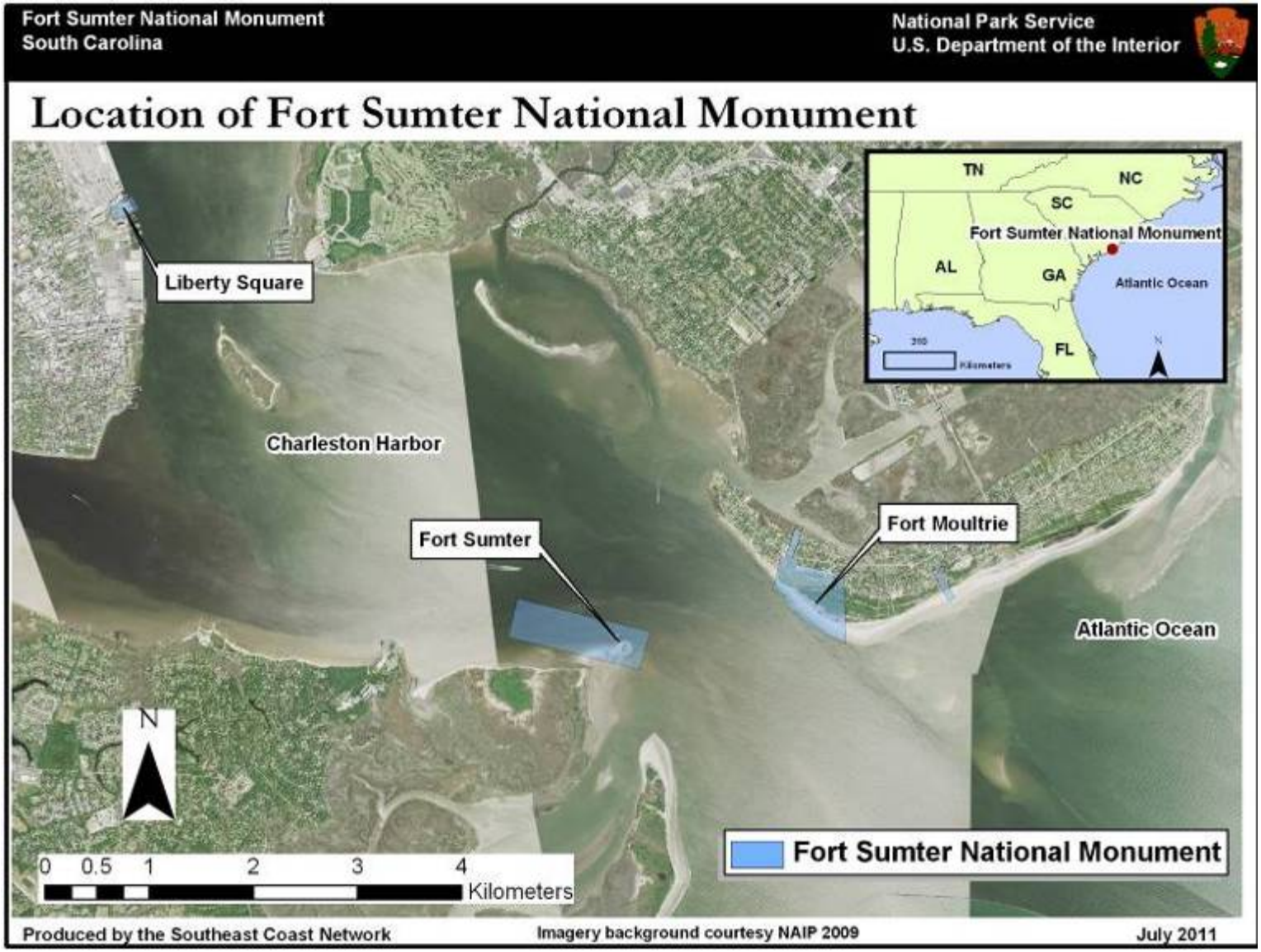

Figure 1. Location of Fort Sumter National Monument in South Carolina.

Figure 2. Fort Moultrie as it appears today, restored to portray the major periods of its history (courtesy NPS.gov).

Figure 3. Fort Sumter as it appears today, restored to portray the major periods of its history.

Figure 4. Vegetation at Fort Sumter includes Southern Atlantic Coast Salt Marsh.

Figure 5. The largest vegetation association found in Fort Moultrie is the Wax-myrtle – Carolina Laurel Cherry – Toothache-tree Shrubland located between the fort and the dunes.

Climate and Weather

Summer months at FOSU are hot and humid. The mean monthly maximum temperature in July ranges 30.1–31.0ºC (86.2–87.8ºF; 1961–1990). Winter months at FOSU are typically mild with only brief cold spells. The mean monthly minimum temperature in January ranges 4.1–6.0ºC (39.3–42.8ºF; 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. FOSU receives an average precipitation amount of 1,201–1,400 mm/year (47.3 – 55.1 in/year; 1961-1990; Davey et al. 2007).

Soils

There are two soil types within the main park boundaries of FOSU where natural vegetation occur: Coastal Beaches and Dune Land and Made Land (Figure 6). The Liberty Square portion of the park occurs on Urban Land of the Yauhannah-Yemassee-Ogeechee Association, but this unit of the park does not have natural or semi-natural vegetation of any considerable area. The Coastal Beaches and Dune Land soil consist mainly of sandy shoreline and sand dunes that border the Atlantic Ocean. The shoreline areas are flooded twice a day by ocean tides. Dunes are composed of dry, loose, pale sand that are mounded and shaped by the wind. As expected, this soil type has very low water capacity and low organic content. Plant cover can often be sparse or lacking, and water erosion from storms and hurricanes are frequent disturbances. The Made Land soil type is composed of areas that have been excavated, filled, or otherwise disturbed by man. The composition, color, and texture of this type are highly variable. These soils contain varying amounts of sand, silt, clay, and/or seashell fragments (USDA-SCS 1971).

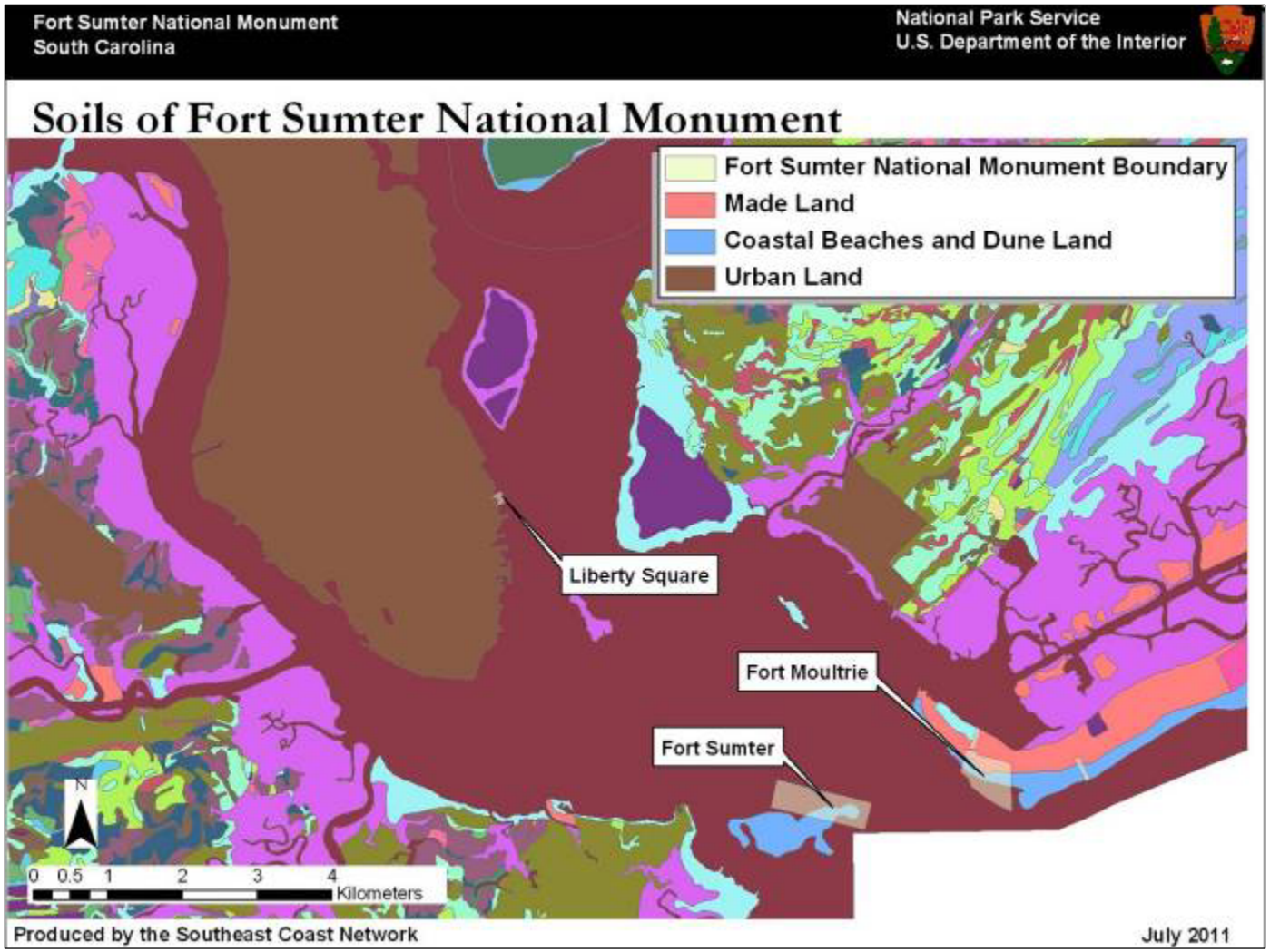

Figure 6. Soils of Fort Sumter National Monument (Data from SSURGO).

Project Scoping and Planning

In 2005, the Southeast Coast Network of the National Park Service proposed to develop vegetation classification and maps for 16 parks in the SECN (Cape Hatteras National Seashore, Cape Lookout National Seashore, Fort Sumter National Monument, 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 FOSU vegetation mapping boundary extent includes 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 137.6 hectares (340 ac), with 93.9 hectares (232 ac) occurring within park boundaries and the remaining 43.7 hectares (108 ac) 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 FOSU. Published floristic information, the plant-species list of FOSU, and expert local knowledge, including NPS staff at FOSU, 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.). Plots were deliberately placed in certain areas in order to capture the diversity of vegetation communities at the park. Plot size was 10 m × 20 m for the three plots sampled and was decided at the time of sampling based on which dimension would most adequately characterize the vegetation sampled in each plot. Three vegetation plots were sampled in FOSU in December 2007 (Figure 7).

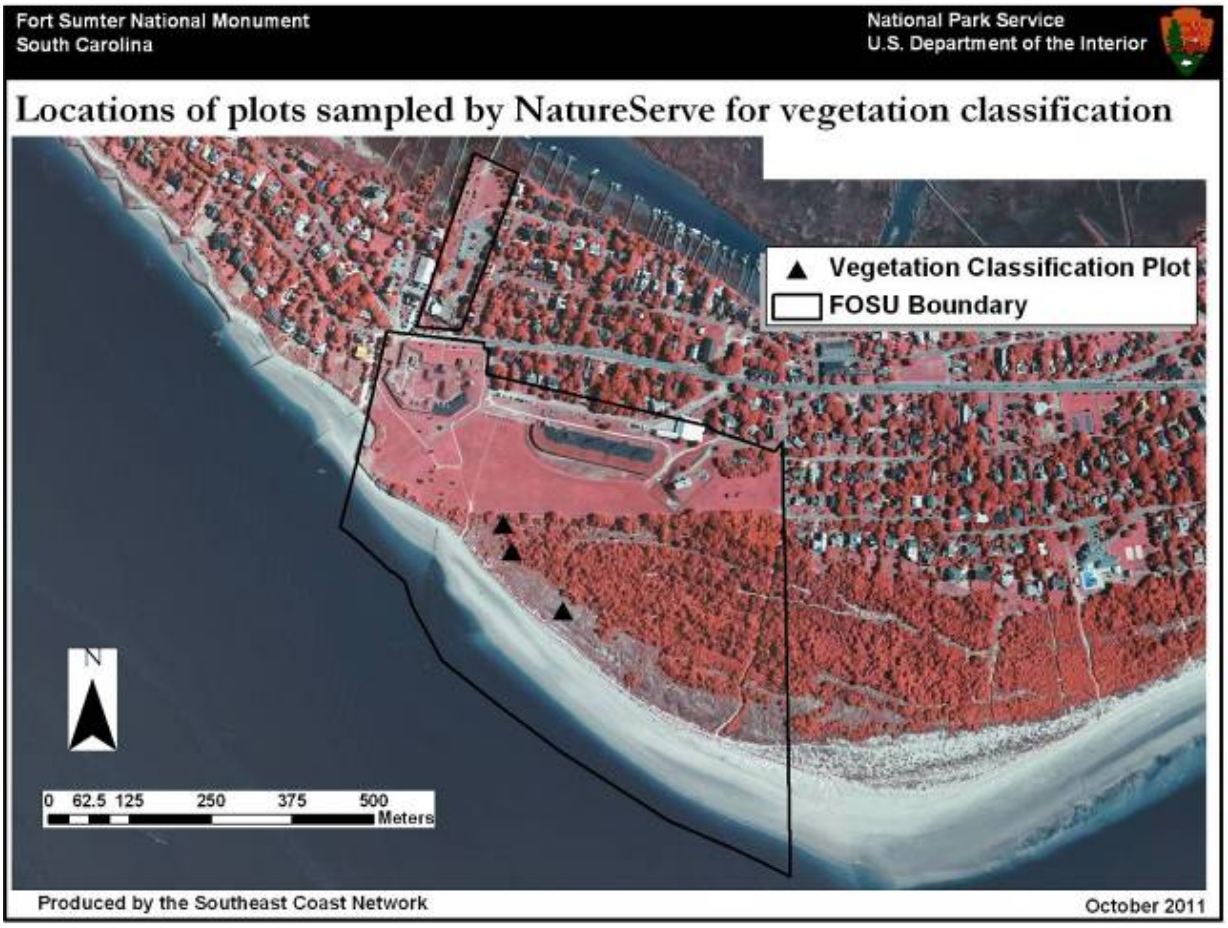

Figure 7. Locations of plots sampled in Fort Sumter National Monument used for vegetation classification by NatureServe.

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

The locations of the vegetation plots were not permanently marked. The bounds of each plot were marked temporarily using measuring tapes (Figure 8). The Universal Transverse Mercator (UTM) coordinates at the center of each lot were recorded (Zone 17, NAD83) on Garmin hand-held GPS receivers.

Figure 8. Example of a vegetation classification plot for the Fort Sumter National Monument vegetation mapping project (Photo courtesy of Southeast regional office of NatureServe).

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.

Other Ancillary Information Useful to Classification

Field crews could record 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.

Table 2. Vegetation height and cover classes used in the Fort Sumter National Monument Vegetation Mapping Project.

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

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, NRCS 2012). Data were thoroughly proofed after entry to minimize errors.

Due to a relatively small sample size, cluster analysis techniques that have been traditionally used in other vegetation mapping projects to generate vegetation classifications were not used for FOSU. 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.). The Vegetation Classification combined the vegetation at Fort Sumter National Monument with that at Fort Pulaski National Monument (FOPU) based on similar vegetation communities occurring at these two parks. The vegetation associations and descriptions can be found on the NatureServe Explorer (see http://www.natureserve.org/explorer/index.htm) (NatureServe 2009).

Addition to the FOSU Vegetation Classification by the *SECN*

During the field verification step of photo-interpretation (see more below), the SECN remote sensing specialist identified an additional vegetation community that had not been included in the original Vegetation Classification developed by NatureServe. The Tallowtree Seasonally Flooded Forest Alliance (A.335) was added to the Vegetation Classification based on a small (but mappable) wetland inclusion found within the Wax-myrtle-Carolina Laurel Cherry-Toothache-tree Shrubland. This area is dominated by the exotic Tallowtree (*Triadica sebifera*) and also contains Carolina Willow (*Salix caroliniana*), Wax-myrtle (*Morella cerifera*), Virginia saltmarsh mallow (*Kosteletzkya virginica*), smallspike false nettle (*Boehmeria cylindrica*), peppervine (*Ampelopsis arborea*), saltmarsh morning glory (*Ipomoea sagittata*), and various wetland grasses and sedges (Figure 9).

Figure 9. Tallowtree Seasonally Flooded Forest Alliance in Fort Sumter National Monument.

Final Map Classifications

Once the associations/alliances were finalized, a dichotomous key that was originally developed by NatureServe and later revised by the SECN based on the addition to the Vegetation Classification (Appendix C), was finalized for use during field reconnaissance by the photo-interpreter and for use during the accuracy assessment. The key includes vegetation communities present at both FOSU and FOPU since the vegetation at these two park communities were analyzed together by NatureServe. The full NVCS hierarchical classification and global descriptions are available in Appendix B. FOSU specific vegetation (i.e., local) descriptions were written based on FOSU 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 remote sensing specialist.

Vegetation that did not fall into the natural/semi-natural category (e.g., warm season lawn) was assigned to the Cultural Vegetation of the NVCS at the Type level (NVCS Version 2, FGDC 2008).

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).

‘Fort’ is a specific modifier we included under ‘Urban and Built-up Land’. The ‘Other Urban or Built-Up Land’ category was used to characterize maintained turf grass areas within the park, which also falls under the cultural vegetation category as “Warm Season Lawn.” The ‘Commercial and Services’ category was used to map areas containing buildings and facilities. The ‘Residential’ category was used to map private residences. The ‘Transportation, Communications, and Utilities’ category was used to map roads and parking lots.

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 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 hectares.
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 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 10). 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:

1. 11 photographs

2. 234 image points

3. 8 Horizontal and Vertical ground control points

4. 7.8 microns image sigma

5. 207 degrees of freedom

6. Root mean square error of residuals for 8 ground control points:
   a. 0.029 meters for horizontal-control eastings
   b. 0.028 meters for horizontal-control northings
   c. 0.024 meters for vertical control

7. Root mean square error of residuals for 11 ABPGS exposure station control points:
   a. 0.024 meters for horizontal-control eastings
   b. 0.009 meters for horizontal-control northings
   c. 0.046 meters for vertical control.

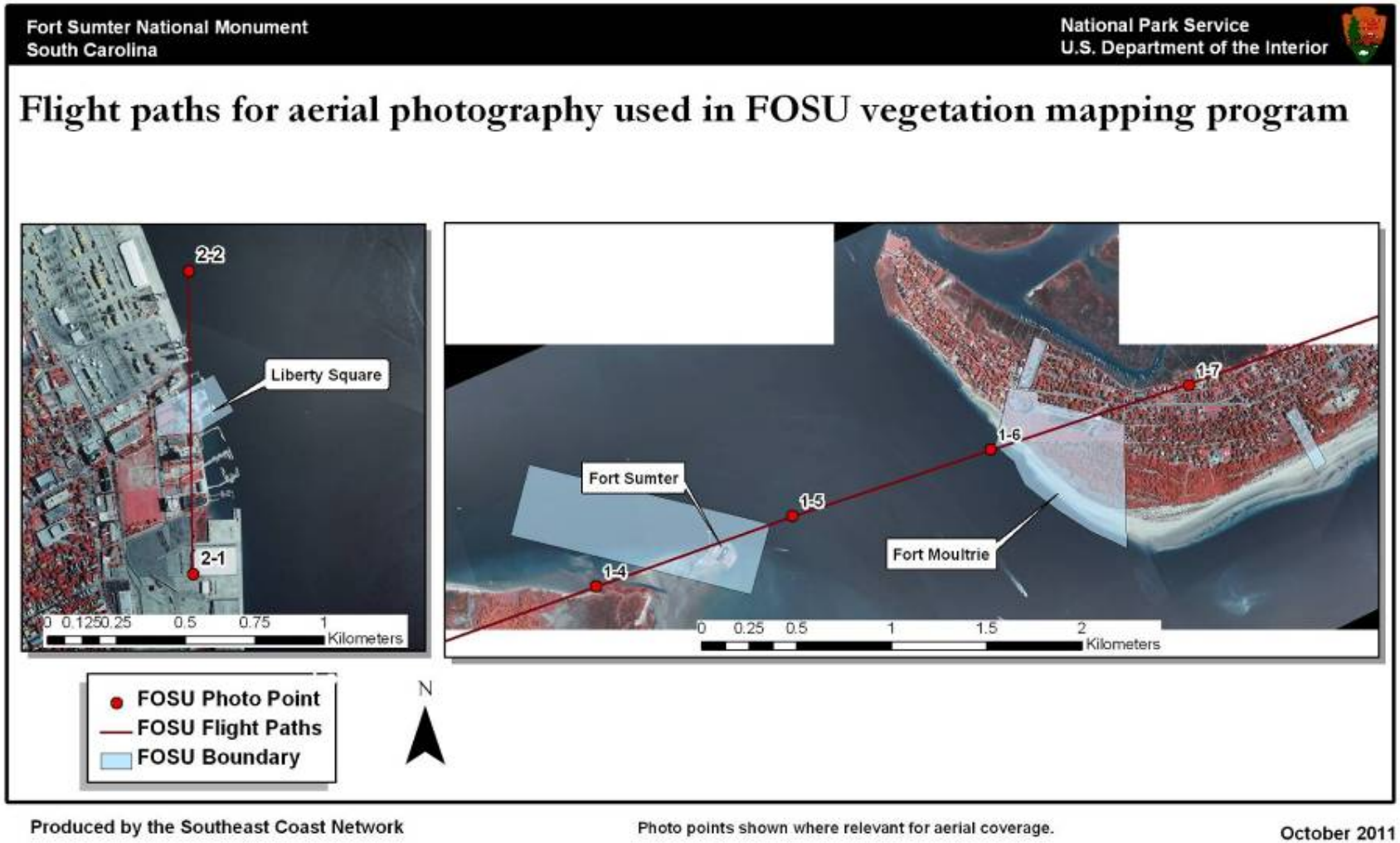

Figure 10. Flight path for the 2009 color infrared aerial photography coverage of Fort Sumter National Monument.

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 vegetation mapper(s) to identify particular areas of interest to visit during the field reconnaissance step. For this preliminary mapping, the 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 ArcGIS (Version 9.3, © 2008 Environmental Systems Research Institute, Redlands, California).

Field Reconnaissance

The purpose of this step is to train the vegetation mapper(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 represent a particular vegetation association on the imagery. 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 photo-interpretor to identify diagnostic characteristics on the imagery that can be tied directly to a vegetation association is a key component to successful 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 photo-interpreter 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. Unfortunately, there are still instances where a photo-signature cannot clearly be identified for each association. In these instances it is allowable to pool associations and map at a higher level of the hierarchy, or with less accuracy (ESRI 1994).

A field reconnaissance trip was taken to FOSU in February 2011. During this trip, the 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 rensing 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 (as possible) by using the key developed by NatureServe and revised by the SECN. 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 remote sensing specialist developed a photo-interpretation guide that aided the delineation of vegetation classes (see Appendix D). Standard photo-signature characteristics were applied during the photo-interpretation, 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 ArcGIS version 9.3. 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, 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 Fort Sumter National Monument Vegetation 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 FOSU in June 2011 for field verification. Field verification allows the vegetation mapper(s) 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) and revised by SECN. Difficulties in determining association, if any, were documented on the field sheet (same field sheet used during field reconnaissance).

Accuracy Assessment

The main goal of an accuracy assessment (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 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 isn't 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 happen to 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 as 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 FOSU. 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. Based on these criteria, five map classes were eligible for sampling.

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

Four of the five vegetation classes sampled in the AA covered less than 8.33 hectares; therefore these six map classes warranted five observations each. The one remaining map class (Wax-myrtle-Carolina Laurel Cherry-Toothache-tree Shrubland) was slightly over the 8.3 hectares threshold at 8.9 hectares. Based on the guideline of 0.6 observations per hectare, the number of observations was calculated to be five. Following this sampling criteria, the total number of AA observations for FOSU was 25. However, the minimum sampling size for several of the map classes had to be further reduced in order to ensure that the observation sites would be spatially independent (non-overlapping). After this reduction, the final number of AA sites for FOSU was 20 (Figure 11).

In order 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, wherever possible. Because most of the polygons were small in size, and several were linear in shape, we were only able to buffer the largest polygons (the Wax-myrtle-Carolina Laurel Cherry-Toothache-tree Shrubland polygon and the Sea-oats-Beach Pennywort Herbaceous Vegetation polygon). The AA points were generated randomly in ArcGIS using the Create Random Points tool in ArcToolbox.

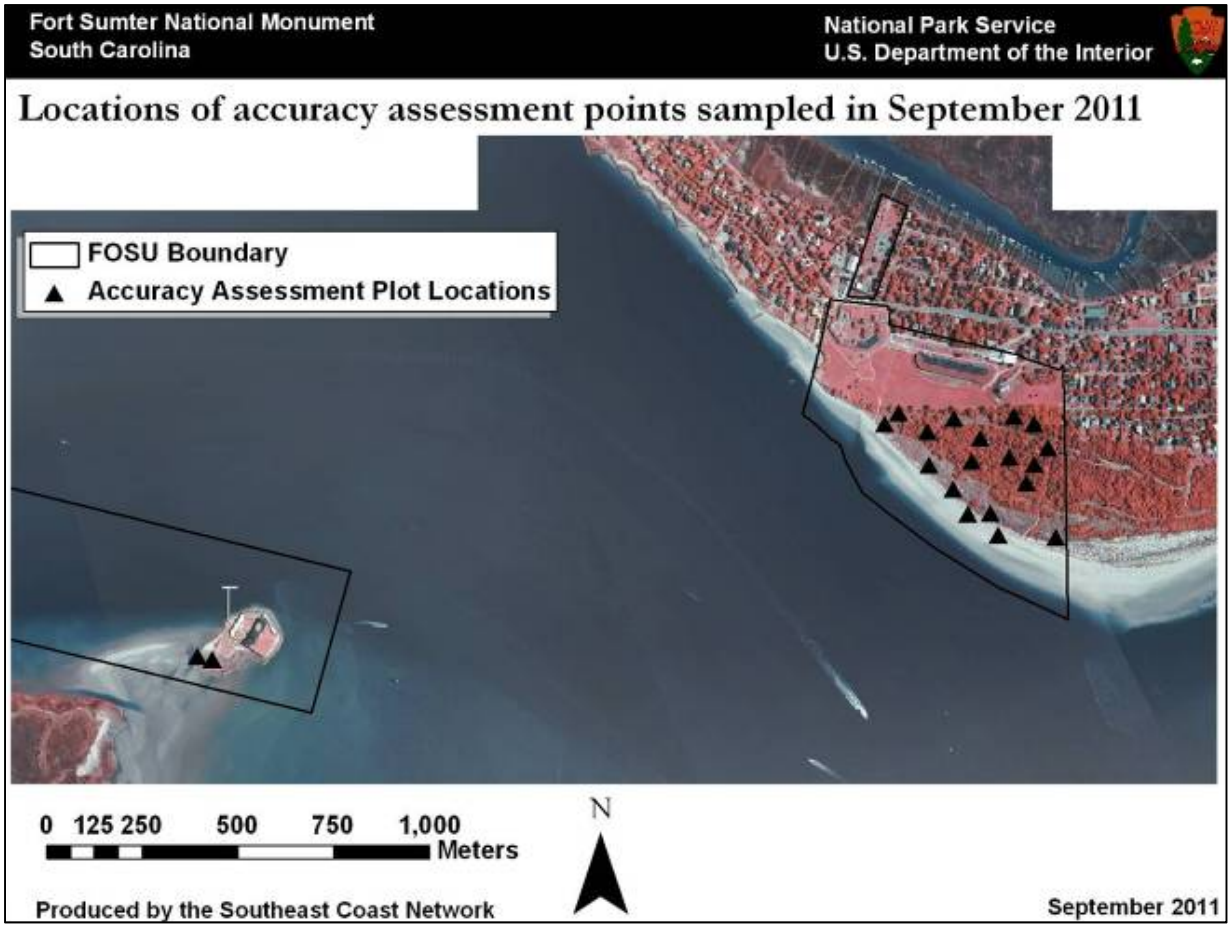

Figure 11. Locations of accuracy assessment points sampled in Fort Sumter National Monument.

Field Data Collection

Accuracy assessment point data were collected at FOSU during September 2011. Staff 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, field crews used copies of the ortho-photographs 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 staff assessed the site within an area of equal size to the minimum radius (ha) of the observation area following methodology outlined by Lea and Curtis (2010). At each AA point, SECN staff collected environmental data such as hydrology, topography, etc., where meaningful. 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 SECN staff 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 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.

<u>Initial Comparative Analysis</u>

We used the Intersect Tool in Arc Toolbox 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.

<u>Review of Disagreements</u>

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. This review process involved looking at the AA sites and their corresponding polygons in ArcGIS in order to locate them and view them on the aerial photographs. 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. None of the mismatches were determined to be a result of a false error. Therefore, we used all 20 of the 20 AA field sites for the final comparative analysis of the vegetation map layer.

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 (ESRI et al. 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 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 (from Lea and Curtis 2010; see Appendix G).

We examined the overall accuracy and the accuracy for each map-class on an individual basis to determine if accuracy requirements of the NPS VIP were met. Based on these results, we determined whether or not it would be necessary to merge certain map classes to gain higher accuracy. The original overall accuracy did not meet the NPS VIP accuracy standard of 80% (overall accuracy = 73.2%; 90% confidence interval: 57.2– 89.2%). Upon review of where most of the errors in the AA occurred, we determined that it would be beneficial to merge three of the original classes: the Seaside Greenbrier/Camphor Goldenaster-Trailing Wild Bean-(Sea-oats) Herbaceous Vegetation, the Sea-oats-Beach Pennywort Herbaceous Vegetation, and the Sea Rocket Sparsely Vegetated Alliance (the latter was added by SECN, not NatureServe, after the field reconnaissance). We merged these classes to the alliance level and classified them as the Sea-oats Temperate Herbaceous Alliance. After merging these classes, the overall accuracy improved greatly and met the NPS VIP standard. The values reported in the final sample contingency table and final population contingency table (Appendix G) reflect the accuracies after this merge in classes was made.

AA Spatial Database

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

Results

Vegetation Classification

The final classifications for FOSU (reflecting the addition that the SECN made to the associations developed by NatureServe as well as the merge made following the AA) resulted in five vegetation associations in the NVCS (see Appendix B for full association descriptions).

Land management practices, hydrology, climate, soil type, and disturbance are just a few of the factors that have strongly influenced the types and distributions of vegetation communities represented in FOSU. We will highlight three specific examples where disturbance and coastal change processes have significantly impacted the present-day vegetated communities.

The SECN noted during field reconnaissance and the AA that the Wax-myrtle-Carolina Laurel-Toothache-tree Shrubland, in most places observed, was structurally more consistent with a forested area rather than a shrubland. While species composition matched well with the description provided by NatureServe for the shrubland (see Appendix B), during the AA SECN staff noted that many individuals present, especially *Celtis laevigata* (sugarberry) were 5–8 cm diameter at breast height (DBH), with some individuals reaching over 20 cm DBH. Heights of species present were 10–15 m. These diameters and heights are larger than the diameters and heights of a typical "shrubland." While the description of the Wax-myrtle-Carolina Laurel-Toothache-tree Shrubland provided by NatureServe (see Appendix B) does mention a moderate (40% cover) tree canopy 10–15 m tall, the present-day canopy at Fort Moultrie was generally closed throughout. Based on these observations, we considered changing the vegetation classification from a shrubland to a forested class. However, because the species composition fit so well to the shrubland class, and since the area lacked any recent, large-scale disturbance (i.e., hurricane), we determined that the Wax-myrtle-Carolina Laurel-Toothache-tree Shrubland was still the best fit. We reasoned that it is highly likely that a future disturbance will return this community to a structure that is more similar to what is described in the NatureServe classification.

The introduction of an exotic species to a natural community is another type of disturbance that can shape species composition. The SECN identified a mappable area of Tallowtree Seasonally Flooded Forest Alliance in FOSU. Native to China and Japan, Tallowtree (*Triadica sebifera)* was introduced to the lower Gulf Coastal Plain as an ornamental and has become an aggressive weed tree of the southeastern United States capable of transforming important natural communities into monospecific Tallowtree forests (NatureServe 2009). Within FOSU, the Tallowtree community occupies a vegetated wetland that in the absence of Tallowtree would be dominated largely by Carolina Willow (*Salix caroliniana*) and Seaside Hibiscus (*Kosteletzkya virginica*).

The Southern Atlantic Coastal Salt Marsh at Fort Sumter is very frequently inundated. The area where this vegetation community occurs within park boundaries is on a spit off of the backside of the fort, a spit that from appearances may only be temporary. Natural coastal processes in addition to potential future sea-level rise could result in inundation too extreme for the continued survival of smooth cordgrass (*Spartina alterniflora*) in this area.

Digital Imagery and Interpretation

For FOSU, five map units were developed and directly matched to the corresponding final vegetation associations in the NVCS (Table 6). One map class representing cultural vegetation in the NVCS (e.g., Warm Season Lawn) was identified. Eight map classes representing non-vegetated units (e.g., open water bodies, buildings, roads, etc.) were identified (Table 7).

Table 6. Final vegetation associations of the NVCS used for vegetation mapping (with their assigned Map Codes) in Fort Sumter National Monument.

	Association (or Alliance) Common Name	NVCS Code	Map Code
Forest			
	Tallowtree Seasonally Flooded Forest Alliance	A. 335	FOREST
Shrubland			
	Wax-myrtle-Carolina Laurel Cherry-Toothache-tree Shrubland	CEGL004484	SHRUB1
	Atlantic Coast Interdune Swale	CEGL003839	SHRUB2
Herbaceous			
	Sea-oats Temperate Herbaceous Alliance	A. 1199	HERB1
	Southern Atlantic Coast Salt Marsh	CEGL004191	HERB2

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

Map Class Code	Anderson Land Use and Land Cover Level II (Anderson et. al 1976)
11	Residential
12	Commercial and Services
14	Transportation, Communication, and Utilities
18	Fort (Modified for this project)
54	Bays and Estuaries
72	Beaches
73	Sandy Areas other than Beaches
74	Bare Exposed Rock

The size of the park allowed very thorough examination of subtle vegetation characteristics and photo-signatures on the imagery as well as on the ground. 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.

Vegetation Map

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

Collectively, the FOSU spatial database layer is composed of 43 polygons covering 137.5 ha, with an average polygon size of 32.1 ha. Map classes representing natural/semi-natural types in the NVCS apply to 10 polygons (23.3% of all polygons) covering 17.0 ha (12.4 % of entire area) with an average polygon size of 1.71 ha. Of these natural/semi-natural types, the Wax-myrtle-Carolina Laurel Cherry-Toothache-tree Shrubland dominates, both in frequency of polygons (4),

and in size (8.9 hectares). The Sea-oats Temperate Herbaceous Alliance also covers a considerable portion of the park (5.83 ha). The Wax-myrtle-Carolina Laurel Cherry-Toothache-tree Shrubland dominates the flat interdunal swale located between the fort and primary dunes at Fort Sumter. The Sea-oats Temperate Herbaceous Alliance mainly covers the primary dunes at Fort Sumter.

The single cultural type in the NVCS (Warm Season Lawn) consists of three polygons (7.0% of all polygons) and covers 8.13 ha (5.9% of the entire area). This particular type accounts for the maintained lawns surrounding the forts at both Fort Sumter and Fort Moultrie.

Non-vegetated areas (including developed areas) consist of 30 polygons (69.8% of all polygons) and cover 112.4 ha (81.7% of the entire area). Developed areas in the park include the NPS visitor center and maintenance buildings, roads, and residential and commercial buildings within the project boundary.

Vegetated wetlands consist of three polygons (7.0% of all polygons) and cover 1.88 ha (1.4% of entire area). Vegetation associations in the NVCS that are considered wetlands according to the U.S. Fish and Wildlife Service include the following: Southern Atlantic Coast Salt Marsh and Tallowtree Seasonally Flooded Forest Alliance.

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 Fort Sumter National Monument.

Map Class	Park Boundary and Buffer			Within Park Boundary Only		
Natural/Semi-natural Vegetation	**Frequency (# polygons)**	**Mean (ha)**	**Sum (ha)**	**Frequency (# polygons)**	**Mean (ha)**	**Sum (ha)**
Tallowtree Seasonally Flooded Forest Alliance	1	N/A	0.4	1	N/A	0.4
Wax-myrtle-Carolina Laurel Cherry-Toothache-tree Shrubland	4	2.2	8.9	4	1.9	7.6
Atlantic Coast Interdune Swale	1	N/A	0.4	1	N/A	0.4
Sea-oats Temperate Herbaceous Alliance	2	2.9	5.8	2	2.6	5.1
Southern Atlantic Coast Salt Marsh	2	0.7	1.5	2	0.2	0.5
Natural/Semi-natural Vegetation subtotal:	**10**	**1.71**	**17.0**	**10**	**1.4**	**14.0**
Cultural Vegetation						
Warm season lawn	3	2.7	8.1	3	2.7	8.0
Cultural vegetation subtotal:	**3**	**2.7**	**8.1**	**3**	**2.7**	**8.0**
Non-Vegetated Areas						
Residential	6	1.7	10.1	4	0.5	2.2
Commercial and Services	3	2.3	6.8	3	1.1	3.3
Transportation, Communications, and Utilities	3	0.6	1.8	3	0.4	1.3
Fort	4	1.2	4.6	4	1.2	4.6
Bays and Estuaries	6	13.3	79.7	3	17.9	53.8
Beaches	2	4.2	8.3	2	2.9	5.8
Sandy Areas other than Beaches	3	0.04	0.13	3	0.04	0.13
Bare Exposed Rock	3	0.3	0.8	3	0.3	0.8
Non-Vegetated Areas subtotal:	**30**	**3.7**	**112.4**	**25**	**2.9**	**71.9**
Grand Total:	**43**	**3.1**	**137.5**	**38**	**2.5**	**93.9**

Map Layer Presentation

Figure 12 presents the map layer produced for the FOSU vegetation mapping project. The map is shown at its finest level, i.e., vegetation classes are shown at either the association or alliance level. The boundary for FOSU and the mapping boundary for the project are both included. Figure 13 presents the vegetated wetlands in FOSU.

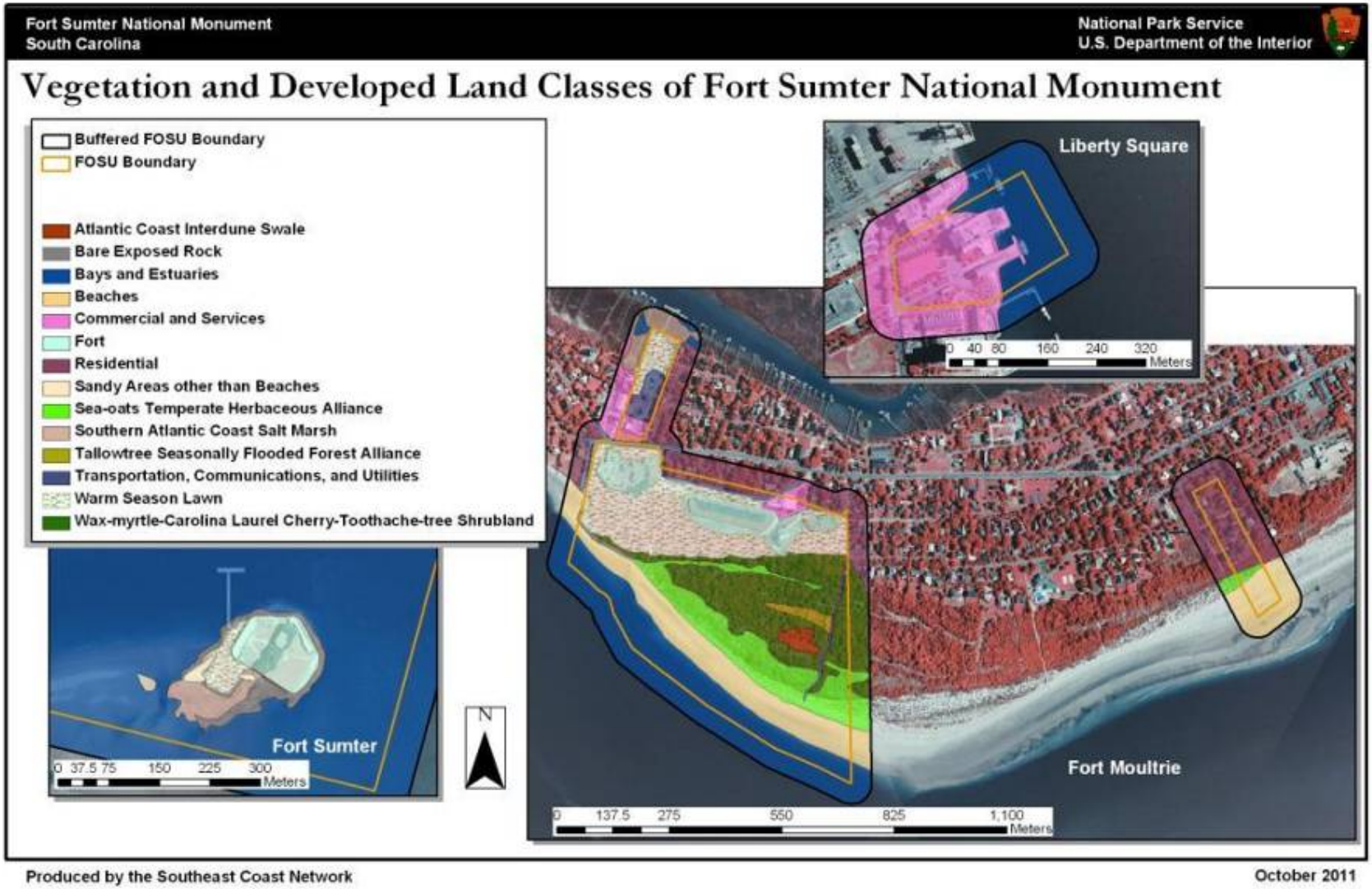

Figure 12. Vegetation (NVCS 2008) and Land Use (Anderson et al. 1976) map classes for Fort Sumter National Monument.

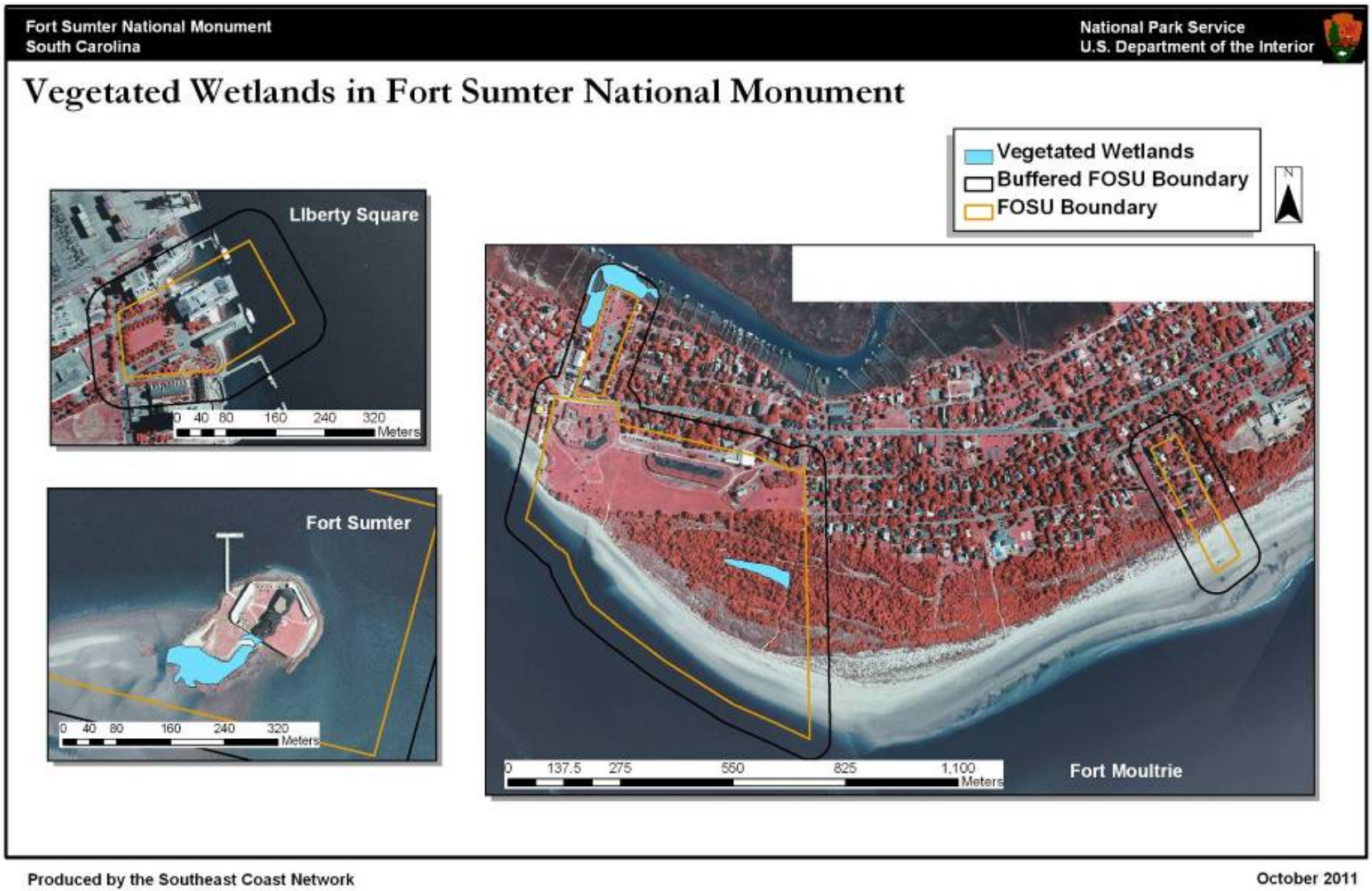

Figure 13. Distribution of vegetated wetlands (Cowardin et al. 1979) in Fort Sumter National Monument.

Accuracy Assessment

Overall accuracy was 92.2% (90% confidence interval (CI): 80.3–100%) 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 92.6% (90% CI: 80.6–100%). These values represent the accuracies calculated after three of the vegetation classes were merged in order to meet the 80% accuracy requirement established by the NPS VIP. The sample and population contingency matrices for AA results are provided in Appendix G. 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 confidence interval is affected by the sample size used to derive the point estimate.

Some individual classes, however, did not meet the 80% accuracy requirement. The following are map classes that did not meet the required accuracy, either with the actual percentage or within the confidence intervals.

User's Accuracy (Errors of Commission)

The lower end of the confidence interval of the user's accuracy for the Wax-myrtle-Carolina Laurel Cherry-Toothache-tree Shrubland dipped below 80% (accuracy = 85.7%; 90% CI: 56.8–100%). One of the seven AA points sampled in the Wax-myrtle-Carolina Laurel Cherry-Toothache-tree Shrubland was determined to be Atlantic Coast Interdune Swale. That error, coupled with the influence of a relatively small sample size (which was an issue for all classes sampled), caused the confidence interval for the accuracy of this class to drop below the standard. The user's accuracy for the Atlantic Coast Interdune Swale is 0% because it was not included as one of the vegetation classes prior to the AA, but during the AA one of the points was classified as this class.

Producers' Accuracy (Errors of Omission)

Similar to the user's accuracy, the producer's accuracy for the Atlantic Coast Interdune Swale is also 0% since it was not included as one of the vegetation classes prior to the AA.

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Appendix A: Field Survey Form

NPS SE COAST PROJECT: Plot Sampling Form Page 1

County: Chatham Charleston Park: Fort Sumter Fort Pulaski Plot Code: FOSU01 State: GA SC Location org: NPS

Provisional community name

Classified community name Uniola paniculata - Hydrocotyle bonariensis Herbaceous Vegetation

Classifier _____ *Date* 1/16/08 *NVC ELCODE* CEGL 004040

Survey date: 12/31/07 **time** 10 : 00 AM **Surveyors initials:** JMG

Directions to plot (including any notes on best access route, and mile marker):

Just off the beach 1/4 mile east of the Station 13 Beach Access

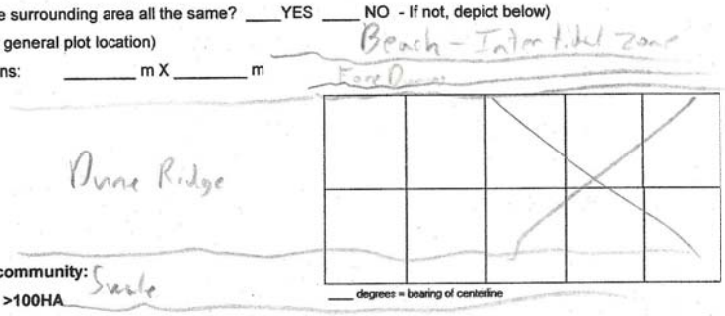
Time taken to walk to plot: 3-5 mins from Fort Moultrie

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: _____ m X _____ m



Est. Extent of occurrence of community: Swale

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

PIC # FOSU01N - FOSU01W **Description of pictures (N,E,S & W from GPS point at middle of plot) :**

FOSU01N, FOSU01E, FOSU01S, FOSU01W

Select one: UTM / Lat/long (If lat/long, then values are 32° 45.372' N 79° 51.343' W (degrees decimal minutes)

GPS Techniques/Equipment: Garmin V **Datum(pick one)** WGS84 / NAD83 / NAD27 **UTM Zone:** 17

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

Field UTM X _____ **m E Y** _____ **m N Elevation** 2 m / ft

Averaging performed (at least 120 observations)? X **Coordinate accuracy** 7.8 m / ft **DOP** _____ **# sats** 9 WAS 11 total 17

Community Survey
Page 1

NPS SE COAST PROJECT: Plot Sampling Form Page 2

County: Chatham Charleston Park: Fort Sumter Fort Pulaski Plot Code: FOSU01 State: GA SC Location org: NPS

ENVIRONMENTAL / SITE INFORMATION

Measured Slope _____ ° _____ %

- X 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 °)

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

Topographic Position

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

Cowardin System

- X Upland
- __ Palustrine
- __ Estuarine
- __ Lacustrine
- __ Riverine

Landform (check most applicable)

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

Rock types present:

Hydrologic Regime:

X 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:

Well-drained/sand dune ridge

B) LANDSCAPE AND LANDUSE HISTORY (including disturbance history and possible threats to sustainability):

Recently (<30yrs.) accreted dune system; subject to overwash during storm events

Soil Texture:

- X Sand
- __ Peat
- __ Silt loam
- __ Muck
- __ Sandy loam
- __ Loam
- __ Clay loam
- __ Clay

Drainage:

- X 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
- ____% Large rocks (cobbles, boulders >10cm)
- ____% Small rocks (gravel, 0.2-10 cm)
- ____% Loose sand (0.1-2 mm)
- 15 % Litter, duff
- ____% Wood (> 1 cm)
- ____% Water
- 85 % Bare soil
- ____% Other _____

Leaf type:

- __ Broad-leaved
- __ Needle-leaved
- __ Microphyllous
- X Graminoid
- __ Broad-leaved herbaceous
- __ Pteridophyte
- __ Extremely xeromorphic
- __ Succulent
- __ Mixed

Leaf phenology (dominant stratum)

- __ Evergreen
- __ Cold-deciducus
- __ Drought-deciduous
- __ Mixed evergreen-cold-deciduous
- __ Mixed evergreen drought deciduous
- __ Herb - Annual
- X Herb - Perennial

Physiognomic Class

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

Natural and Anthropogenic Disturbance

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

Disturbance and animal use comments:

Salt spray

Community Survey

Page 2

NPS SE COAST PROJECT: Plot Sampling Form Page 3

County: Chatham Charleston Park: Fort Sumter Fort Pulaski Plot Code: FOSU01 State: GA SC Location org: NPS

QUANTITATIVE VEGETATION SAMPLE "DEFAULT" TAXONOMIC REFERENCE: Weakley 2007

STRATA	STRATA HEIGHT (1 only)	COVER CLASS	DOMINANT/DIAGNOSTIC SPECIES	Height scale (use tallest one for strata)	% cover for strata = top of cover class
Emergent – T1				< .5m 1	0-5% 1
Tree Canopy T2				.5-1m 2	5-10% 2
Subcanopy T3				1-2m 3	10-20% 3
Tall shrub S1				2-5m 4	20-30% 4
Short shrub S2				5-10m 5	30-40% 5
Herbaceous			Uniola paniculata / Andropogon virginicus / Panicum amarum	10-15m 6	40-50% 6
Non-vascular				15-20m 7	50-60% 7
Vine/liana			Smilax auriculata	20-35m 8	60-70% 8
Other notable species (indicators of distinctive conditions, e.g. high pH soil, elevation, geographic region, other particularly abundant species):				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 ?
					8				8	Uniola paniculata		
					2				2	Andropogon virg		
					2				2	Panicum amarum		
							3		3	Smilax auriculata		
					2				2	Heteranthera subbaxilaris		
					2				2	Opuntia pusilla		
					2				2	Hydrocotle bonariensis		
					2				2	Spartina patens		
					2				2	Oenothera humifusa		
					2				2	Aster tenuifolia		
					2				2	Panicum virg. var. virg.	X	X
					2				2	Croton punctatus		
					2				2	Yucca aloifolia		
					2				2	Yucca gloriosa		
					2				2	Cenchrus tribuloides	X	X

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
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Appendix B: Descriptions of Vegetation Types

This subset of the International Ecological Classification Standard covers associations and alliances attributed to Fort Sumter National Monument. 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.

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

NatureServe. 2008. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 24 April 2008.

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Forest (I.)

Lowland temperate seasonal evergreen forest (I. A.4.N.a)

Quercus virginiana – (Sabal palmetto) Forest Alliance (A.55)

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)

Similar Alliance Comments: Also compare other West Gulf Coastal Plain *Quercus virginiana* alliances.

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

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 Caroline, Fort Matanzas, 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?)

(CEGL007813) Cedar - Live Oak - Cabbage Palmetto Marsh Hammock

***Juniperus virginiana var. silicicola - (Quercus virginiana, Sabal palmetto)* Forest**
Coastal Red-cedar - (Live Oak, Cabbage Palmetto) Forest

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	Lowland temperate seasonal evergreen forest (I.A.4.N.a.)
Alliance	Quercus virginiana - (Sabal palmetto) Forest Alliance (A.55)
Alliance (English name)	Live Oak - (Cabbage Palmetto) Forest Alliance
Association	Juniperus virginiana var. silicicola - (Quercus virginiana, Sabal palmetto) Forest
Association (English name)	Coastal Red-cedar - (Live Oak, Cabbage Palmetto) Forest
Association (Common name)	Cedar - Live Oak - Cabbage Palmetto Marsh Hammock
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)

Element Concept

Global Summary: This association occupies marsh hammocks (small islands surrounded by tidal marsh) along the South Atlantic Coast from eastern North Carolina south through South Carolina and Georgia to northeastern Florida. Related vegetation along central Florida spring runs is also covered here for now. The canopy can be relatively open or completely closed. *Juniperus virginiana var. silicicola* (southern redcedar) typically dominates the canopy, while other species such as *Quercus virginiana* (live oak), *Sabal palmetto* (cabbage palmetto), and *Celtis laevigata var. laevigata* (sugarberry) may be present. This association is related to other associations in this alliance in the same geographic range but differs in being shorter in stature, coastal red-cedar-dominated, with fewer strata, and floristically depauperate (often with some marsh species present).

Environmental Description

Fort Pulaski National Monument Environment: This marsh hammock association was sampled at three locations in the park. The sites are flat to gently sloping, southwest-facing lowlands. Much of the uplands where this forest occurs are on old dredge spoil. One site is on top of historic dike system located adjacent to a maintained area along the entrance road, two are old dredge spoil/fill areas that have not been recently disturbed. Soils are moderately well- to well-drained sandy loam, and may have with oyster shells on the soil surface. The unvegetated surface is made up of leaf litter (48-80% cover), wood (2-5% cover) and bare soil (15-50%). Evidence of disturbance includes the presence of trails and exotic plants. One site is located on the highest elevation and most protected portion of the island (Govus 1998).

Global Environment: This association occupies marsh hammocks (small islands surrounded by tidal marsh) along the South Atlantic Coast. In North Carolina this type is found primarily in a matrix of brackish or full salt marshes (M. Schafale pers. comm.). The community may be dependent on occasional salty inundation to keep less salt-tolerant plants out. Related vegetation found near the edge of Silver Glen Spring Run, Ocala National Forest in Florida is also covered here for now.

Vegetation Description

Fort Pulaski National Monument Vegetation: The moderately to very dense (70-90% cover) tree canopy, 10-20 m tall, is dominated by *Juniperus virginiana var. silicicola* (southern redcedar) along with *Sabal palmetto* (cabbage palmetto) and *Ulmus americana* (American elm) (in one stand), or codominated by *Ilex vomitoria* (yaupon) (one stand). Additional tree species include *Celtis laevigata* (sugarberry), *Quercus virginiana* (live oak), *Sabal palmetto* (cabbage palmetto), and *Melia azedarach* (Chinaberrytree) (exotic). *Tillandsia usneoides* (Spanish moss) is an epiphyte found growing in the tree canopy. The moderate (50% cover) subcanopy (10-15 m) is codominated by *Juniperus virginiana var. silicicola* (southern redcedar) and *Prunus caroliniana* (Carolina laurelcherry). The very sparse to moderate (5-60% cover) tall-shrub layer (2-5 m) includes *Ilex vomitoria* (yaupon), *Morella cerifera* (wax myrtle), *Prunus serotina* (black cherry), *Prunus caroliniana* (Carolina laurelcherry), and *Sabal palmetto* (cabbage palmetto). The moderate (40-60% cover) short-shrub layer (0.5-2 m) is dominated by *Sabal palmetto* (cabbage palmetto) and includes other species from the upper layers as well as *Rubus trivialis* (southern dewberry), *Yucca aloifolia* (aloe yucca), *Rhus copallinum* (flameleaf sumac), *Zanthoxylum clava-herculis* (Hercules' club), and *Triadica sebifera* (tallowtree) (exotic). The very sparse (<5% cover) herbaceous layer is dominated by the native grass *Oplismenus hirtellus ssp. setarius* (bristle basketgrass). Vines include *Ampelopsis arborea* (peppervine), *Parthenocissus quinquefolia* (Virginia creeper), *Vitis rotundifolia* (muscadine), *Campsis radicans* (trumpet creeper), *Smilax bona-nox* (saw greenbrier), and *Lonicera japonica* (Japanese honeysuckle) (exotic). Other species observed in a previous study include *Sanicula canadensis* (Canadian blacksnakeroot), *Callicarpa americana* (American beautyberry), *Dichanthelium* (rosette grass) sp., *Smilax auriculata* (earleaf greenbrier), and *Persea borbonia* (redbay) (Govus 1998).

Global Vegetation: *Juniperus virginiana var. silicicola* (southern redcedar) typically dominates the canopy, while other species, such as *Quercus virginiana* (live oak), *Sabal palmetto* (cabbage palmetto), and *Celtis laevigata var. laevigata* (sugarberry), may be present. Exotic species, such as *Triadica sebifera* (tallowtree), *Tamarix* (tamarisk) spp., and *Melia azedarach* (Chinaberrytree), can be invasive in these communities. On Ocala National Forest a plot attributed to this association is additionally characterized by *Quercus hemisphaerica* (Darlington oak), *Callicarpa americana* (American beautyberry), *Persea borbonia* (redbay), *Morella caroliniensis* (southern bayberry), *Ageratina aromatica* (lesser snakeroot), *Dichondra carolinensis* (Carolina ponysfoot), *Oplismenus hirtellus ssp. setarius* (bristle basketgrass), *Chasmanthium sessiliflorum* (longleaf woodoats), *Thelypteris kunthii* (Kunth's maiden fern), *Parthenocissus quinquefolia* (Virginia creeper), *Bignonia capreolata* (crossvine), *Toxicodendron radicans* (eastern poison ivy), *Smilax smallii* (lanceleaf greenbrier), and *Vitis aestivalis* (summer grape) (NatureServe Ecology unpubl. data).

Most Abundant Species

Fort Pulaski National Monument

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Juniperus virginiana var. silicicola* (southern redcedar)
Tree canopy	Broad-leaved deciduous tree	*Celtis laevigata* (sugarberry)
Tree canopy	Broad-leaved evergreen tree	*Ilex vomitoria* (yaupon)
Tree subcanopy	Broad-leaved evergreen tree	*Prunus caroliniana* (Carolina laurelcherry)
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Ilex vomitoria* (yaupon)
Herb (field)	Graminoid	*Oplismenus hirtellus ssp. setarius* (bristle basketgrass)

Characteristic Species

Fort Pulaski National Monument: *Ampelopsis arborea* (peppervine), *Celtis laevigata* (sugarberry), *Ilex vomitoria* (yaupon), *Juniperus virginiana* var. *silicicola* (southern redcedar), *Morella cerifera* (wax myrtle), *Quercus virginiana* (live oak), *Rubus trivialis* (southern dewberry), *Sabal palmetto* (cabbage palmetto), *Tillandsia usneoides* (Spanish moss)

Other Noteworthy Species

Fort Pulaski National Monument

Exotic and Invasive Species	I-Rank	Note
Eremochloa ophiuroides (centipede grass)	-	exotic
Ligustrum japonicum (Japanese privet)	-	exotic
Ligustrum sinense (Chinese privet)	High/Medium	exotic
Lonicera japonica (Japanese honeysuckle)	High/Medium	exotic
Melia azedarach (Chinaberrytree)	Medium/Low	exotic
Sporobolus indicus (smut grass)	-	exotic
Triadica sebifera (tallowtree)	High	exotic

Global

Exotic and Invasive Species	I-Rank	Note
Melia azedarach (Chinaberrytree)	Medium/Low	invasive exotic
Triadica sebifera (tallowtree)	High	invasive exotic

Conservation Status Rank

Global Rank & Reasons: G3? (14-Dec-1998). This community occupies marsh hammock islands along the South Atlantic Coast of North Carolina, South Carolina, Georgia, and northern Florida. This community is restricted in occurrence, and most occurrences are small, but threats are few.

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Global Comments: There are examples of this type in Onslow County, North Carolina, and in the brackish marshes of the Embayed Region of North Carolina, such as along the estuarine Pungo River, and probably Swanquarter National Wildlife Refuge as well (M. Schafale pers. comm.). This type is presumably most common in the Sea Islands region. The hydrology of this association is variable, and some examples are near the conceptual border between upland, saturated, and tidal. These communities' simpler structure may be maintained in part by infrequent catastrophic storm events (hurricane wind and overwash events). Exotic species, such

as *Triadica sebifera (= Sapium sebiferum), Tamarix* spp., and *Melia azedarach* can be invasive in these communities.

Global Similar Associations:

- *Juniperus virginiana* var. *silicicola - Zanthoxylum clava-herculis - Quercus virginiana - (Sabal palmetto) / Sageretia minutiflora - (Sideroxylon tenax)* Woodland (CEGL003525)--more calcareous.
- *Quercus virginiana - (Juniperus virginiana) - Zanthoxylum clava-herculis / Sideroxylon lanuginosum* Woodland (CEGL003523)--more open, more *Sabal palmetto*.
- *Sabal palmetto - (Juniperus virginiana* var. *silicicola)* Woodland (CEGL003526)

Element Distribution

Fort Pulaski National Monument Range: This community is found on the southeast side of the park entrance road before reaching the Visitor Center parking lot and near the picnic area. This is the most widespread forest type on Cockspur Island and occurs largely on the older spoil deposits to the west of the dike system and along the southwestern edge of the island within the dike system. Portions of this association also occur in low-lying areas within the dike system on the southern part of Cockspur Island, on the east side of the paved trail northeast of the Visitor Center, and on central Cockspur Island within the dike system, to the northwest of the fort (Govus 1998).

Global Range: This association is found along the South Atlantic Coast from eastern North Carolina south through South Carolina and Georgia to northeastern Florida. Related vegetation along certain central Florida spring runs is also covered here for now.

Nations: US

States/Provinces: FL, GA, NC, SC

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

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

Federal Lands: NPS (Fort Pulaski, Timucuan?); USFS (Ocala); USFWS (Swanquarter?)

Element Sources

Fort Pulaski National Monument Plots: FOPU.4, FOPU.13, FOPU.16.

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

Global Description Authors: C.W. Nordman, mod. J. Gramling

References: EPA 2004, Govus 1998, Keys et al. 1995, NatureServe Ecology - Southeastern U.S. unpubl. data, Peet et al. unpubl. data 2002, Schafale pers. comm., Southeastern Ecology Working Group n.d.

Planted/cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.x.)

Pinus elliottii 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, 232Ce: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 Plantation

Pinus elliottii var. elliottii Planted Forest
Slash Pine Planted 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	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

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

Fort Pulaski National Monument Environment: Slash pine plantation was sampled once in the picnic area of the park. The site is a gently sloping area with dry-mesic, moderately well-drained sand soil. Evidence of disturbance includes the presence of tables and grills and exotic plants. This forest, located on south-central Cockspur Island, was planted by the National Park Service early on in the history of their management of Fort Pulaski (Govus 1998).

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

Vegetation Description

Fort Pulaski National Monument Vegetation: The dense (80% cover) tree canopy, 15-20 m tall, is made up entirely of *Pinus elliottii var. elliottii* (Honduras pine). *Sabal palmetto* (cabbage palmetto) comprises the sparse (10% cover) subcanopy (10-15 m); *Prunus caroliniana* (Carolina laurelcherry) may also occur in the subcanopy (Govus 1998). The sparse (10% cover) short-shrub layer (0.5-2 m) includes *Ilex vomitoria* (yaupon), *Juniperus virginiana var. silicicola* (southern redcedar), *Rubus trivialis* (southern dewberry), and *Smilax bona-nox* (saw greenbrier). The moderate (50% cover) herbaceous layer is dominated by *Axonopus fissifolius* (common carpetgrass) and includes small amounts of *Eragrostis spectabilis* (purple lovegrass), *Hydrocotyle bonariensis* (largeleaf pennywort), *Pyrrhopappus carolinianus* (Carolina desert-

chicory), *Phyla nodiflora* (turkey tangle fogfruit), and *Sporobolus indicus* (smut grass). It is regularly mowed.

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

Fort Pulaski National Monument

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus elliottii* var. *elliottii* (Honduras pine)
Tree subcanopy	Palm tree	*Sabal palmetto* (cabbage palmetto)
Herb (field)	Graminoid	*Axonopus fissifolius* (common carpetgrass)

Global

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus elliottii* var. *elliottii* (Honduras pine)

Characteristic Species

Fort Pulaski National Monument: *Axonopus fissifolius* (common carpetgrass), *Ilex vomitoria* (yaupon), *Pinus elliottii* var. *elliottii* (Honduras pine), *Sabal palmetto* (cabbage palmetto)
Global: *Pinus elliottii* var. *elliottii* (Honduras pine)

Other Noteworthy Species

Fort Pulaski National Monument

Exotic and Invasive Species	I-Rank	Note
Sporobolus indicus (smut grass)	-	exotic
Triadica sebifera (tallowtree)	High	exotic
Wahlenbergia marginata (southern bellflower)	-	exotic

Conservation Status Rank

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

Classification

Status: Standard
Classification Confidence: 2 - Moderate

Fort Pulaski National Monument Comments: Although of little botanical importance, this pine-dominated community has apparent significance for nesting birds on Cockspur Island (Southeastern Wildlife Services 1981).

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 North Carolina and eastern Texas, and now reproduces naturally in these locations.

Element Distribution

Fort Pulaski National Monument Range: This association is found near the picnic area.

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: 40:C, 41:C, 43:P, 52:P, 53:C, 55:P, 56:P, 57:C, 58:P
USFS Ecoregions: 231:C, 232Br:CCC, 232Ca:CCC, 232Cb:CCC, 232Ce: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
Fort Pulaski National Monument Plots: FOPU.1.
Local Description Authors: M.J. Russo and C.W. Nordman
Global Description Authors: A.S. Weakley
References: Govus 1998, Schotz pers. comm., Southeastern Ecology Working Group n.d., Southeastern Wildlife Services 1981

Lowland or submontane cold-deciduous forest (I.B.2.N.a.)

Triadica sebifera Forest Alliance (A.257)

Alliance Concept
Summary: Exotic-dominated upland forests often developed on old fields, dredge spoil, or other disturbed sites. Understory and herb layers often poorly developed. Range so far restricted to Texas, Louisiana, and Alabama, but possible in other parts of the southeastern United States.

Alliance Description
Range: The range of this alliance is so far restricted to Texas, Louisiana, and Alabama, but it could possibly be found in other parts of the southeastern United States, including Florida, Georgia, Mississippi, and South Carolina.
Nations: US
Subnations: AL, FL?, GA, LA, MS?, SC?, TX
TNC Ecoregions: 31:C, 40:C, 41:C, 53:C, 55:P
USFS Ecoregions: 231E:C?, 231Fa:CCP, 231Fb:CCC, 232Ba:CC?, 232Bg:CC?, 232Bj:CC?, 232Bs:CCC, 232Ce:CCC, 232Dc:CCC, 232Dd:CCC, 232E:CP, 232F:CP, 232Ga:CPP, 234An:???, 255Da:CCC, 255Db:CCP, 255Dc:CCC
Federal Lands: NPS (Fort Pulaski); USFWS (Anahuac, Brazoria)

(CEGL007037) Tallowtree Upland Forest

Triadica sebifera Upland Forest
Chinese Tallowtree Upland Forest

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	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Triadica sebifera* Forest Alliance (A.257)
Alliance (English name)	Chinese Tallowtree Forest Alliance
Association	*Triadica sebifera* Upland Forest
Association (English name)	Chinese Tallowtree Upland Forest
Association (Common name)	Tallowtree Upland Forest

Element Concept

Global Summary: *Triadica sebifera* (tallowtree)-dominated upland forests, often developed on old fields, dredge spoil, or other disturbed sites. Understory and herb layers often poorly developed. This association is defined broadly until further information is available to refine its classification.

Environmental Description

Fort Pulaski National Monument Environment: This invasive community was sampled once along the entrance road into the park. The site is a flat lowland with somewhat poorly drained clay loam soil. Evidence of disturbance includes the presence of exotic plants. In addition, many dead plants were observed in the understory, possibly due to allelopathic influences.

Vegetation Description

Fort Pulaski National Monument Vegetation: The moderately dense (70% cover) tree canopy, 15-20 m tall, is dominated by the invasive exotic *Triadica sebifera* (tallowtree), as is the sparse (20% cover) subcanopy (10-15 m). Additional tree species include *Juniperus virginiana var. silicicola* (southern redcedar) and *Celtis laevigata* (sugarberry). The moderate (50% cover) tall-shrub layer (2-5 m) is dominated by *Ilex vomitoria* (yaupon) and *Sabal palmetto* (cabbage palmetto) and includes *Juniperus virginiana var. silicicola* (southern redcedar), *Morella cerifera* (wax myrtle), *Rubus trivialis* (southern dewberry), and *Melia azedarach* (Chinaberrytree) (exotic). The herbaceous layer is very sparse (<5% cover).

Most Abundant Species

Fort Pulaski National Monument

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Triadica sebifera* (tallowtree)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Ilex vomitoria* (yaupon)
Tall shrub/sapling	Palm shrub	*Sabal palmetto* (cabbage palmetto)

Most Abundant Species

Fort Pulaski National Monument: *Juniperus virginiana* var. *silicicola* (southern redcedar), *Morella cerifera* (wax myrtle), *Sabal palmetto* (cabbage palmetto), *Triadica sebifera* (tallowtree)

Other Noteworthy Species

Fort Pulaski National Monument

Exotic and Invasive Species	**I-Rank**	**Note**
Lonicera japonica (Japanese honeysuckle)	High/Medium	exotic
Melia azedarach (Chinaberrytree)	Medium/Low	exotic
Triadica sebifera (tallowtree)	High	exotic

Conservation Status Rank

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

Classification

Status: Standard

Classification Confidence: 1 - Strong

Element Distribution

Fort Pulaski National Monument Range: This community is found on Cockspur Island, along the entrance road from Highway 80 to the Visitor Center.

Global Range: The range of this association includes Texas, Louisiana, Alabama, and Georgia, but it could possibly be found in other parts of the southeastern United States, including Florida, Mississippi and South Carolina.

Nations: US

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

TNC Ecoregions: 31:C, 40:C, 41:C, 53:C, 55:P

USFS Ecoregions: 231E:C?, 231Fa:CCP, 231Fb:CCC, 232Bs:CCC, 232Ce:CCC, 232Dc:CCC, 232Dd:CCC, 232E:CP, 232F:CP, 255Da:CCC, 255Db:CCP, 255Dc:CCC

Federal Lands: NPS (Fort Pulaski); USFWS (Anahuac, Brazoria)

Element Sources

Fort Pulaski National Monument Plots: FOPU.14.

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

Global Description Authors: A.S. Weakley and L.M. Smith

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

During the field verification step of photo-interpretation (see more below), the SECN Remote Sensing Specialist identified an additional vegetation community that had not been included in the original Vegetation Classification developed by NatureServe. The Tallowtree Seasonally Flooded Forest Alliance (A.335) was added to the Vegetation Classification based on a small (but mappable) wetland inclusion found within the Wax-myrtle-Carolina Laurel Cherry-Toothache-tree Shrubland. This area is dominated by the exotic Tallowtree (*Triadica sebifera*) and also contains Carolina Willow (*Salix caroliniana*), Wax-myrtle (*Morella cerifera*), Virginia saltmarsh mallow (*Kosteletzkya virginica*), smallspike false nettle (*Boehmeria cylindrica*), peppervine (*Ampelopsis arborea*), saltmarsh morning glory (*Ipomoea sagittata*), and various wetland grasses and sedges.

Seasonally flooded cold-deciduous forest (I.B.2.N)

Triadica sebifera Seasonally Flooded Forest Alliance (A.335)

Alliance Description

Seasonally flooded forests dominated by the exotic *Triadica sebifera* (= *Sapium sebiferum*) (Euphorbiaceae). This tree was introduced into the lower Gulf Coastal Plain as an ornamental and is spreading. It can overtake native vegetation types to become the strong dominant. Other wetland trees may be present, including *Acer rubrum var. drummondii*, *Salix nigra*, and *Salix caroliniana*. Various wetland grasses, sedges, and forbs are present in these forests as well.

Note: The Alliance Description is the only information currently available for this alliance.

Woodland (II.)

Temperate broad-leaved evergreen woodland (II. A.2.N.a)

Quercus virginiana – Juniperus virginiana – (Sabal palmetto) Woodland Alliance (A.479)

Alliance Concept

Summary: This alliance accommodates calciphilic communities occurring on coastal sands, Amerindian shell middens, and natural shell deposits of the Outer Coastal Plain. Composition varies along a latitudinal gradient; associations have been defined for two separate geographic zones, one of the Atlantic Coast from northern Florida north to Virginia, and another in the Gulf Coast from Florida west to Texas. This vegetation occurs under more severe and unstable conditions than related forests, which are found in the *Quercus virginiana - (Sabal palmetto)* Forest Alliance (A.55).

Similar Alliances:

- *Quercus virginiana - (Sabal palmetto)* Forest Alliance (A.55)

Similar Alliance Comments: This vegetation occurs under more severe conditions than related forests, which are found in the *Quercus virginiana - (Sabal palmetto)* Forest Alliance (A.55).

Related Concepts:

- Live Oak: 89 (Eyre 1980) I

Alliance Description

Environment: This alliance accommodates calciphilic communities occurring on coastal sands, on Amerindian shell middens, and natural shell deposits of the Outer Coastal Plain.

Dynamics: This vegetation occurs under more severe and unstable conditions than related forests.

Alliance Distribution

Range: Associations have been defined for two separate geographic zones, one of the Atlantic Coast from northern Florida north to southeastern Virginia, and another in the Gulf Coast from Florida west to Texas.

Nations: US

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

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

USFS Ecoregions: 231Fb:PPP, 232Ce:CCC, 232Ch:CCC, 232Ci:CCP, 232Dc:CCC, 232Eb:CCC, 232Ec:CCC, 232Gb:CCC, 255Dc:PPP, 411Ad:PPP, 411Ae:PPP, 411Af:PPP, 411Ag:PPP

Federal Lands: NPS (Canaveral, Fort Pulaski, Timucuan); USFS (Francis Marion); USFWS (Back Bay?)

(CEGL003525) South Atlantic Coastal Shell Midden Woodland

Juniperus virginiana var. silicicola - Zanthoxylum clava-herculis - Quercus virginiana - (Sabal palmetto) / Sageretia minutiflora - (Sideroxylon tenax) Woodland
Coastal Red-cedar - Toothache-tree - Live Oak - (Cabbage Palmetto) / Small-flower Mock Buckthorn - (Tough Bumelia) Woodland

NVC Classification

Physiognomic Class	Woodland (II)
Physiognomic Subclass	Evergreen woodland (II.A.)
Physiognomic Group	Temperate broad-leaved evergreen woodland (II.A.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate broad-leaved evergreen woodland (II.A.2.N.)
Formation	Temperate broad-leaved evergreen woodland (II.A.2.N.a.)
Alliance	*Quercus virginiana - Juniperus virginiana - (Sabal palmetto)* Woodland Alliance (A.479)
Alliance (English name)	Live Oak - Eastern Red-cedar - (Cabbage Palmetto) Woodland Alliance
Association	*Juniperus virginiana* var. *silicicola - Zanthoxylum clava-herculis - Quercus virginiana - (Sabal palmetto) / Sageretia minutiflora - (Sideroxylon tenax)* Woodland
Association (English name)	Coastal Red-cedar - Toothache-tree - Live Oak - (Cabbage Palmetto) / Small-flower Mock Buckthorn - (Tough Bumelia) Woodland
Association (Common name)	South Atlantic Coastal Shell Midden Woodland
Ecological System(s):	Southern Atlantic Coastal Plain Maritime Forest (CES203.537)

Element Concept

Global Summary: This calciphilic community occurs on calcareous coastal sands, shell hashes, Amerindian shell middens, and natural shell deposits, from mid-peninsular Florida (Cape Canaveral) north to South Carolina (southern Atlantic Coast), in maritime-influenced landscapes. The canopy consists of *Juniperus virginiana var. silicicola* (southern redcedar), *Sabal palmetto* (cabbage palmetto), *Celtis laevigata var. laevigata* (sugarberry), *Zanthoxylum clava-herculis* (Hercules' club), *Quercus virginiana* (live oak), *Osmanthus americanus* (devilwood), and other species. Shrubs are prominent and may include *Ilex vomitoria* (yaupon), *Yucca aloifolia* (aloe yucca), *Sageretia minutiflora* (smallflower mock buckthorn), *Forestiera segregata* (Florida swampprivet), *Frangula caroliniana* (Carolina buckthorn), *Opuntia humifusa var. austrina* (devil's-tongue), and others. Composition is very variable from site to site, depending on environmental conditions and accidents of establishment and persistence.

Environmental Description

Fort Pulaski National Monument Environment: This coastal shell midden woodland was sampled twice in the park. The sites are gently sloping oyster shell middens of unknown age with dry-mesic, well-drained sand soil. The unvegetated surface is made up of leaf litter (25-50% cover), wood (5% cover), bare soil (0-5% cover), and shells (40-70% cover). Evidence of disturbance includes the presence of exotic plants. The four large elliptical mounds suggest, from aerial view, to be of aboriginal origin. Regardless of origin, these oyster shell heaps support vegetation typical of shell midden sites along the Sea Islands section of the south Atlantic Coast (Govus 1998).

Global Environment: This calciphilic community occurs on Amerindian shell middens and natural shell deposits, from mid-peninsular Florida (Cape Canaveral) north to South Carolina (southern Atlantic Coast), and occurs along the ecotone between tidal marshes and upland maritime forests (C. Nordman pers. obs.).

Vegetation Description

Fort Pulaski National Monument Vegetation: The moderate to dense (70-80% cover) tree canopy, 2-15 m tall, is dominated by *Juniperus virginiana var. silicicola* (southern redcedar). Additional tree species may include *Forestiera segregata* (Florida swampprivet) (state-imperiled), *Sabal palmetto* (cabbage palmetto), *Ilex vomitoria* (yaupon), *Celtis laevigata* (sugarberry), and *Morus alba* (white mulberry) (exotic). The sparse (20% cover) shrub layer (0.5-5 m) includes tall shrubs *Forestiera segregata* (Florida swampprivet), *Sideroxylon tenax* (tough bully), *Ilex vomitoria* (yaupon), *Osmanthus americanus* (devilwood), and *Rhus copallinum* (flameleaf sumac), and short shrubs *Baccharis halimifolia* (eastern baccharis), *Borrichia frutescens* (bushy seaside tansy), *Sabal palmetto* (cabbage palmetto), and *Zanthoxylum clava-herculis* (Hercules' club). The herbaceous layer is very sparse (<5% cover) and includes *Solidago sempervirens* (seaside goldenrod). Other species also found include *Prunus caroliniana* (Carolina laurelcherry), *Persea borbonia* (redbay), and *Baccharis halimifolia* (eastern baccharis) (Govus 1998).

Global Vegetation: The canopy of this calciphilic community consists of *Juniperus virginiana var. silicicola* (southern redcedar), *Sabal palmetto* (cabbage palmetto), *Celtis laevigata var. laevigata* (sugarberry), *Zanthoxylum clava-herculis* (Hercules' club), *Quercus virginiana* (live oak), *Osmanthus americanus* (devilwood), and other species. Shrubs are prominent and may include *Ilex vomitoria* (yaupon), *Yucca aloifolia* (aloe yucca), *Sageretia minutiflora* (smallflower mock buckthorn), *Forestiera segregata* (Florida swampprivet), *Frangula caroliniana* (Carolina buckthorn), *Opuntia humifusa var. austrina* (devil's-tongue), and others. Composition is very variable from site to site, depending on environmental conditions and accidents of establishment and persistence.

Most Abundant Species

Fort Pulaski National Monument

Stratum	Lifeform	Species
Tree subcanopy	Needle-leaved tree	*Juniperus virginiana* var. *silicicola* (southern redcedar)
Tree subcanopy	Broad-leaved evergreen tree	*Forestiera segregata* (Florida swampprivet)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Forestiera segregata* (Florida swampprivet)
Short shrub/sapling	Palm shrub	*Sabal palmetto* (cabbage palmetto)

Characteristics Species

Fort Pulaski National Monument: *Baccharis halimifolia* (eastern baccharis), *Borrichia frutescens* (bushy seaside tansy), *Forestiera segregata* (Florida swampprivet), *Ilex vomitoria* (yaupon), *Juniperus virginiana* var. *silicicola* (southern redcedar), *Opuntia stricta* var. *stricta*, *Sabal palmetto* (cabbage palmetto), *Solidago sempervirens* (seaside goldenrod), *Zanthoxylum clava-herculis* (Hercules' club)

Other Noteworthy Species

Fort Pulaski National Monument

Exotic and Invasive Species	I-Rank	Note
Ligustrum lucidum (glossy privet)	-	exotic
Morus alba (white mulberry)	High/Medium	exotic
Other Plant Species	**GRank**	**Note**
Forestiera segregata (Florida swampprivet)	G4	GA state-imperiled

Global

Other Plant Species	GRank	Note
Harrisia simpsonii (Simpson's applecactus)	G2	imperiled
Lantana depressa var. *floridana* (Florida shrubverbena)	G2T1	critically imperiled
Sideroxylon tenax (tough bully)	G3?	

Conservation Status Rank

Global Rank & Reasons: G2? (16-Jan-2001). This community is naturally rare because of the relative rarity of the edaphic conditions on which it depends. Examples on isolated islands remain in excellent to good condition (they may have had *Quercus virginiana* removed for ship-building or *Juniperus virginiana var. silicicola* removed for pencil manufacture). Other examples on larger and more accessible barrier islands, spits, or peninsulas have in some cases been destroyed by coastal development. Some examples have been altered by exotics, such as *Triadica sebifera*.

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Global Comments: *Sideroxylon tenax* is included in the name as a geographic indicator of the southern Atlantic Coast and distinguishing the type from temperate shell middens on the Gulf Coast. *Zanthoxylum clava-herculis* is an environmental indicator of the high calcium substrate.

Global Similar Associations:

- *Juniperus virginiana* var. *silicicola - (Quercus virginiana, Sabal palmetto)* Forest (CEGL007813)
- *Quercus virginiana - (Sabal palmetto)* Tropical Shell Midden Woodland (CEGL008411)--occurs farther south, is codominated by tropical species, and lacks *Juniperus virginiana var. silicicola*.

Global Related Concepts:

- IB8b. Temperate Shell Midden Woodland (Allard 1990) B

Element Distribution

Fort Pulaski National Monument Range: This association is found on McQueens Island north of Highway 80 and near the Lazaretto Creek fishing pier, on shell deposits near the mouth of the south channel of the Savannah River on northeast McQueens Island (Govus 1998).

Global Range: This calciphilic community occurs on calcareous coastal sands, shell hashes, Amerindian shell middens, and natural shell deposits, from mid-peninsular Florida (Cape Canaveral) north to South Carolina (southern Atlantic Coast).

Nations: US

States/Provinces: FL, GA, NC, SC

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

USFS Ecoregions: 232Ce:CCC, 232Gb:CCC

Federal Lands: NPS (Canaveral, Fort Pulaski, Timucuan); USFS (Francis Marion)

Element Sources
Fort Pulaski National Monument Plots: FOPU.8, FOPU.9.
Local Description Authors: M.J. Russo and C.W. Nordman
Global Description Authors: D.J. Allard, mod. A.S. Weakley and H. Summer
References: Allard 1990, Dorroh 1971, Govus 1998, Nelson 1986, Nordman pers. comm., Peet et al. unpubl. data 2002, Southeastern Ecology Working Group n.d.

Sabal palmetto Temperate Woodland Alliance (A.479)

Alliance Concept
Summary: This alliance consists of upland palm savannas dominated by open to scattered canopy of *Sabal palmetto* (cabbage palmetto). In some cases, these communities occupy narrow strips of upland adjacent to marsh. They have a dense shrubby understory and a high water table. Severe conditions, likely including periodic hurricane damage (by wind and flooding), preclude forest development. They occur in the ACE (Ashepoo-Combahee-Edisto) Basin and may be most common in the Sea Islands Section of the Coastal Plain. In southern Florida, vegetation of this alliance occurs on similar sites to *Pinus elliottii var. densa* (Florida slash pine) communities but with more frequent fire (2- to 3-year return time) favoring the palm species *Sabal palmetto* (cabbage palmetto) and *Serenoa repens* (saw palmetto).

Classification Comments: This alliance includes an association (CEGL003796) previously placed in III.A.1.N.d *Serenoa repens* Wooded Shrubland Alliance (A.727).

Similar Alliances:
- *Sabal palmetto* Saturated Woodland Alliance (A.488)
- *Sabal palmetto* Seasonally Flooded Tropical Woodland Alliance (A.1983)--is attributed to the Bahamas and not to the United States.

Related Concepts:
- Cabbage Palmetto: 74 (Eyre 1980) I

Alliance Description
Environment: In some cases, these communities occupy narrow strips of upland adjacent to marsh. They have a dense shrubby understory and a high water table. They occur in the ACE (Ashepoo-Combahee-Edisto) Basin and may be most common in the Sea Islands Section of the Coastal Plain.

Vegetation: This alliance consists of upland palm savannas dominated by open to scattered canopy of *Sabal palmetto* (cabbage palmetto). In southern Florida, vegetation of this alliance occurs on similar sites to *Pinus elliottii var. densa* (Florida slash pine) communities but with more frequent fire (2- to 3-year return time) favoring the palm species *Sabal palmetto* (cabbage palmetto) and *Serenoa repens* (saw palmetto).

Dynamics: Severe conditions, likely including periodic hurricane damage (by wind and flooding), preclude forest development in the habitat of this alliance. More frequent fire (2- to 3-year return time) favors the palm species *Sabal palmetto* and *Serenoa repens* instead of *Pinus elliottii var. densa*.

Alliance Distribution

Range: This alliance is found in Florida, Georgia, and South Carolina.
Nations: US
Subnations: FL, GA, SC
TNC Ecoregions: 53:P, 54:C, 55:C, 56:C, 57:P
USFS Ecoregions: 232Ce:CCC, 232Da:CCC, 232Dc:CCP, 232Ga:CC?, 232Gb:CCC, 411Ac:CCP, 411Af:CCC
Federal Lands: NPS (Canaveral, Fort Pulaski); USFS (Ocala)

(CEGL003526) Cabbage Palmetto Woodland
Sabal palmetto - (Juniperus virginiana var. silicicola) Woodland
Cabbage Palmetto - (Coastal Red-cedar) Woodland

NVC Classification

Physiognomic Class	Woodland (II)
Physiognomic Subclass	Evergreen woodland (II.A.)
Physiognomic Group	Temperate broad-leaved evergreen woodland (II.A.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate broad-leaved evergreen woodland (II.A.2.N.)
Formation	Temperate broad-leaved evergreen woodland (II.A.2.N.a.)
Alliance	*Sabal palmetto* Temperate Woodland Alliance (A.481)
Alliance (English name)	Cabbage Palmetto Temperate Woodland Alliance
Association	*Sabal palmetto - (Juniperus virginiana* var. *silicicola)* Woodland
Association (English name)	Cabbage Palmetto - (Coastal Red-cedar) Woodland
Association (Common name)	Cabbage Palmetto Woodland
Ecological System(s):	Southern Atlantic Coastal Plain Maritime Forest (CES203.537)

Element Concept

Global Summary: This community consists of pure to mixed, open stands of *Sabal palmetto* (cabbage palmetto), often with *Juniperus virginiana var. silicicola* (southern redcedar). Shrub and herb species can include *Yucca aloifolia* (aloe yucca), *Rhus copallinum* (flameleaf sumac), *Ilex vomitoria* (yaupon), and *Morella cerifera* (wax myrtle). This community is described from the outer South Atlantic Coastal Plain of Georgia and South Carolina, where it occurs in exposed situations on marsh hammock islands. This, or related vegetation, could occur in the adjacent Mid-Atlantic Coastal Plain, East Gulf Coastal Plain and/or Florida Peninsula. More information is needed on the range and variability of this type.

Environmental Description

Fort Pulaski National Monument Environment: This cabbage palmetto woodland was sampled once in the park. The site is a gently sloping ridge with dry-mesic, well-drained clay loam soil. The unvegetated surface is dominated by leaf litter (90% cover) with some wood (4% cover) and bare soil (6% cover). Evidence of disturbance includes the presence of spoil mounds from ditching and exotic plants.

Global Environment: This community occurs in exposed situations on marsh hammock islands.

Vegetation Description

Fort Pulaski National Monument Vegetation: The moderate (60% cover) tree canopy, 5-10 m tall, is dominated by *Celtis laevigata* (sugarberry), *Ilex vomitoria* (yaupon), *Juniperus virginiana var. silicicola* (southern redcedar), *Sabal palmetto* (cabbage palmetto), and *Triadica sebifera*

(tallowtree) (exotic). The moderate (60% cover) shrub layer (1-5 m) includes dominant *Ilex vomitoria* (yaupon) along with *Morella cerifera* (wax myrtle) and *Rubus trivialis* (southern dewberry). No herbaceous layer was observed, except the vine *Ampelopsis arborea* (peppervine). Other plants documented previously in this community include *Smilax auriculata* (earleaf greenbrier), *Rhus copallinum* (flameleaf sumac), and *Yucca aloifolia* (aloe yucca) (Govus 1998).

Global Vegetation: Examples of this association are pure to mixed, open stands of *Sabal palmetto* (cabbage palmetto), often with *Juniperus virginiana var. silicicola* (southern redcedar). Shrub and herb species can include *Yucca aloifolia* (aloe yucca), *Rhus copallinum* (flameleaf sumac), *Ilex vomitoria* (yaupon), and *Morella cerifera* (wax myrtle).

Most Abundant Species

Fort Pulaski National Monument

Stratum	Lifeform	Species
Tree subcanopy	Needle-leaved tree	*Juniperus virginiana* var. *silicicola* (southern redcedar)
Tree subcanopy	Broad-leaved deciduous tree	*Celtis laevigata* (sugarberry), *Triadica sebifera* (tallowtree)
Tree subcanopy	Broad-leaved evergreen tree	*Ilex vomitoria* (yaupon)
Tree subcanopy	Palm tree	*Sabal palmetto* (cabbage palmetto)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Ilex vomitoria* (yaupon)

Characteristic Species

Fort Pulaski National Monument: *Ampelopsis arborea* (peppervine), *Ilex vomitoria* (yaupon), *Juniperus virginiana* var. *silicicola* (southern redcedar), *Morella cerifera* (wax myrtle), *Sabal palmetto* (cabbage palmetto)

Other Noteworthy Species

Fort Pulaski National Monument

Exotic and Invasive Species	I-Rank	Note
Triadica sebifera (tallowtree)	High	exotic

Conservation Status Rank

Global Rank & Reasons: G2? (31-Jan-2001). This community appears to be rare and restricted, but is poorly understood and circumscribed. As defined, its occurrence is limited to barrier island and barrier spit situations, where it is negatively affected by coastal development. It is also affected by natural disturbances in the form of hurricanes, which probably help maintain this community's structure and composition, as *Juniperus virginiana var. silicicola* and *Sabal palmetto* are favored by hurricane disturbance relative to other coastal woody species.

Classification

Status: Standard

Classification Confidence: 2 - Moderate

Global Similar Associations:

- *Juniperus virginiana* var. *silicicola - (Quercus virginiana, Sabal palmetto)* Forest (CEGL007813)

Element Distribution

Fort Pulaski National Monument Range: This community is located near the picnic area and along the north edge of Cockspur Island, adjacent the high marsh communities (Govus 1998).
Global Range: This community is described from the outer South Atlantic Coastal Plain of Georgia and South Carolina. This, or related vegetation, could occur in the adjacent Mid-Atlantic Coastal Plain, East Gulf Coastal Plain and/or Florida Peninsula.
Nations: US
States/Provinces: FL?, GA, SC
TNC Ecoregions: 53:P, 55:P, 56:C, 57:P
USFS Ecoregions: 232Ce:CCC, 232Da:CPP, 232Dc:CPP, 232Ga:CP?, 232Gb:CPP
Federal Lands: NPS (Fort Pulaski); USFS (Ocala?)

Element Sources

Fort Pulaski National Monument Plots: FOPU.3.
Local Description Authors: M.J. Russo and C.W. Nordman
Global Description Authors: Southeastern Ecology Group
References: EPA 2004, Govus 1998, Keys et al. 1995, Peet et al. unpubl. data 2002, Southeastern Ecology Working Group n.d.

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 salt-water 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*.

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

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 salt-water 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).

Alliance Distribution

Range: This alliance consists of upland maritime dune shrublands of southeastern Coastal Plain (southern, mid-Atlantic, and Gulf coasts).
Nations: US
Subnations: AL, FL, GA, LA?, MS, NC, SC, VA
TNC Ecoregions: 53:C, 55:?, 56:C, 57:C
USFS Ecoregions: 232Cb:CCC, 232Ce:CCC, 232Ci:CCC, 232Dc:CCC, 232Dd:CCC, 232Gb:CCC
Federal Lands: DOD (Camp Lejeune?); NPS (Canaveral, Cape Hatteras, Cape Lookout, Fort Pulaski, Fort Sumter, Gulf Islands); USFWS (Back Bay?, Bon Secour, Cape Romain?, Pea Island?)

(CEGL004784) Wax-myrtle - Carolina Laurel Cherry - Toothache-tree Shrubland
Morella cerifera - Prunus caroliniana - Zanthoxylum clava-herculis 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	*Morella cerifera - Prunus caroliniana - Zanthoxylum clava-herculis* Shrubland
Association (English name)	Wax-myrtle - Carolina Laurel Cherry - Toothache-tree Shrubland
Ecological System(s):	Central Atlantic Coastal Plain Maritime Forest (CES203.261)

Element Concept

Global Summary: Maritime shrublands dominated by *Morella cerifera* (wax myrtle), *Prunus caroliniana* (Carolina laurelcherry), and *Zanthoxylum clava-herculis* (Hercules' club). This shrub vegetation occurs on the back side of maritime dunes.

Environmental Description

Fort Pulaski National Monument Environment: This maritime shrubland was sampled once in the park. The site is a flat spoil mound with well-drained sand. The unvegetated surface is dominated by leaf litter (84% cover) with some wood (5% cover), bare soil (10% cover), and shells and debris (1% cover). Evidence of disturbance includes deer browse, many downed trees, the presence of spoil and debris mounds, and exotic plants.

Fort Sumter National Monument Environment: This maritime shrubland was sampled at one location at Fort Moultrie. The site is a flat interdunal swale that is part of an accreting barrier island. Soil is dry-mesic, well-drained sand. The unvegetated surface is dominated by leaf litter

(90% cover) with some bare soil (10%). The site is vulnerable to salt spray or flooding from storm overwash under severe weather conditions.

Vegetation Description

Fort Pulaski National Monument Vegetation: The moderate (40% cover) tree canopy, 10-15 m tall, is dominated by *Celtis laevigata* (sugarberry) and includes lesser amounts of *Morella cerifera* (wax myrtle), *Prunus caroliniana* (Carolina laurelcherry), and *Triadica sebifera* (tallowtree) (exotic). The dense (80% cover) subcanopy (5-10 m) is dominated by *Prunus caroliniana* (Carolina laurelcherry) and *Morella cerifera* (wax myrtle), as is the moderately sparse (30% cover) shrub layer (1-5 m) along with *Sabal palmetto* (cabbage palmetto). The very sparse (<5% cover) herbaceous layer is comprised of *Eragrostis spectabilis* (purple lovegrass) and *Eremochloa ophiuroides* (centipede grass) (exotic). Vines include *Parthenocissus quinquefolia* (Virginia creeper).

Fort Sumter National Monument Vegetation: The moderately dense (70% cover) tall-shrub layer (2-5 m tall) is dominated by *Morella cerifera* (wax myrtle) along with lesser amounts of *Zanthoxylum clava-herculis* (Hercules' club); short shrubs include *Prunus caroliniana* (Carolina laurelcherry) and *Rubus trivialis* (southern dewberry). The herbaceous layer is sparse and includes small amounts of *Andropogon virginicus* (broomsedge bluestem), *Heterotheca subaxillaris* (camphorweed), *Oenothera humifusa* (seabeach evening-primrose), *Opuntia pusilla* (cockspur pricklypear), and *Yucca filamentosa* (Adam's needle). Vines (20%) are dominated by *Smilax bona-nox* (saw greenbrier) along with *Smilax auriculata* (earleaf greenbrier) and *Vitis rotundifolia* (muscadine).

Most Abundant Species

Fort Pulaski National Monument

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved evergreen tree	*Morella cerifera* (wax myrtle), *Prunus caroliniana* (Carolina laurelcherry)
Tree canopy	Broad-leaved deciduous tree	*Celtis laevigata* (sugarberry)
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Prunus caroliniana* (Carolina laurelcherry)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Ilex vomitoria* (yaupon)
Tall shrub/sapling	Palm shrub	*Sabal palmetto* (cabbage palmetto)

Characteristic Species

Fort Pulaski National Monument: *Morella cerifera* (wax myrtle), *Prunus caroliniana* (Carolina laurelcherry)

Fort Sumter National Monument

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved evergreen shrub	*Morella cerifera* (wax myrtle)
Herb (field)	Vine/Liana	*Smilax bona-nox* (saw greenbrier)

Other Noteworthy Species

Fort Pulaski National Monument

Exotic and Invasive Species	I-Rank	Note
Eremochloa ophiuroides (centipede grass)	-	exotic
Lonicera japonica (Japanese honeysuckle)	High/Medium	exotic

Conservation Status Ranks
Global Rank & Reasons: G2? (8-Oct-1997).

Classification
Status: Standard
Classification Confidence: 2 - Moderate

Global Comments: This sounds like the understory of maritime forest, possibly disturbed by hurricane killed overstory (M. Schafale pers. comm.). More information is available in the ACE data for Otter Island (South end).

Element Distribution
Fort Pulaski National Monument Range: This community is found in a spoil area on the west side of the main island.
Fort Sumter National Monument Range: This community was sampled just south of Fort Moultrie and mile east of the Station B beach access.
Nations: US
States/Provinces: GA, SC
TNC Ecoregions: 56:C
USFS Ecoregions: 232Ce:CCC
Federal Lands: NPS (Fort Pulaski, Fort Sumter)

Element Sources
Fort Pulaski National Monument Plots: FOPU.11.
Fort Sumter National Monument Plots: FOSU.2.
Local Description Authors: M.J. Russo and C.W. Nordman
Global Description Authors: K. Tassin and C. Smith
References: 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.

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) Atlantic Coast Interdune Swale

Morella cerifera / Spartina patens Shrubland
Wax-myrtle / Saltmeadow Cordgrass 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	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 Swale (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

Fort Pulaski National Monument Environment: This wax-myrtle shrubland was sampled once in the park. The site is a gently sloping, southeast-facing lowland adjacent to a spoil area with somewhat poorly drained sand soil. The unvegetated surface is made up of leaf litter (80% cover), wood (10% cover) and bare soil (10% cover). Some sites have saturated soils (Govus 1998).

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

Fort Pulaski National Monument Vegetation: Shrubs 2-5 m tall form the dominant layer (80% cover). However, in this example there is also a moderate (30% cover) emergent tree layer of *Celtis laevigata* (sugarberry) and *Morella cerifera* (wax myrtle). Occasionally this association includes widely scattered *Juniperus virginiana var. silicicola)* and *Sabal palmetto* (cabbage palmetto) (Govus 1998). The shrub layer is dominated by *Morella cerifera* (wax myrtle) along

with *Ilex vomitoria* (yaupon), *Sabal palmetto* (cabbage palmetto), and *Rubus trivialis* (southern dewberry). No herbs were observed. The shrubs are so densely arranged that no herbaceous species are afforded light or space to grow (Govus 1998). Vines include *Ampelopsis arborea* (peppervine), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax auriculata* (earleaf greenbrier), and *Smilax bona-nox* (saw greenbrier). In the eastern portion (within the dike system), a substantial amount of *Triadica sebifera* (tallowtree) (exotic) also occurs as widely scattered individuals (Govus 1998).

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

Fort Pulaski National Monument

Stratum	Lifeform	Species
Tree subcanopy	Broad-leaved evergreen tree	*Morella cerifera* (wax myrtle)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Ilex vomitoria* (yaupon), *Morella cerifera* (wax myrtle)

Characteristic Species

Fort Pulaski National Monument: *Ampelopsis arborea* (peppervine), *Celtis laevigata* (sugarberry), *Ilex vomitoria* (yaupon), *Morella cerifera* (wax myrtle), *Parthenocissus quinquefolia* (Virginia creeper), *Sabal palmetto* (cabbage palmetto)

Other Noteworthy Species

Fort Pulaski National Monument

Exotic and Invasive Species	I-Rank	Note
Triadica sebifera (tallowtree)	High	exotic

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

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
Fort Pulaski National Monument Range: This community is found near the dredge spoil area adjacent to the maintenance shed. It occurs along the southern edge of Cockspur Island, just above the tidal shrublands and salt panne communities of central Cockspur Island and within the dike system near the southeastern part of the island in very low-lying areas (Govus 1998).

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: 56:C, 57:C, 58:C, 62:C
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
Fort Pulaski National Monument Plots: FOPU.15.
Local Description Authors: M.J. Russo and C.W. Nordman
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 2001a, Govus 1998, Harrison 2004, Higgins et al. 1971, Hill 1986, Klotz 1986, Martin 1959b, Schafale and Weakley 1990, 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).

Similar Alliances:

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

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

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

Fort Pulaski National Monument Environment: This community occurs as a fringe shrubland between either salt panne communities and upland forests or high marsh communities and upland communities. It is especially well-developed along the southern edge of Cockspur Island where extensive salt flats grade gently into the adjacent upland communities (Govus 1998).

Vegetation Description

Fort Pulaski National Monument Vegetation: The dominant species of this association are *Baccharis halimifolia* (eastern baccharis), *Iva frutescens* (Jesuit's bark), *Morella cerifera* (wax myrtle), and *Ilex vomitoria* (yaupon), other species present include *Baccharis angustifolia* (saltwater false willow), *Limonium carolinianum* (Carolina sealavender), and *Fimbristylis castanea* (marsh fimbry) (Govus 1998).

Most Abundant Species

Fort Pulaski National Monument

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Baccharis halimifolia* (eastern baccharis), *Ilex vomitoria* (yaupon)
Short shrub/sapling	Broad-leaved evergreen shrub	*Morella cerifera* (wax myrtle)

Conservation Status Rank

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

Classification

Status: Standard

Classification Confidence: 2 - Moderate

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

Fort Pulaski National Monument Range: This community is widespread on Cockspur Island, especially along the southern edge of the island where extensive salt flats grade gently into the adjacent upland communities (Govus 1998).

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: 53:C, 55:?, 56:C, 57:C

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

Fort Pulaski National Monument Plots: None.

Local Description Authors: T. Govus

Global Description Authors:

References: Coulling pers. comm., FNAI 1992a, Fleming pers. comm., Govus 1998, Lea 2002b, Schafale 2000, Schotz pers. comm., Southeastern Ecology Working Group n.d., Wolfe 1990

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.

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).

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

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)
Ecological System(s):	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 Mid- 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 pacifica* (Pacific swampfire), *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 pacifica* Dwarf-shrubland (CEGL003956) or *Sarcocornia pacifica - (Batis maritima, Distichlis spicata)* Dwarf-shrubland (CEGL002278).

This shrubland usually occurs as a very narrow band adjacent and below tidal shrublands. Two large examples of this association at Fort Pulaski, Georgia, are extensive enough to map and occur on tidal flats adjacent the extensive salt marsh communities of eastern Cockspur Island. Typically this community is monospecific, being made up almost exclusively of *Borrichia frutescens* (bushy seaside tansy).

Element Description

USFWS Wetland System: Estuarine

Fort Pulaski National Monument Environment: This brackish marsh shrubland was sampled at two locations in the park. The sites are flat to gently sloping, southeast- and south-facing tidal flats. Soils are moderately somewhat poorly drained clay loam and muck. The unvegetated surface is mostly made up of bare soil (89-95% cover), with some leaf litter (1-10% cover), wood (0-3% cover) and debris (1% cover). Evidence of disturbance includes deer trails. This community usually occurs as a very narrow band adjacent to and below Coastal Salt Shrub Thicket (CEGL003920) tidal shrublands on tidal flats adjacent the extensive salt marsh communities such as on eastern Cockspur Island (Govus 1998).

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.

Environmental Description

USFWS Wetland System: Estuarine

Fort Pulaski National Monument Environment: This brackish marsh shrubland was sampled at two locations in the park. The sites are flat to gently sloping, southeast- and south-facing tidal flats. Soils are moderately somewhat poorly drained clay loam and muck. The unvegetated

surface is mostly made up of bare soil (89-95% cover), with some leaf litter (1-10% cover), wood (0-3% cover) and debris (1% cover). Evidence of disturbance includes deer trails. This community usually occurs as a very narrow band adjacent to and below Coastal Salt Shrub Thicket (CEGL003920) tidal shrublands on tidal flats adjacent the extensive salt marsh communities such as on eastern Cockspur Island (Govus 1998).

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

Fort Pulaski National Monument Vegetation: This community is dominated (30-80% cover) by short shrubs (0.5-1 m). However, there may also contains a sparse (20% cover) emergent tall-shrub layer (2-5 m) of *Juniperus virginiana var. silicicola* (southern redcedar), *Ilex vomitoria* (yaupon), *Iva frutescens* (Jesuit's bark), and *Sideroxylon tenax* (tough bully) (globally and state-vulnerable). The short-shrub layer is dominated by *Borrichia frutescens* (bushy seaside tansy) and may include *Sarcocornia pacifica* (Pacific swampfire), *Pinus elliottii* (slash pine), *Sabal palmetto* (cabbage palmetto), and *Yucca aloifolia* (aloe yucca). The moderately sparse to dense (40-80% cover) herbaceous layer is dominated almost exclusively by *Distichlis spicata* (inland saltgrass). Some occurrences of this community are monospecific, being made up almost exclusively of *Borrichia frutescens* (bushy seaside tansy) (Govus 1998).

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 pacifica* (Pacific swampfire), *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

Fort Pulaski National Monument

Stratum	Lifeform	Species
Tall shrub/sapling	Needle-leaved shrub	*Juniperus virginiana* var. *silicicola* (southern redcedar)
Short shrub/sapling	Semi-shrub	*Borrichia frutescens* (bushy seaside tansy)
Herb (field)	Semi-shrub	*Sarcocornia pacifica* (Pacific swampfire)
Herb (field)	Graminoid	*Distichlis spicata* (inland saltgrass)

Characteristic Species

Fort Pulaski National Monument: *Borrichia frutescens* (bushy seaside tansy), *Distichlis spicata* (inland saltgrass), *Juniperus virginiana* var. *silicicola* (southern redcedar), *Sarcocornia pacifica* (Pacific swampfire)

Other Noteworthy Species

Fort Pulaski National Monument

Other Plant Species	**GRank**	**Note**
Sideroxylon tenax (tough bully)	G3?	globally vulnerable

Global

Animal Species	**GRank**	**Note**
Grus americana (whooping crane)	G1	

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

Global Comments: The relationship between this community and similar *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).

NatureServe identified the perennial glasswort plants at Fort Pulaski as *Sarcocornia pacifica* using the recent key in Weakley (2007), which follows Flora of North America (FNA Editorial Committee 2003). The perennial glassworts on the U.S. East Coast have been called *Sarcocornia perennis* in the past (Kartesz 1999), and their taxonomy remains unsettled. For the time being, NatureServe will continue to follow the Kartesz (1999) nomenclature in our global descriptions and U.S. National Vegetation Classification association names.

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

Fort Pulaski National Monument Range: Two large examples of this association are extensive enough to map and occur on tidal flats adjacent to the extensive salt marsh communities of eastern Cockspur Island [see 1998 vegetation map (Govus 1998)].

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: 31:C, 53:C, 55:C, 56:C, 57:C

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
Fort Pulaski National Monument Plots: FOPU.2, FOPU.6.
Local Description Authors: M.J. Russo and C.W. Nordman
Global Description Authors: A.S. Weakley
References: Diamond 1993, FNA Editorial Committee 2003, FNAI 1990, FNAI 1992a, Govus 1998, Kartesz 1999, 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., Weakley 2007

Dwarf-Shrubland (IV.)

Tidal needle-leaved or microphyllous evergreen dwarf - shrubland (IV.A.2.N.e)

Batis maritima Tidal Dwarf-shrubland Alliance (A.1111)

Alliance Concept

Summary: This alliance consists of small to large tidal flats dominated by *Batis maritima* (turtleweed), typically with saltwater-tidal irregularly flooded hydrology. Other species can include *Sarcocornia perennis* (chickenclaws), *Sporobolus virginicus* (seashore dropseed), *Borrichia frutescens* (bushy seaside tansy), *Suaeda linearis* (annual seepweed), *Lycium carolinianum* (Carolina desert-thorn), *Spartina spartinae* (gulf cordgrass), *Monanthochloe littoralis* (shoregrass), *Sesuvium portulacastrum* (shoreline seapurslane), and *Blutaparon vermiculare* (silverhead). This alliance occurs especially in salt panne situations, where tidal saltwater evaporates, augmenting salinity. This is a subtropical alliance, which ranges northwards into the warmest portions of the temperate southeastern United States (e.g., Florida and Texas). This community may occur in areas up to at least 100 hectares.

Similar Alliances:

- *Sarcocornia pacifica - (Distichlis spicata, Spartina alterniflora)* Tidal Dwarf-shrubland Alliance (A.1705)--ranges from the Gulf Coast to the northern Atlantic coast of the United States, and though *Batis maritima* is a component in this alliance, it would only dominate small patches within occurrences.

Similar Alliance Comments: This is a subtropical alliance, dominated by *Batis maritima*, which ranges northwards into the warmest portions of the temperate southeastern United States. It is not regarded as occurring in the South Atlantic Coastal Plain. It is best developed in the United States in Florida and the south-central coast of Texas and may be distinguished from the similar alliance (A.1705) by the dominance of *Batis maritima*. These two alliances can be difficult to distinguish along the upper Texas coast where their ranges overlap.

Related Concepts:

- *Batidion maritimae* Alliance (Borhidi 1991) ?
- *Batis-Salicornia-Sesuvium* (Olmsted et al. 1981) ?
- Glasswort-Saltwort Series (Diamond 1993) I
- Saltwort Scrub -- 11.4 (Dansereau 1966) ?

Alliance Description

Environment: This alliance occurs in lower tidal flats and low areas of higher tidal flats, within the reach of regular high tides. It is regularly to irregularly flooded by shallow brackish waters. As these waters evaporate, high concentrations of salt accumulate, producing hypersaline conditions.

Vegetation: This alliance is dominated by *Batis maritima* (turtleweed) sometimes in association with *Sarcocornia perennis* (chickenclaws), *Sporobolus virginicus* (seashore dropseed), *Borrichia frutescens* (bushy seaside tansy), *Suaeda linearis* (annual seepweed), *Lycium carolinianum*

(Carolina desert-thorn), *Spartina spartinae* (gulf cordgrass), *Sesuvium portulacastrum* (shoreline seapurslane), and *Blutaparon vermiculare* (silverhead). Algal mats of blue-green and sometimes green algae are characteristically present, visible even in densely vegetated pannes.

Alliance Distribution

Range: This is a subtropical alliance, which ranges northwards into the warmest portions of the temperate southeastern United States. This alliance is found in Florida, Texas, and possibly in Alabama, Louisiana, Mississippi, and the Mexican state of Tamaulipas. It is also found in the Caribbean in Puerto Rico, the Bahamas, Cuba, Jamaica, Martinique, and elsewhere in the West Indies and other tropical countries.
Nations: BS, CU, JM, MQ, MX, PR, US, XB
Subnations: AL?, FL, GA, LA?, MS?, MXTM?, TX
TNC Ecoregions: 30:C, 31:C, 53:C, 54:C, 55:C, 56:C
USFS Ecoregions: 231Fb:CCC, 232Ce:CCC, 232Da:CCC, 232Dc:CCC, 232De:CCC, 232Ed:CCC, 232Ee:CCC, 232Gb:CCC, 255Dc:CCC, 315F:CC, 411Ae:CCC, 411Af:CCC, 411Ag:CCC, M411A:CC
Federal Lands: DOD (Guantanamo Bay); NPS (Canaveral, Everglades, Fort Matanzas, Fort Pulaski, Timucuan?); USFWS (Aransas, Big Boggy, Brazoria, Laguna Atascosa, Matagorda Island, San Bernard)

(CEGL003956) Saltwort - Swampfire Dwarf-shrubland
Batis maritima - Sarcocornia pacifica Dwarf-shrubland

NVC Classification

Physiognomic Class	Dwarf-shrubland (IV)
Physiognomic Subclass	Evergreen dwarf-shrubland (IV.A.)
Physiognomic Group	Extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.)
Physiognomic Subgroup	Natural/Semi-natural extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.N.)
Formation	Tidal needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.2.N.c.)
Alliance	*Batis maritima* Tidal Dwarf-shrubland Alliance (A.1111)
Alliance (English name)	Saltwort Tidal Dwarf-shrubland Alliance; Planta de Sal Dwarf-shrubland Alliance
Association	*Batis maritima - Sarcocornia pacifica* Dwarf-shrubland
Association (English name)	Saltwort - Swampfire Dwarf-shrubland
Ecological System(s):	South Texas Salt and Brackish Tidal Flat (CES301.461) Central and Upper Texas Coast Salt and Brackish Tidal Marsh (CES203.473) Florida Big Bend Salt and Brackish Tidal Marsh (CES203.508)

Element Concept

Global Summary: This association includes regularly to irregularly flooded tidal areas dominated (often with 95% or more cover) by *Batis maritima* (turtleweed). Other species can include *Sarcocornia pacifica* (Pacific swampfire), *Sporobolus virginicus* (seashore dropseed), *Borrichia frutescens* (bushy seaside tansy), *Suaeda* (seepweed) sp., *Lycium carolinianum* (Carolina desert-thorn), *Spartina spartinae* (gulf cordgrass), *Monanthochloe littoralis* (shoregrass), *Sesuvium portulacastrum* (shoreline seapurslane), and *Blutaparon vermiculare* (silverhead). This community generally lacks trees, though scattered individuals of *Avicennia germinans* (black mangrove) can occur in Florida and southern Texas. It may occur as a narrow band or occupy areas up to at least 100 hectares. This is generally a subtropical community, which also ranges northwards into the warmest portions of the temperate southeastern United States.

Environmental Description

USFWS Wetland System: Estuarine

Fort Pulaski National Monument Environment: This saltwort dwarf-shrubland was sampled at one location in the park. The site is a hypersaline tidal flat with very poorly drained muck soil. The unvegetated surface is made up entirely of bare soil (100% cover), wood (2-5% cover) and bare soil (45-50% cover). These flats are only flooded during high tides.

Global Environment: This association occurs in lower tidal flats and low areas of higher tidal flats, within the reach of regular high tides. It is regularly to irregularly flooded by shallow brackish waters. As these waters evaporate, high concentrations of salt accumulate, producing hypersaline conditions.

Vegetation Description

Fort Pulaski National Monument Vegetation: The moderate (40% cover) dwarf-shrub layer (0.5-1 m tall) is dominated by *Batis maritima* (turtleweed) and additionally only includes lesser amounts of *Borrichia frutescens* (bushy seaside tansy) and *Sarcocornia pacifica* (Pacific swampfire). Other halophytes found here include *Suaeda linearis* (annual seepweed), *Sesuvium portulacastrum* (shoreline seapurslane), and *Limonium carolinianum* (Carolina sealavender) (Govus 1998).

Global Vegetation: This community is dominated by *Batis maritima* (turtleweed) sometimes in association with *Sarcocornia pacifica* (Pacific swampfire), *Sporobolus virginicus* (seashore dropseed), *Borrichia frutescens* (bushy seaside tansy), *Suaeda linearis* (annual seepweed), *Suaeda conferta* (beach seepweed) (in southern Texas), *Lycium carolinianum* (Carolina desert-thorn), *Spartina spartinae* (gulf cordgrass), *Sesuvium portulacastrum* (shoreline seapurslane), and *Blutaparon vermiculare* (silverhead). Algal mats of blue-green and sometimes green algae are characteristically present, visible even in densely vegetated pannes.

Most Abundant Species

Fort Pulaski National Monument

Stratum	Lifeform	Species
Herb (field)	Semi-shrub	*Batis maritima* (turtleweed)

Characteristic Species

Fort Pulaski National Monument: *Batis maritima* (turtleweed), *Borrichia frutescens* (bushy seaside tansy), *Sarcocornia pacifica* (Pacific swampfire)

Other Noteworthy Species

Global

Animal Species	GRank	Note
Grus americana (whooping crane)	G1	

Conservation Status Rank

Global Rank & Reasons: G5 (15-May-1995). This is a common tidal flat community along the Gulf Coast of Texas and Florida. It may occur as a narrow band or occupy areas up to at least 100 hectares.

Classification
Status: Standard
Classification Confidence: 2 - Moderate

Fort Pulaski National Monument Comments: NatureServe identified the perennial glasswort plants at Fort Pulaski as *Sarcocornia pacifica* using the recent key in Weakley (2007), which follows Flora of North America (FNA Editorial Committee 2003). The perennial glassworts on the U.S. East Coast have been called *Sarcocornia perennis* in the past (Kartesz 1999), and their taxonomy remains unsettled. For the time being, NatureServe will continue to follow the Kartesz (1999) nomenclature in our global descriptions and U.S. National Vegetation Classification association names.

Global Comments: This association is currently known only from Florida, Georgia and the southern coast of Texas and may be distinguished from *Sarcocornia pacifica - (Batis maritima, Distichlis spicata)* Dwarf-shrubland (CEGL002278) by the dominance of *Batis maritima*. *Sarcocornia pacifica - (Batis maritima, Distichlis spicata)* Dwarf-shrubland (CEGL002278) ranges along the Gulf Coast of the United States, and though *Batis maritima* is a component in this association, it is rarely dominant, and then only at small scales. These two associations can be difficult to distinguish along the middle and upper Texas coast where their ranges overlap.

NatureServe identified the perennial glasswort plants at Fort Pulaski as *Sarcocornia pacifica* using the recent key in Weakley (2007), which follows Flora of North America (FNA Editorial Committee 2003). The perennial glassworts on the U.S. East Coast have been called *Sarcocornia perennis* in the past (Kartesz 1999), and their taxonomy remains unsettled. For the time being, NatureServe will continue to follow the Kartesz (1999) nomenclature in our global descriptions and U.S. National Vegetation Classification association names.

Global Similar Associations:
- *Salicornia (virginica, bigelovii, maritima) - Spartina alterniflora* Herbaceous Vegetation (CEGL004308)
- *Sarcocornia pacifica* - (*Batis maritima, Distichlis spicata*) Dwarf-shrubland (CEGL002278)

Global Related Concepts:
- Glasswort-Saltwort Series (Diamond 1993) B

Element Distribution
Fort Pulaski National Monument Range: This community occurs beyond the dike system south of the fort. At least two large mappable examples of this association occur on hypersaline flats that grade into other salt panne communities along eastern and southeastern Cockspur Island (Govus 1998).
Global Range: This association is currently only known from Texas, Georgia and Florida. It may also occur in Alabama, Mississippi, and Louisiana, and the Mexican state of Tamaulipas. It does not extend to South Carolina.
Nations: MX?, US
States/Provinces: AL?, FL, GA, LA?, MS?, MXTM?, TX

TNC Ecoregions: 30:C, 31:C, 53:C, 54:C, 55:C, 56:C
USFS Ecoregions: 231Fb:CCC, 232Ce:CCC, 232Da:CCC, 232Dc:CCC, 232De:CCC, 232Ed:CCC, 232Ee:CCC, 232Gb:CCC, 255Dc:CCC, 315F:CC, 411Ae:CCC, 411Af:CCC, 411Ag:CCC, M411:C
Federal Lands: NPS (Canaveral, Everglades, Fort Matanzas, Fort Pulaski, Timucuan?); USFWS (Aransas, Big Boggy, Brazoria, Laguna Atascosa, Matagorda Island, San Bernard)

Element Sources
Fort Pulaski National Monument Plots: FOPU.17.
Local Description Authors: M.J. Russo and C.W. Nordman
Global Description Authors: A.S. Weakley and K.D. Patterson
References: Diamond 1993, FNA Editorial Committee 2003, FNAI 1992a, Govus 1998, Johnston 1952, Kartesz 1999, McAlister and McAlister 1993, McAlister and McAlister 1995, Schotz pers. comm., Southeastern Ecology Working Group n.d., Weakley 2007

Sarcocornia pacifica – (Distichlis spicata, Spartina alterniflora) Tidal Dwarf-shrubland Alliance (A.1705)

Alliance Concept
Summary: Tidally flooded hypersaline flats or very shallow depressions, dominated by halophytic herbs, including *Sarcocornia perennis* (chickenclaws), *Salicornia bigelovii* (dwarf saltwort), *Salicornia virginica* (Virginia glasswort), *Distichlis spicata* (inland saltgrass), and stunted *Spartina alterniflora* (smooth cordgrass). Total vegetative cover is quite variable in pannes, from near total absence of vascular plants to a dense cover of *Salicornia bigelovii* (dwarf saltwort), *Salicornia virginica* (Virginia glasswort), *Sarcocornia perennis* (chickenclaws), or *Spartina alterniflora* (smooth cordgrass). *Limonium carolinianum* (Carolina sealavender) is another common associate. In the southern portions of its distribution, *Monanthochloe littoralis* (shoregrass) and *Batis maritima* (turtleweed) can be major components. Algal mats are characteristically present, visible even in densely vegetated pannes. Blue-green algae are an important component of this community, in some cases contributing significantly more biomass 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*, *Symploca* spp. (Webber 1967). Diagnostic species are *Salicornia bigelovii* (dwarf saltwort), *Salicornia virginica* (Virginia glasswort), and *Sarcocornia perennis* (chickenclaws). Vegetation of this alliance tends to develop in shallow depressions within high salt marshes where drainage is poor. The depressions are 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, or by mosquito ditch levees which create small impoundments. This community is regularly to irregularly flooded by nearby brackish water. Bare peat and/or mucky soils are prevalent (up to 85% bare soils), and standing water covers this community at high tide.

Similar Alliances:
- *Batis maritima* Tidal Dwarf-shrubland Alliance (A.1111)

Similar Alliance Comments: This is a temperate alliance, dominated by the perennial glasswort *Sarcocornia perennis*. It is best developed in the United States in the Gulf and upper to mid Atlantic coasts and may be distinguished from the similar alliance (A.1111) by the lack of dominance of *Batis maritima*. These two alliances can be difficult to distinguish along the upper Texas coast where their ranges overlap.

Related Concepts:

- Glasswort-Saltwort Series (Diamond 1993) ?
- Salt Flat (Wieland 1994b) ?
- Salt Flat (Nelson 1986) ?
- Salt Flat (Schafale and Weakley 1990) ?

Alliance Description

Environment: Tidally flooded hypersaline flats or very shallow depressions, dominated by halophytic herbs. Vegetation of this alliance tends to develop in shallow depressions within high salt marshes where drainage is poor. The depressions are 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, or by mosquito ditch levees which create small impoundments. This community is regularly to irregularly flooded by nearby brackish water. Bare peat and/or mucky soils are prevalent (up to 85% bare soils), and standing water covers this community at high tide.

Vegetation: Tidally flooded hypersaline flats or very shallow depressions, dominated by halophytic herbs, including *Sarcocornia perennis* (chickenclaws), *Salicornia bigelovii* (dwarf saltwort), *Salicornia virginica* (Virginia glasswort), *Distichlis spicata* (inland saltgrass), and stunted *Spartina alterniflora* (smooth cordgrass). Total vegetative cover is quite variable in pannes, from near total absence of vascular plants to a dense cover of *Salicornia bigelovii* (dwarf saltwort), *Salicornia virginica* (Virginia glasswort), *Sarcocornia perennis* (chickenclaws), or *Spartina alterniflora* (smooth cordgrass). *Limonium carolinianum* (Carolina sealavender) is another common associate. In the southern portions of its distribution, *Monanthochloe littoralis* (shoregrass) and *Batis maritima* (turtleweed) can be major components. Algal mats are characteristically present, visible even in densely vegetated pannes. Blue-green algae are an important component of this community, in some cases contributing significantly more biomass 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*, *Symploca* spp. (Webber 1967). Diagnostic species are *Salicornia bigelovii* (dwarf saltwort), *Salicornia virginica* (Virginia glasswort), and *Sarcocornia perennis* (chickenclaws).

Alliance Distribution

Range: This alliance is found in the southern United States and adjacent Mexico, ranging from South Carolina and Florida, west to Texas and Tamaulipas, Mexico.
Nations: CA?, MX, US
Subnations: AL, FL, GA, LA, MS, MXTM, SC, TX
TNC Ecoregions: 30:P, 31:C, 41:P, 53:C, 54:P, 55:C, 56:C, 57:C, 58:C, 62:C, 63:C

USFS Ecoregions: 212C:PP, 212Db:PPP, 221Aa:CCC, 221Ab:CCC, 221Ac:CCC, 221Ad:CCC, 221Ae:CC?, 221Ak:CCC, 221B:CC, 221Dc:CPP, 231Fb:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Bb:CCP, 232Bc:CCP, 232Bd:CCP, 232Bx:CC?, 232Bz:CCC, 232Cb:CC?, 232Ce:CCC, 232Ch:CCP, 232Ci:CCP, 232Db:CC?, 232Dc:CCC, 232Dd:CCC, 232De:CCC, 232Eb:CCC, 232Ed:CCC, 232Ee:CCC, 232Gb:CCC, 255Da:CCC, 255Dc:CCC, 315F:PP

Federal Lands: NPS (Acadia, Assateague Island, Canaveral, Fort Pulaski, Gulf Islands, Timucuan); USFWS (Anahuac, Aransas, Brazoria, Matagorda Island, McFaddin, San Bernard, Texas Point)

(CEGL002278) Salt Flat (Swampfire Type)

Sarcocornia pacifica - (Batis maritima, Distichlis spicata) Dwarf-shrubland
Swampfire - (Saltwort, Saltgrass) Dwarf-shrubland

NVC Classification

Physiognomic Class	Dwarf-shrubland (IV)
Physiognomic Subclass	Evergreen dwarf-shrubland (IV.A.)
Physiognomic Group	Extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.)
Physiognomic Subgroup	Natural/Semi-natural extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.N.)
Formation	Tidal needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.2.N.c.)
Alliance	*Sarcocornia pacifica - (Distichlis spicata, Spartina alterniflora)* Tidal Dwarf-shrubland Alliance (A.1705)
Alliance (English name)	Swampfire - (Saltgrass, Saltmarsh Cordgrass) Tidal Dwarf-shrubland Alliance
Association	*Sarcocornia pacifica* - (*Batis maritima, Distichlis spicata*) Dwarf-shrubland
Association (English name)	Swampfire - (Saltwort, Saltgrass) Dwarf-shrubland
Association (Common name)	Salt Flat (Swampfire Type)
Ecological System(s):	Atlantic Coastal Plain Indian River Lagoon Tidal Marsh (CES203.257) Mississippi Delta Salt and Brackish Tidal Marsh (CES203.471) South Texas Salt and Brackish Tidal Flat (CES301.461) 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 is one of several associations found in tidally influenced hypersaline areas along the southern Atlantic Coast and Gulf of Mexico region. In contrast to other tidal salt flats or pannes of this region, examples attributable to this type are dominated by the succulent dwarf-shrub *Sarcocornia pacifica* (Pacific swampfire) while stands dominated by *Batis* (turtleweed) or *Salicornia* (pickleweed) are accommodated by other associations [see *Batis maritima - Sarcocornia pacifica* Dwarf-shrubland (CEGL003956) and *Salicornia (virginica, bigelovii, maritima) - Spartina alterniflora* Herbaceous Vegetation (CEGL004308), respectively]. Examples of this association may occur in patches throughout this relatively large range. They vary somewhat locally in expression, but all tend to exhibit low vascular plant diversity, dominated by halophytic species. In addition to *Sarcocornia pacifica* (Pacific swampfire), other commonly encountered species may include *Salicornia bigelovii* (dwarf saltwort), *Distichlis spicata* (inland saltgrass), and sometimes stunted *Spartina alterniflora* (smooth cordgrass). Other typical species can include *Batis maritima* (turtleweed), *Suaeda* (seepweed) spp., *Sporobolus virginicus* (seashore dropseed), *Sesuvium portulacastrum* (shoreline seapurslane), and *Limonium carolinianum* (Carolina sealavender). Total vegetative cover is quite variable, from near total absence of vascular plants to a dense cover of the nominal species.

Algal mats are characteristically present, visible even in densely vegetated pannes. Blue-green algae may contribute significantly more biomass than vascular species.

Environmental Description

USFWS Wetland System: Estuarine

Fort Pulaski National Monument Environment: This woody glasswort dwarf-shrubland was sampled at one location in the park. The site is a tidal flat located on slightly higher ground than adjacent to cordgrass salt marsh. Soil is very poorly drained muck. The unvegetated surface is made up of equal parts leaf litter (50% cover) and bare soil (50%). This association represents the salt panne community. It is particularly well-developed on the broad gentle flats that lie along the south side of Cockspur Island. This is a hypersaline environment caused by the repeated evaporation of tidal water from these expansive shallow areas (Govus 1998).

Global Environment: Typically, this vegetation tends to develop in lower tidal flats and shallow depressions within upper tidal flats and high salt marshes where drainage is poor. These areas flood during high tides, and salt accumulates as the water evaporates during low tides, producing hypersaline conditions, forming salt pannes.

Vegetation Description

Fort Pulaski National Monument Vegetation: This sparse dwarf-shrubland is dominated (20% cover) by *Sarcocornia pacifica* (Pacific swampfire). The only other species present is *Spartina alterniflora* (smooth cordgrass). Vegetative cover varies from a total absence of vascular plants to a dense concentration of halophytic herbs, particularly *Sarcocornia pacifica* (Pacific swampfire), which is clearly dominant. *Batis maritima* (turtleweed) and *Distichlis spicata* (inland saltgrass) are also abundant and usually interspersed with dwarfed *Spartina alterniflora* (smooth cordgrass). Additional species found in this association include *Limonium carolinianum* (Carolina sealavender), *Suaeda linearis* (annual seepweed), and *Sesuvium portulacastrum* (shoreline seapurslane) (Govus 1998).

Global Vegetation: This community is dominated by the halophytic, succulent dwarf-shrub *Sarcocornia pacifica* (Pacific swampfire) and other halophytes, including *Salicornia bigelovii* (dwarf saltwort), *Distichlis spicata* (inland saltgrass), and sometimes stunted *Spartina alterniflora* (smooth cordgrass). Other typical species can include *Suaeda* (seepweed) spp., *Sporobolus virginicus* (seashore dropseed), *Sesuvium portulacastrum* (shoreline seapurslane), and *Limonium carolinianum* (Carolina sealavender). Algal mats are characteristically present, visible even in densely vegetated pannes. Blue-green algae may contribute significantly more biomass than vascular species. Texas examples, of alternately wet and dry saline soils along the Gulf Coast, may contain *Monanthochloe littoralis* (shoregrass), *Rayjacksonia phyllocephala* (camphor daisy), *Borrichia frutescens* (bushy seaside tansy), *Maytenus phyllanthoides* (Florida mayten), *Suaeda* (seepweed) spp., *Sesuvium portulacastrum* (shoreline seapurslane), and *Sporobolus virginicus* (seashore dropseed).

Most Abundant Species

Fort Pulaski National Monument

Stratum	Lifeform	Species
Herb (field)	Semi-shrub	*Sarcocornia pacifica* (Pacific swampfire)

Characteristic Species
Fort Pulaski National Monument: *Sarcocornia pacifica* (Pacific swampfire), *Spartina alterniflora* (smooth cordgrass)

Conservation Status Rank
Global Rank & Reasons: G4 (15-Dec-1994). This is a common tidal flat community along the Gulf and South Atlantic coasts of the United States.

Classification
Status: Standard
Classification Confidence: 2 - Moderate

Fort Pulaski National Monument Comments: NatureServe identified the perennial glasswort plants at Fort Pulaski as *Sarcocornia pacifica* using the recent key in Weakley (2007), which follows Flora of North America (FNA Editorial Committee 2003). The perennial glassworts on the U.S. East Coast have been called *Sarcocornia perennis* in the past (Kartesz 1999), and their taxonomy remains unsettled. For the time being, NatureServe will continue to follow the Kartesz (1999) nomenclature in our global descriptions and U.S. National Vegetation Classification association names.

Global Comments: This association is dominated by *Sarcocornia pacifica* and may be distinguished from *Batis maritima - Sarcocornia pacifica* Dwarf-shrubland (CEGL003956) by the lack of dominance by *Batis maritima*. These two associations can be difficult to distinguish along the middle and upper Texas coast where their ranges overlap. A similar community, *Salicornia (virginica, bigelovii, maritima) - Spartina alterniflora* Herbaceous Vegetation (CEGL004308), occurs along the mid- and northern Atlantic Coast.

NatureServe identified the perennial glasswort plants at Fort Pulaski as *Sarcocornia pacifica* using the recent key in Weakley (2007), which follows Flora of North America (FNA Editorial Committee 2003). The perennial glassworts on the U.S. East Coast have been called *Sarcocornia perennis* in the past (Kartesz 1999), and their taxonomy remains unsettled. For the time being, NatureServe will continue to follow the Kartesz (1999) nomenclature in our global descriptions and U.S. National Vegetation Classification association names.

Global Similar Associations:
- *Batis maritima - Sarcocornia pacifica* Dwarf-shrubland (CEGL003956)
- *Salicornia (virginica, bigelovii, maritima) - Spartina alterniflora* Herbaceous Vegetation (CEGL004308)--similar habitat with a more northerly range along the mid and northern Atlantic coasts.

Global Related Concepts:
- Glasswort-Saltwort Series (Diamond 1993) ?

Element Distribution

Fort Pulaski National Monument Range: This community is located northeast of the fort. It is widely represented on the south side of Cockspur Island and, to a lesser extent, also on McQueens Island (Govus 1998).

Global Range: This community ranges from the Atlantic coast of South Carolina across the Gulf of Mexico region of the United States into Mexico. It ranges from South Carolina to the upper coast of Mexico.

Nations: MX, US

States/Provinces: AL:S1, FL, GA, LA, MS, MXTM, SC, TX

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

USFS Ecoregions: 231Fb:CCC, 232Ce:CCC, 232Db:CC?, 232Dc:CCC, 232Dd:CCC, 232De:CCC, 232Eb:CCC, 232Ed:CCC, 232Ee:CCC, 232Gb:CCC, 255Da:CCC, 255Dc:CCC, 315F:PP

Federal Lands: NPS (Canaveral, Fort Pulaski, Gulf Islands, Timucuan); USFWS (Anahuac, Aransas, Brazoria, Matagorda Island, McFaddin, San Bernard, Texas Point)

Element Sources

Fort Pulaski National Monument Plots: FOPU.5.

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

Global Description Authors: R.E. Evans

References: Diamond 1993, FNA Editorial Committee 2003, Govus 1998, Kartesz 1999, Peet et al. unpubl. data 2002, Schotz pers. comm., Southeastern Ecology Working Group n.d., Weakley 2007, Wieland 1994a, Wieland 1994b, Wieland 2000b

Herbaceous Vegetation (V.)

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).

Alliance Distribution

Range: This alliance is found in coastal areas of the southeastern U.S.
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, Fort Matanzas, Fort Sumter, Padre Island, Timucuan); USFWS (Back Bay, Bon Secour, Cape Romain, Matagorda Island)

Tidal temperate or subpolar grassland (V.A.5.N.n)

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)

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 Description

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.

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) Needlerush High Marsh

***Juncus roemerianus* Herbaceous Vegetation**

Black Needlerush 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	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)
Ecological System(s):	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

Fort Pulaski National Monument Environment: This needlerush high marsh was sampled at one location in the park. The site is a tidally flooded marsh with very poorly drained muck soil. Examples of it are usually located near the low salt marsh fringe (Govus 1998). The unvegetated surface is made up of standing water (50% cover), leaf litter (10% cover) and bare soil (40% cover). Evidence of disturbance includes the presence of trails.

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

Fort Pulaski National Monument Vegetation: The dense (80% cover) herbaceous layer is dominated by *Juncus roemerianus* (needlegrass rush), with small amounts of *Spartina alterniflora* (smooth cordgrass). *Limonium carolinianum* (Carolina sealavender), *Distichlis spicata* (inland saltgrass), and *Symphyotrichum tenuifolium* (perennial saltmarsh aster) are also sometimes present (Govus 1998).

Global Vegetation: The very dense vegetation is typically exclusively codominated by *Juncus roemerianus* (needlegrass rush) and *Spartina alterniflora* (smooth cordgrass). 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 may occur at low cover 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

Fort Pulaski National Monument

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Juncus roemerianus* (needlegrass rush)

Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Juncus roemerianus* (needlegrass rush)

Characteristic Species

Fort Pulaski National Monument: *Juncus roemerianus* (needlegrass rush), *Spartina alterniflora* (smooth cordgrass)

Global: *Juncus roemerianus* (needlegrass rush)

Other Noteworthy Species

Global

Other Plant Species	**GRank**	**Note**
Ptilimnium nodosum (piedmont mock bishopweed)	G2	Federally listed endangered; globally imperiled

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

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

Fort Pulaski National Monument Range: This community is located along the rails to trails between the gate and first wooden bridge. This community is not widely developed at Fort Pulaski and does not occur in large enough patches to be mapped at a reasonable scale. Discrete examples are visible on both Cockspur and McQueens islands (Govus 1998).

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: 31:C, 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, Big Boggy, Bon Secour, Brazoria, Chesapeake Marshlands, McFaddin, San Bernard, Texas Point)

Element Sources

Fort Pulaski National Monument Plots: FOPU.12.

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

Global Description Authors: R.E. Evans, mod. L.A. Sneddon and M. Pyne

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, Govus 1998, 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

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 "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.

Similar Alliances:

- *Schoenoplectus americanus* Tidal Herbaceous Alliance (A.2007)
- *Spartina patens - (Distichlis spicata)* Tidal Herbaceous Alliance (A.1481)

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 "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.

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) Southern Atlantic Coast Salt Marsh

***Spartina alterniflora* Carolinian Zone Herbaceous Vegetation**
Saltmarsh Cordgrass Carolinian Zone 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	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 "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-statured species.

Environmental Description

USFWS Wetland System: Estuarine

Fort Pulaski National Monument Environment: This coastal salt marsh association was sampled at two locations but is the most abundant vegetation in the park. The sites are tidal with very poorly drained muck soil. The unvegetated surface is made up entirely of standing water (100% cover). These flats are in areas between mean high and low tides and are flooded twice a day. It also slowly grades into salt panne communities that include *Spartina alterniflora* along the extensive gentle flats along the southern edge of Cockspur Island.

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

Fort Pulaski National Monument Vegetation: The sparse to moderately dense (30-70% cover) herbaceous layer is dominated by *Spartina alterniflora* (smooth cordgrass). Other species present are *Distichlis spicata* (inland saltgrass), *Sarcocornia pacifica* (Pacific swampfire), and *Juncus roemerianus* (needlegrass rush).

Global Vegetation: This community is commonly known as "low salt marsh," occurring as 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-statured 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

Fort Pulaski National Monument

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Spartina alterniflora* (smooth cordgrass)

Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Spartina alterniflora* (smooth cordgrass)

Characteristic Species

Fort Pulaski National Monument: *Sarcocornia pacifica* (Pacific swampfire), *Spartina alterniflora* (smooth cordgrass)

Global: *Spartina alterniflora* (smooth cordgrass)

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

Fort Pulaski National Monument Comments: NatureServe identified the perennial glasswort plants at Fort Pulaski as *Sarcocornia pacifica* using the recent key in Weakley (2007), which follows Flora of North America (FNA Editorial Committee 2003). The perennial glassworts on the U.S. East Coast have been called *Sarcocornia perennis* in the past (Kartesz 1999), and their taxonomy remains unsettled. For the time being, NatureServe will continue to follow the Kartesz (1999) nomenclature in our global descriptions and U.S. National Vegetation Classification association names.

Global Similar Associations:

- *Spartina alterniflora / (Ascophyllum nodosum)* Acadian/Virginian Zone Herbaceous Vegetation (CEGL004192)

Global Related Concepts:

- Salt Marsh (Carolinian Subtype) (Schafale 2000) ?

Element Distribution

Fort Pulaski National Monument Range: This community was sampled in the salt marsh northeast of the fort and west of the gate house. This community by far occupies the greatest amount of the property present at Fort Pulaski National Monument. Over 340 acres of Cockspur Island and over 4400 acres of McQueens Island are dominated by salt marsh (Govus 1998).

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: 55:P, 56:C, 57:C

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

Federal Lands: NPS (Cape Hatteras, Cape Lookout, Fort Pulaski, Timucuan); USFS (Croatan)

Element Sources

Fort Pulaski National Monument Plots: FOPU.7, FOPU.10.

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

Global Description Authors: A.S. Weakley

References: Cowardin et al. 1979, FNA Editorial Committee 2003, FNAI 1992a, Govus 1998, Kartesz 1999, Nelson 1986, Peet et al. unpubl. data 2002, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Southeastern Ecology Working Group n.d., Weakley 2007

Spartina cynosuroides Tidal Herbaceous Alliance (A.1480)

Alliance Concept

Summary: This alliance occurs as narrow, almost pure, stands of *Spartina cynosuroides* (big cordgrass) along tidal creeks and sloughs or on levees of oligohaline tidal marshes. Some *Spartina cynosuroides* (big cordgrass) communities are nearly monospecific, while others have a diverse component of other graminoids and forbs. Associated plants include *Schoenoplectus pungens* (common threesquare), *Schoenoplectus robustus* (sturdy bulrush), *Schoenoplectus tabernaemontani* (softstem bulrush), *Pontederia cordata* (pickerelweed), *Peltandra virginica* (green arrow arum), *Typha domingensis* (southern cattail), and *Typha angustifolia* (narrowleaf cattail), among others. Communities in this alliance occur mainly in the mid-Atlantic states with the northern extent of distribution being southern New England.

Classification Comments: There may be several associations, determined by salinity.

Related Concepts:

- Big Cordgrass Community Type (Odum et al. 1984) ?
- Brackish Marsh (Nelson 1986) I
- Brackish Marsh (Schafale and Weakley 1990) I
- Brackish Marsh (Wharton 1978) I
- Tidal Freshwater Marsh, Oligohaline Variant (Schafale and Weakley 1990) ?

Alliance Description

Environment: This alliance occurs as narrow, almost pure, stands of *Spartina cynosuroides* along tidal creeks and sloughs or on levees of oligohaline tidal marshes.

Vegetation: Some *Spartina cynosuroides* (big cordgrass) communities are nearly monospecific, while others have a diverse component of other graminoids and forbs. Associated plants include *Schoenoplectus pungens* (common threesquare), *Schoenoplectus robustus* (sturdy bulrush), *Schoenoplectus tabernaemontani* (softstem bulrush), *Pontederia cordata* (pickerelweed), *Peltandra virginica* (green arrow arum), *Typha domingensis* (southern cattail), and *Typha angustifolia* (narrowleaf cattail), among others.

Alliance Distribution

Range: Communities in this alliance occur mainly in the mid-Atlantic states with the northern extent of distribution being southern New England. It is found in Georgia, North Carolina, South Carolina, Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, and Virginia.
Nations: US
Subnations: DE, GA, MA, MD, NC, NJ, SC, VA
TNC Ecoregions: 52:P, 56:C, 57:C, 58:C, 62:C

USFS Ecoregions: 221Ab:CCC, 232Ab:CCP, 232Ac:CCP, 232Ad:CCC, 232Br:CCC, 232Bt:CCC, 232Bx:CCC, 232Bz:CCC, 232Cb:CCP, 232Ce:CCC, 232Ch:CCC, 232Ci:CCC
Federal Lands: NPS (Assateague Island, Cape Cod, Colonial, Fort Pulaski, George Washington Birthplace); USFWS (Back Bay, Chesapeake Marshlands)

(CEGL004195) Atlantic Giant Cordgrass Marsh

***Spartina cynosuroides* Herbaceous Vegetation**
Giant Cordgrass 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	Tidal temperate or subpolar grassland (V.A.5.N.n.)
Alliance	*Spartina cynosuroides* Tidal Herbaceous Alliance (A.1480)
Alliance (English name)	Giant Cordgrass Tidal Herbaceous Alliance
Association	*Spartina cynosuroides* Herbaceous Vegetation
Association (English name)	Giant Cordgrass Herbaceous Vegetation
Association (Common name)	Atlantic Giant Cordgrass Marsh
Ecological System(s):	Northern Atlantic Coastal Plain Brackish Tidal Marsh (CES203.894) Central Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.376) Atlantic Coastal Plain Embayed Region Tidal Freshwater Marsh (CES203.259)

Element Concept

Global Summary: This community includes narrow, almost pure stands of *Spartina cynosuroides* (big cordgrass) along tidal creeks and sloughs or on levees of oligohaline tidal marshes along the central Atlantic Coast. Some occurrences are nearly monospecific, while others have a diverse component of other graminoids and forbs. Where mixed, associated plants include *Schoenoplectus pungens* (common threesquare), *Schoenoplectus robustus* (sturdy bulrush), *Schoenoplectus americanus* (chairmaker's bulrush), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Hibiscus moscheutos* (crimsoneyed rosemallow), *Amaranthus cannabinus* (tidalmarsh amaranth), *Panicum virgatum* (switchgrass), *Peltandra virginica* (green arrow arum), and *Polygonum punctatum* (dotted smartweed). Where more saline, *Spartina alterniflora* (smooth cordgrass) and *Iva frutescens* (Jesuit's bark) can become more frequent. Where less saline, associates can include *Schoenoplectus tabernaemontani* (softstem bulrush), *Pontederia cordata* (pickerelweed), *Peltandra virginica* (green arrow arum), *Leersia oryzoides* (rice cutgrass), *Mikania scandens* (climbing hempvine), *Rumex verticillatus* (swamp dock), *Echinochloa walteri* (coast cockspur grass), *Polygonum hydropiperoides* (swamp smartweed), and *Typha angustifolia* (narrowleaf cattail) (or *Typha domingensis* (southern cattail) in the south), among others. In more disturbed areas, this association can be displaced by *Phragmites australis* (common reed).

Environmental Description

USFWS Wetland System: Estuarine

Fort Pulaski National Monument Environment: This community does not occur over a large area; typically it is located in narrow bands associated with tidal ditches and along fringe areas between tidal herbaceous vegetation and tidal shrublands (Govus 1998).

Global Environment: This association occurs along tidal creeks, guts, and levees of oligohaline to mesohaline marshes in irregularly flooded high marsh situations, but in areas that are well-drained.

Vegetation Description

Fort Pulaski National Monument Vegetation: In addition to *Spartina cynosuroides* (big cordgrass), *Schoenoplectus robustus* (sturdy bulrush) is also sometimes present (Govus 1998).

Global Vegetation: *Spartina cynosuroides* (big cordgrass) is strongly dominant in this community, often occurring in pure stands. Where stands are mixed, common associates can include *Schoenoplectus robustus* (sturdy bulrush), *Schoenoplectus pungens* (common threesquare), *Schoenoplectus americanus* (chairmaker's bulrush), *Peltandra virginica* (green arrow arum), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Amaranthus cannabinus* (tidalmarsh amaranth), *Panicum virgatum*, *Peltandra virginica* (green arrow arum), and *Polygonum punctatum* (dotted smartweed). Where more saline, *Spartina alterniflora* (smooth cordgrass) and *Iva frutescens* (Jesuit's bark) can become more frequent. Where less saline, *Schoenoplectus tabernaemontani* (softstem bulrush), *Polygonum hydropiperoides* (swamp smartweed), *Pontederia cordata* (pickerelweed), *Peltandra virginica* (green arrow arum), *Leersia oryzoides* (rice cutgrass), *Mikania scandens* (climbing hempvine), *Rumex verticillatus* (swamp dock), *Echinochloa walteri* (coast cockspur grass), and *Typha angustifolia* (narrowleaf cattail) are also common associates. In more disturbed areas, this association can be displaced by *Phragmites australis* (common reed).

Most Abundant Species

Fort Pulaski National Monument

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Spartina cynosuroides* (big cordgrass)

Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Spartina cynosuroides* (big cordgrass)

Characteristic Species

Fort Pulaski National Monument: *Spartina cynosuroides* (big cordgrass)
Global: *Spartina cynosuroides* (big cordgrass)

Conservation Status Rank

Global Rank & Reasons: G4 (13-Aug-1997).

Classification

Status: Standard
Classification Confidence: 2 - Moderate

Global Comments: *Spartina cynosuroides* - *Panicum virgatum* - *Phyla lanceolata* Herbaceous Vegetation (CEGL007741) is similar in terms of dominant and codominant species, however, associated species differ somewhat and CEGL007741 occurs in wind-tidal situations in North Carolina and Virginia. North of New Jersey, *Spartina cynosuroides* is a component of brackish high marsh associations, but does not tend to dominate.

Global Similar Associations:

- *Spartina cynosuroides - Panicum virgatum - Phyla lanceolata* Herbaceous Vegetation (CEGL007741)

Global Related Concepts:

- *Spartina cynosuroides* Herbaceous Vegetation (Coulling 2002) =
- Big Cordgrass Community Type (Odum et al. 1984) ?
- Brackish Marsh (Wharton 1978) B
- Brackish tidal marsh complex (Breden 1989) ?
- Tidal Freshwater Marsh (Giant Cordgrass Subtype) (Schafale 2000) ?

Element Distribution

Fort Pulaski National Monument Range: This community does not occur over a large area; typically it is located in narrow bands associated with tidal ditches and also along fringe areas between tidal herbaceous vegetation and tidal shrublands (Govus 1998).
Global Range: This association occurs along the Atlantic coast from New Jersey to Georgia.
Nations: US
States/Provinces: DE:S3?, GA, MA, MD:S4?, NC, NJ:S3, SC, VA
TNC Ecoregions: 56:C, 57:C, 58:C, 62:C
USFS Ecoregions: 221Ab:CCC, 232Ab:CCP, 232Ac:CCP, 232Ad:CCC, 232Br:CCC, 232Bt:CCC, 232Bx:CCC, 232Bz:CCC, 232Cb:CCP, 232Ce:CCC, 232Ch:CCC, 232Ci:CCC
Federal Lands: NPS (Assateague Island, Cape Cod, Colonial, Fort Pulaski, George Washington Birthplace); USFWS (Back Bay, Chesapeake Marshlands)

Element Sources

Fort Pulaski National Monument Plots: None.
Local Description Authors: M.J. Russo and C.W. Nordman
Global Description Authors: S.L. Neid
References: Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1996, Coulling 2002, Fleming 2001a, Fleming and Moorhead 1998, Fleming et al. 2001, Govus 1998, Harrison 2001, Harrison 2004, Nelson 1986, Odum 1988, Odum and Smith 1981, Odum et al. 1984, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Southeastern Ecology Working Group n.d., Wharton 1978

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); USFWS (Anahuac, Back Bay?, Big Boggy, Brazoria, Chesapeake Marshlands, Matagorda Island, McFaddin, Moosehorn, Parker River?, Prime Hook, Rachel Carson, San Bernard, Texas Point)

(CEGL004197) Mid-Atlantic High Salt Marsh

Spartina patens - Distichlis spicata - (Juncus roemerianus) Herbaceous Vegetation
Saltmeadow Cordgrass - Saltgrass - (Black Needlerush) 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	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

Fort Pulaski National Monument Environment: This community is found on infrequently tidally flooded terraces (Govus 1998).

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

Fort Pulaski National Monument Vegetation: This is one of the most diverse and scenically attractive natural communities present on the park. In addition to *Spartina patens* (saltmeadow cordgrass), *Distichlis spicata* (inland saltgrass), and *Borrichia frutescens* (bushy seaside tansy), other species found here include *Solidago sempervirens* (seaside goldenrod), *Limonium carolinianum* (Carolina sealavender), *Cynanchum angustifolium* (gulf coast swallow-wort), *Paspalum distichum* (knotgrass), *Fimbristylis* (fimbry) sp., and, along the upper edges in overwash areas, *Atriplex prostrata* (triangle orache) (Govus 1998).

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

Fort Pulaski National Monument

Stratum	Lifeform	Species
Herb (field)	Forb	*Borrichia frutescens* (bushy seaside tansy)
Herb (field)	Graminoid	*Spartina patens* (saltmeadow cordgrass)

Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Distichlis spicata* (inland saltgrass), *Spartina patens* (saltmeadow cordgrass)

Characteristic Species

Fort Pulaski National Monument: *Borrichia frutescens* (bushy seaside tansy), *Spartina patens* (saltmeadow cordgrass)

Global: *Distichlis spicata* (inland saltgrass), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Pluchea odorata* (sweetscent), *Spartina patens* (saltmeadow cordgrass)

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

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

Fort Pulaski National Monument Range: This communit is found in large areas, primarily along the infrequently tidally flooded terraces of north-central Cockspur Island (Govus 1998).
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: 56:C, 57:C, 58:C, 62:C

USFS Ecoregions: 232Br:CCC, 232Bx:CCC, 232Bz:CCC, 232Ce:CCC, 232Ch:CCC, 232Ci:CCC
Federal Lands: NPS (Assateague Island, Cape Hatteras, Cape Lookout, Fort Pulaski); USFWS (Back Bay?, Chesapeake Marshlands, Chincoteague, Prime Hook)

Element Sources
Fort Pulaski National Monument Plots: None.
Local Description Authors: M.J. Russo and C.W. Nordman
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 2001a, Fleming et al. 2001, Govus 1998, 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

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Appendix C: Field Key to Vegetation Types

Key to the National Vegetation Classification (NVC) Associations
Fort Pulaski and Fort Sumter National Monuments

May 2008

NatureServe, Durham, NC

Revised by Southeast Coast Inventory and Monitoring Network October 2011

Associations which are documented from Fort Pulaski and/or Fort Sumter National Monuments are in **bold 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. Only forests dominated by *Triadica sebifera* (Tallowtree) occur at FOSU.....**KEY A – FORESTS & WOODLANDS**

1. Vegetation not dominated by trees, trees absent or very sparse **2**

2. Shrub dominated and vine dominated areas, with few or no trees. This includes areas that may be dominated by shrub species of very large size (technically tree size of 4cm in DBH or larger, and over 1.5m in height). Shrubs of large size may include *Morella cerifera*, *Juniperus virginiana* var. *silicicola*, *Prunus caroliniana*, *Zanthoxylon clava-herculis*, and *Ilex vomitoria*. .....**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 & WOODLANDS

1. Forest dominated by Slash Pine (*Pinus elliottii var. elliottii*)..... ....**Slash Pine Plantation (CEGL007170) [A.95]**

1. Forest not dominated by Slash Pine (*Pinus elliottii var. elliottii*)..... **2**

2. Forest dominated by Tallowtree (*Triadica sebifera*) **3**

2. Forest dominated by evergreen or deciduous trees, some combination of Live Oak (*Quercus virginiana*), Cabbage Palmetto (*Sabal palmetto*), and/or Coastal Red-cedar (*Juniperus virginiana* var. *silicicola*) **4**

3. Upland forest dominated by Tallowtree (*Triadica sebifera*) (FOPU only) ....**Tallowtree Upland Forest (CEGL007037) [A.257]**

3. Wetland forest dominated by Tallowtree (*Triadica sebifera*). *Salix caroliniana* may be sub-dominant (FOSU ONLY)..... **Tallowtree Seasonally Flooded Forest Alliance [A.335]**

4. Open stands dominated by *Celtis laevigata* (sugarberry), *Ilex vomitoria* (yaupon), *Juniperus virginiana var. silicicola* (southern redcedar), *Sabal palmetto* (cabbage palmetto), and *Triadica sebifera* (tallowtree) (exotic) ..... **Cabbage Palmetto Woodland (CEGL003526) [A.481]**

4. Closed forest stands dominated by *Juniperus virginiana var. silicicola* (southern redcedar) **5**

5. Shell midden (on McQueens Island) dominated by *Juniperus virginiana var. silicicola* (southern redcedar). Additional tree species may include *Forestiera segregata* (Florida swampprivet), *Sabal palmetto* (cabbage palmetto), *Ilex vomitoria* (yaupon), *Celtis laevigata* (sugarberry) ....**South Atlantic Coastal Shell Midden Woodland (CEGL003525) [A.479]**

5. Hammock forest (on Cockspur Island) mostly on old dredge spoil with dense (70-90% cover) tree canopy, 10-20 m tall, dominated by *Juniperus virginiana var. silicicola* (southern redcedar) along with *Sabal palmetto* (cabbage palmetto) and *Ulmus americana* (American elm) or *Ilex vomitoria* (yaupon)..... ..... **Cedar - Live Oak - Cabbage Palmetto Marsh Hammock (CEGL007813) [A.55]**

KEY B –SHRUBLANDS

1. Tidally influenced sparse to moderate (20 - 40% cover) dwarf-shrubland (generally < 1 m tall) dominated by *Batis maritima* (turtleweed) and/or *Sarcocornia pacifica* (Pacific swampfire) and may include lesser amounts of *Borrichia frutescens* (bushy seaside tansy or seaside oxeye). These sites include open salt flats. Other halophytes may include *Suaeda linearis* (annual seepweed), *Sesuvium portulacastrum* (shoreline seapurslane), and *Limonium carolinianum* (Carolina sealavender) **2**

1. Shrublands (tidal and non-tidal), not dominated by *Batis maritima* (turtleweed) and/or *Sarcocornia pacifica* (Pacific swampfire) **3**

2. Tidally influenced sparse to moderate (20 - 40% cover) dwarf-shrubland (generally < 0.5 m tall) dominated by *Batis maritima* (turtleweed) and additionally only includes lesser amounts of *Borrichia frutescens* (bushy seaside tansy or seaside oxeye) and *Sarcocornia pacifica* (Pacific swampfire)..... .....**Saltwort - Swampfire Dwarf-shrubland (CEGL003956) [A.1111]**

2. Tidally influenced sparse dwarf-shrubland is dominated (20% cover) by *Sarcocornia pacifica* (Pacific swampfire). Other plants may include *Batis maritima* (turtleweed) and *Distichlis spicata* (inland saltgrass) and dwarfed *Spartina alterniflora* (smooth cordgrass)... **Salt Flat (Swampfire Type) (CEGL002278) [A.1705]**

3. Shrublands which are generally not tidally influenced, dominated by Wax-myrtle (*Morella cerifera),* or *Prunus caroliniana* (Carolina laurelcherry) along with lesser amounts of *Zanthoxylum clava-herculis* (Hercules' club), *Celtis laevigata* (sugarberry), and *Sabal palmetto* (cabbage palmetto). Vines include may include *Parthenocissus quinquefolia* (Virginia creeper), *Smilax auriculata* (earleaf greenbrier), and *Smilax bona-nox* (saw greenbrier) **4**

3. Tidal fringe shrublands, generally at upper edge of tidal influence, dominated by Seaside Oxeye (*Borrichia frutescens),*or some combination of Groundsel-tree *(Baccharis halimifolia),* Maritime Marsh-elder (*Iva frutescens),* and Wax-myrtle (*Morella cerifera),* and Yaupon (*Ilex vomitoria*) **5**

4. Wax-myrtle (*Morella cerifera)* dominates the shrub layers; additional shrubs may include Yaupon *(Ilex vomitoria),* and Coastal Red-cedar (*Juniperus virginiana var. silicicola), Celtis laevigata* (sugarberry),

Sabal palmetto (cabbage palmetto), and *Rubus trivialis* (southern dewberry). Vines include *Ampelopsis arborea* (peppervine), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax auriculata* (earleaf greenbrier), and *Smilax bona-nox* (saw greenbrier)..... ....**Atlantic Coast Interdune Swale (CEGL003839) [A.1906]**

4. Vegetation is dominated *Morella cerifera* (wax myrtle) and *Prunus caroliniana* (Carolina laurelcherry) along with lesser amounts of *Zanthoxylum clava-herculis* (Hercules' club); and *Rubus trivialis* (southern dewberry). Some trees of *Celtis laevigata* (sugarberry) and tree sized *Prunus caroliniana* (Carolina laurelcherry) may be present. Vines include *Vitis rotundifolia* (muscadine), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax auriculata* (earleaf greenbrier), and *Smilax bona-nox* (saw greenbrier)..... **Wax-myrtle – Carolina Laurel Cherry – Toothache-tree Shrubland (CEGL004784) [A.785]**

5. Vegetation is tidal shrubland is dominated by a sparse to very dense (20-100% cover) shrub layer (0.5-1 m tall) of Seaside Oxeye (*Borrichia frutescens)*. The moderate to dense (40-80%) herbaceous layer is dominated by *Distichlis spicata* (inland saltgrass). Additional shrubs may include *Juniperus virginiana var. silicicola* (southern redcedar), *Ilex vomitoria* (yaupon), *Iva frutescens* (Jesuit's bark), and *Sideroxylon tenax* (tough bully) (globally and state-vulnerable). The short-shrub layer is dominated by *Borrichia frutescens* (bushy seaside tansy) and may include *Sarcocornia pacifica* (Pacific swampfire), *Pinus elliottii* (slash pine), *Sabal palmetto* (cabbage palmetto), and *Yucca aloifolia* (aloe yucca). .... **Seaside Oxeye Tidal Shrub Flat (CEGL003924) [A.1026]**

5. Vegetation on interdunal swales and/or salt flats that are subject to irregular storm and tidal flooding. 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*). Other species present may include *Baccharis angustifolia* (saltwater false willow), *Limonium carolinianum* (Carolina sealavender), and *Fimbristylis castanea* (marsh fimbry).....**Coastal Salt Shrub Thicket (CEGL003920) [A.1023]**

KEY C – GRAMINOID VEGETATION

1. Sparse vegetation of dunes and fore dunes and interdunal swales, generally dominated by Sea Oats (*Uniola paniculata)* or *Heterotheca subaxillaris* (camphorweed). Vines (5% - 40% cover) are dominated by *Smilax auriculata* (earleaf greenbrier), *Strophostyles helvula* (trailing wild bean), or *Hydrocotyle bonariensis* (beach pennywort). *Spartina patens* (saltmeadow cordgrass), *Cenchrus incertus* (coast sandspur), *Panicum amarum* (bitter panicgrass), *Ipomoea imperati* (beach morning-glory), and *Oenothera drummondii* (beach evening primrose) may also be common ..... ***Uniola paniculata* Temperate Herbaceous Alliance [A.1119]**

1. Tidal salt marshes, including the higher areas with less tidal influence sometimes called salt flats **2**

2. High salt marsh, with vegetation dominated by Black Needlerush (*Juncus roemerianus*) .... **Needlerush High Marsh (CEGL004186) [A.1475]**

2. Salt marsh dominated by cordgrasses (*Spartina spp.)* or *Distichlis spicata* (inland saltgrass)..... **3**

3. Tidal salt marsh vegetation, dominated by Salt marsh Cordgrass (*Spartina alterniflora*). Very extensive on McQueens Island ..... **Southern Atlantic Coast Salt Marsh (CEGL004191)**

3. Vegetation dominated by grasses other than Salt marsh Cordgrass (*Spartina alterniflora*)..... **4**

4. Vegetation dominated or codominated *Spartina patens* (saltmeadow cordgrass), *Distichlis spicata* (inland saltgrass), and/or *Borrichia frutescens* (bushy seaside tansy, or seaside oxeye) .... **Mid-Atlantic High Salt Marsh (CEGL004197) [A.1481]**

4. Vegetation narrow, almost pure stands of *Spartina cynosuroides* (big cordgrass) along tidal creeks, ditches and sloughs ..... **Atlantic Giant Cordgrass Marsh (CEGL004195) [A.1480]**

4. Grassland vegetation, dominated by the Common Reed (Phragmites australis), generally in brackish marshes (FOPU only)..... **Reed Tidal Marsh (CEGL004187) [A. 1477]**

Appendix D: Photo-Interpretation Guide

Photo-Interpretation Guide to the Vegetated Map Classes of Fort Sumter National Monument

Wetland Forest

Map Class 1: Tallowtree Seasonally Flooded Forest

Upland Shrubland

Map Class 2: Wax-myrtle-Carolina Laurel Cherry-Toothache-tree Shrubland

Map Class 3: Atlantic Coast Interdune Swale

Upland Herbaceous

Map Class 4: Sea-oats Temperate Herbaceous Alliance

Wetland Herbaceous

Map Class 5: Southern Atlantic Coast Salt Marsh

I. Wetland Forest

MAP CLASS 1

Tallowtree Seasonally Flooded Forest:

Abundant species:

- *Triadica sebifera*
- *Salix sp.*
- *Various wetland grasses, sedges, and forbs*

Map Class Statistics

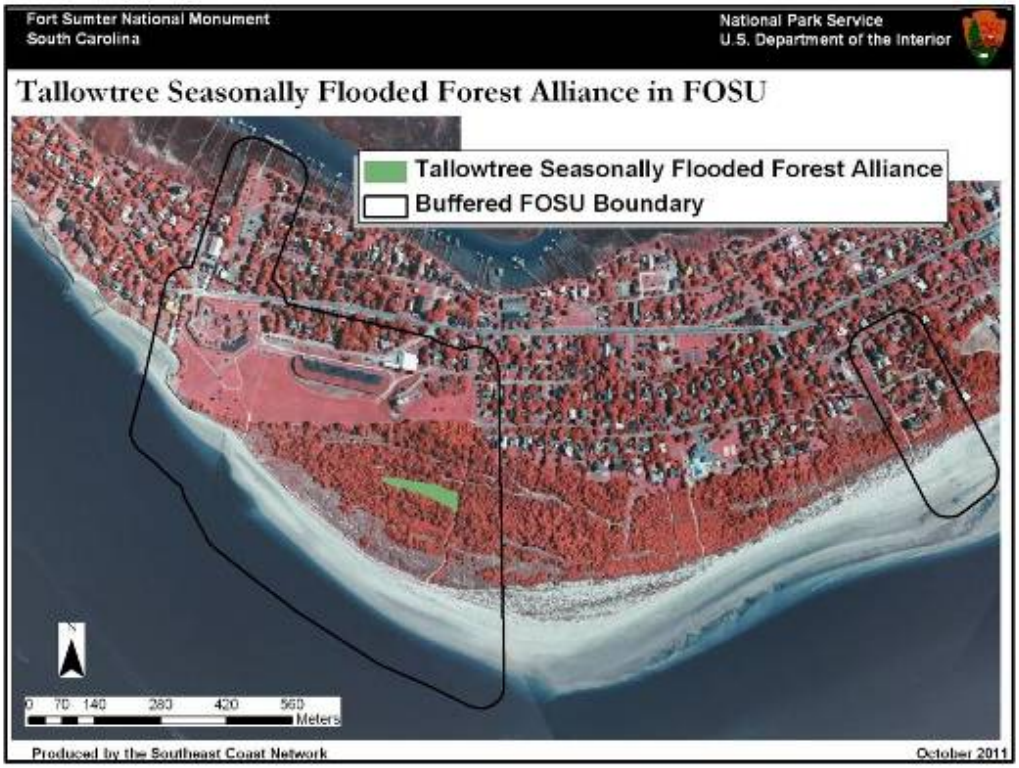
Frequency: 1

Total area: 0.4 ha

Average polygon size: N/A

Producer's accuracy: 100%
User's accuracy: 100%

Distribution in Mapping Area:



Interpretation:

This wetland forest occupies a small (~0.42 ha) area within FOSU that is low enough in elevation to retain water seasonally. The canopy and subcanopy is dominated by Tallowtree (*Triadica sebifera*), which has a small crown size and pink color on the imagery. Willow (*Salix* sp.) is another fairly common species in the understory that has a pink appearance. Closer to the road, a small stand of bald cypress (*Taxodium distichum*) is visible, with has a lavender and fluffy appearance on the imagery.

Example of photo-signature of Tallowtree Seasonally Flooded Forest Alliance

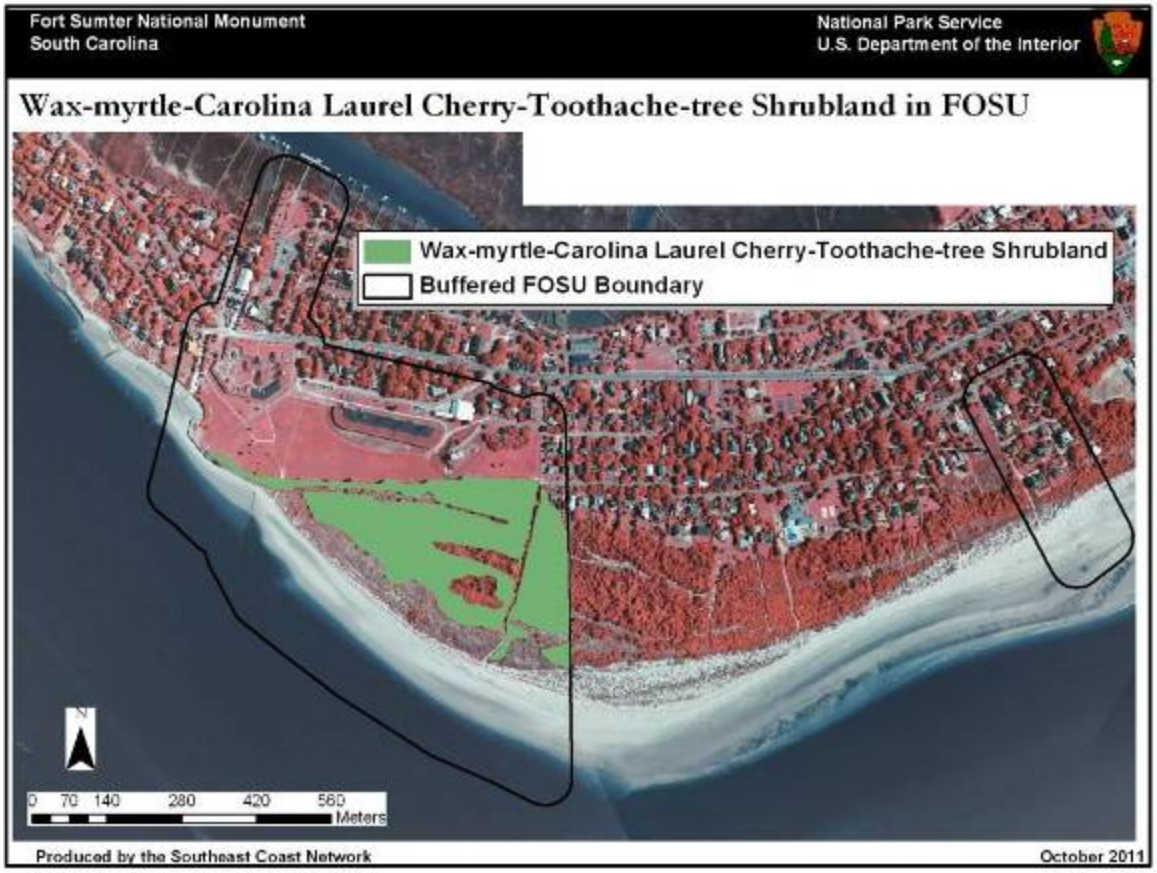
II. Upland Shrubland

MAP CLASS 2
Wax-myrtle-Carolina Laurel Cherry-Toothache-tree Shrubland

Abundant species
- *Morella cerifera (*wax myrtle*)*
- *Prunus caroliniana (*Carolina laurelcherry*)*
- *Celtis laevigata (*sugarberry*)*
- *Ilex vomitoria (*yaupon*)*
- *Sabal palmetto (*cabbage palmetto)

Map Class Statistics
Frequency: 4
Total area: 8.9 ha
Average polygon size: 2.2 ha
Producer's accuracy: 92 %
User's accuracy: 100%

Distribution in Mapping Area:



Interpretation:

This shrubland covers the largest area in Fort Sumter National Monument and is found at Fort Moultrie between the fort and the dunes. The photo-signature is a mixture of reds, pinks, and oranges, based on a variety of evergreen and deciduous species present. Based on photo-signature alone, it is very difficult to differentiate from the Atlantic Coast Interdune Swale.

Example of photo-signature for Wax-myrtle-Carolina Laurel Cherry-Toothache-tree Shrubland

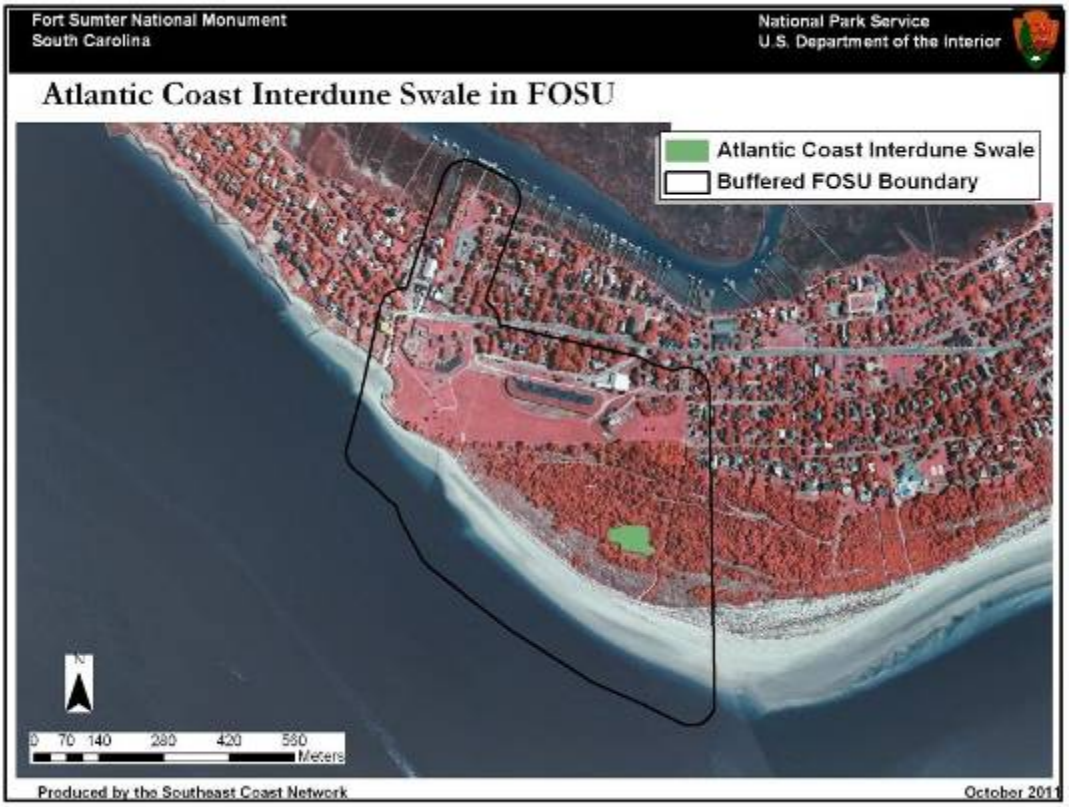
MAP CLASS 3
Atlantic Coast Interdune Swale:

Abundant species

- *Morella cerifera* (Wax myrtle)
- *Ilex vomitoria* (Yaupon)

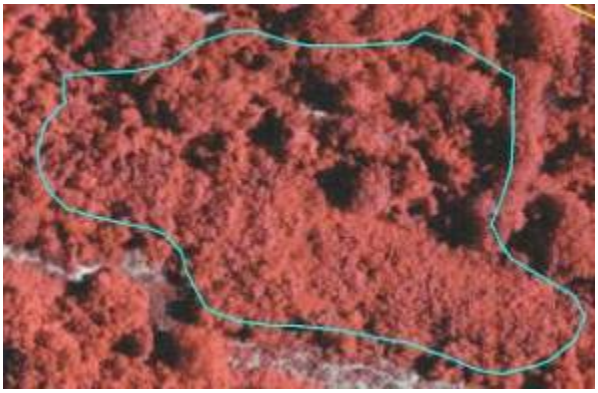
Map Class Statistics:
Frequency: 1
Total area: 0.4 ha
Average polygon size: N/A
Producer's accuracy: 0%
User's accuracy: 0%

Distribution in Mapping Area:



Interpretation:

The Atlantic Coast Interdune Swale is very difficult to differentiate from the Wax-myrtle-Carolina Laurel Cherry-Toothache-tree shrubland based on photo-signature alone, since the two photo-signatures appear almost identical. This association was identified on the ground during the AA.



Example of photo-signature for Atlantic Coast Interdune Swale

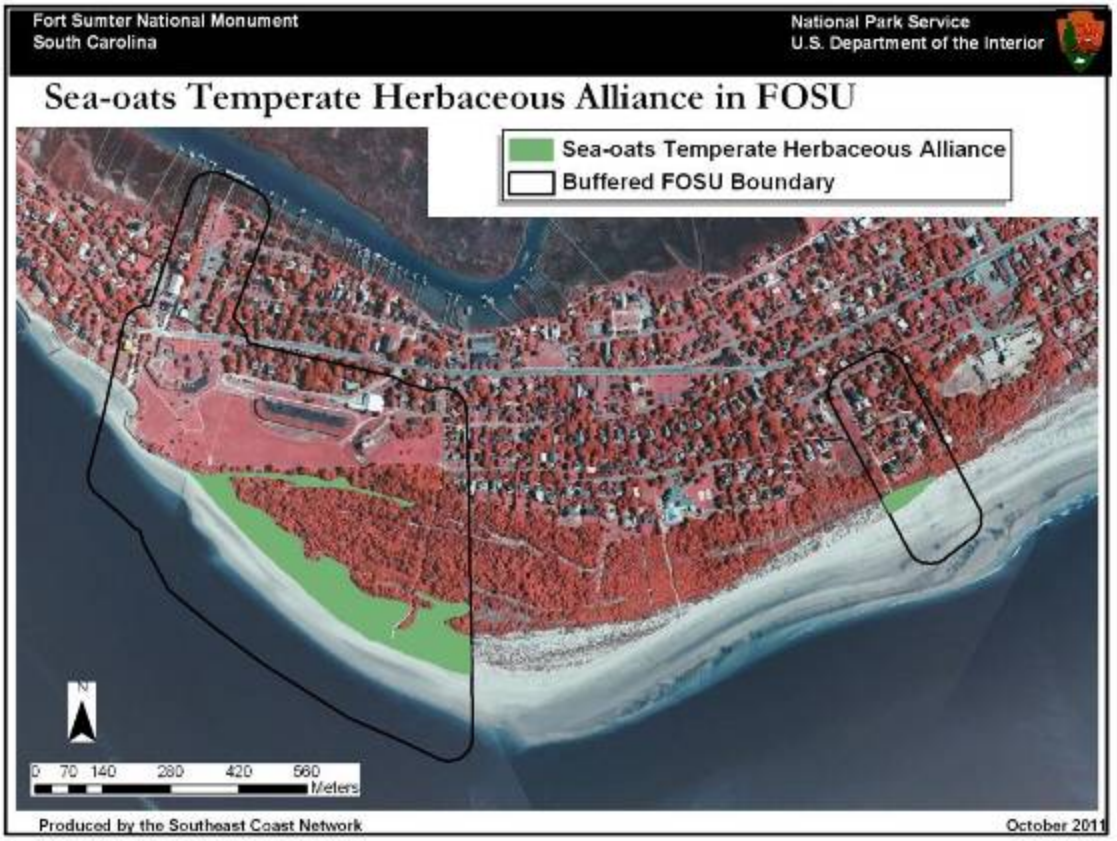
III. Upland Herbaceous

MAP CLASS 4
Sea-oats Temperate Herbaceous Alliance

Abundant species
- *Smilax auriculata (*earleaf greenbrier*)*
- *Heterotheca subaxillaris (*camphorweed)

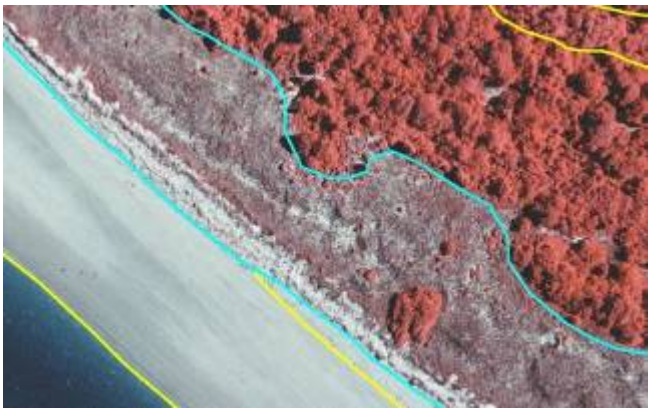
Map Class Statistics
Frequency: 2
Total area: 5.8 ha
Average polygon size: 2.9 ha
Producer's accuracy: 100%
User's accuracy: 100%

Distribution in Mapping Area:



Interpretation:

The Sea-oats Temperate Herbaceous Alliance is characterized by a stippled gray appearance with a few larger shrubs and grasses appearing as larger red features.



Example of photo-signature for Sea-oats Temperate Herbaceous Alliance

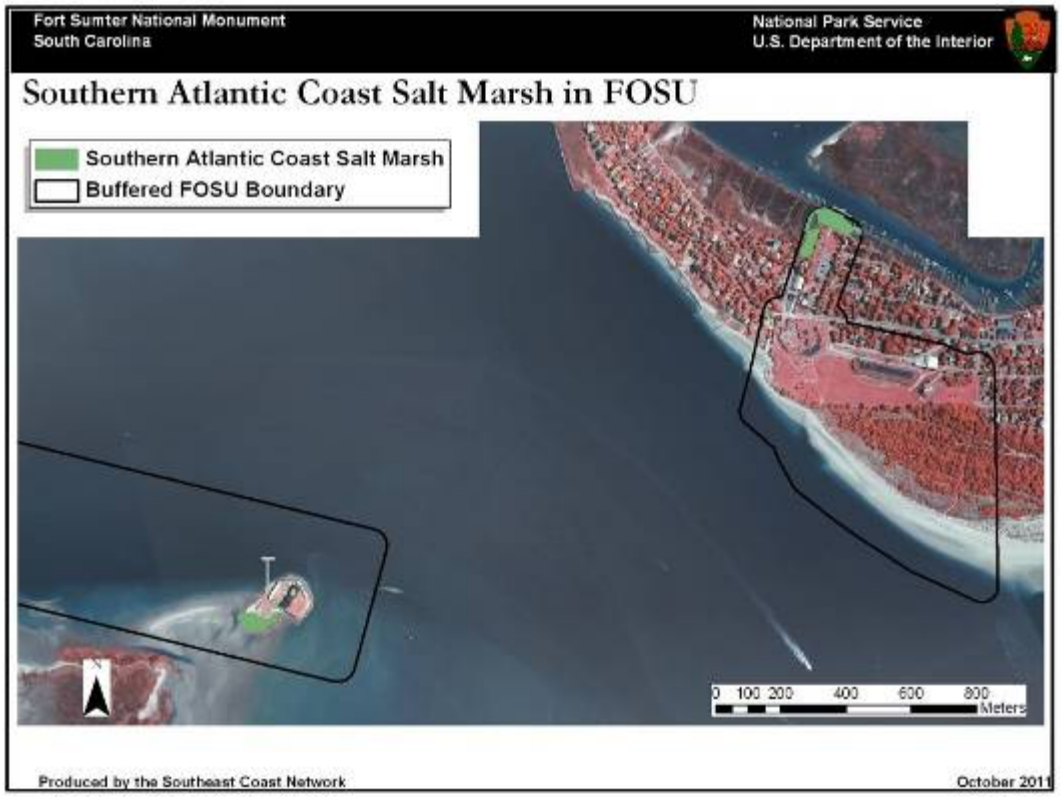
IV. Wetland Herbaceous

MAP CLASS 5
Southern Atlantic Coast Salt Marsh

Abundant species
- *Spartina alterniflora* (smooth cordgrass)

Map Class Statistics
Frequency: 2
Total area: 1.5 ha
Average polygon size: 0.7 ha
Producer's accuracy: 100%
User's accuracy: 100%

Distribution in Mapping Area:



Interpretation:

The Southern Atlantic Coast Salt Marsh has a smooth texture and magenta color.

Example of photo-signature for Southern Atlantic Coast Salt Marsh.

Appendix E: Field Reconnaissance Form

FORT SUMTER NATIONAL MONUMENT FIELD RECONNAISSANCE SHEET

I. LOCATION DATA

1. Point #: _____ 2. Date: _____ 3. Observers: _____

4. Photo (s) #: _____

5. Coordinates: X:_____ Y: _____

6. GPS Error: _____ (m) 7. Number of satellites: _____ 8. Elevation: _____

II. ENVIRONMENTAL/ SITE DESCRIPTION

1. Environmental Comments *(site specific information (if applicable) such as hydrology, topographic position, unvegetated surfaces, recent disturbances, etc.)*

III. VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	**Leaf Type (of dominant stratum)**	**Physiognomic class**
Trees and Shrubs	___Broad-leaved	___Forest
___Evergreen	___Needle-leaved	___Woodland
___Cold-deciduous	___Mixed broad-leaved/Needle leaved	___Shrubland
___Drought-deciduous	___Microphyllous	___Dwarf Shrubland
___Mixed evergreen - cold-deciduous	___Graminoid	___Herbaceous
___Mixed evergreen - drought-deciduous	___Forb	___Nonvascular
	___Pteridophyte	___Sparsely Vegetated
Herbs		
___Annual		
___Perennial		

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:

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) #:_____

5. GPS Unit: _____ 6. Projection: _____ 7. Map Datum: _____ 8. Zone: ____

9. Easting __ __ __ __ __ __ E 10. Northing __ __ __ __ __ __ __ N

11. Estimated Accuracy (m): _____

II. ENVIRONMENTAL/ SITE DESCRIPTION

1. Environmental Comments *(site specific information (if applicable) such as hydrology, topographic position, unvegetated surfaces, recent disturbances, etc.)*

III. VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	**Leaf Type (of dominant stratum)**	**Physiognomic class**
Trees and Shrubs	___Broad-leaved	___Forest
___Evergreen	___Needle-leaved	___Woodland
___Cold-deciduous	___Mixed broad-leaved/Needle leaved	___Shrubland
___Drought-deciduous	___Microphyllous	___Dwarf Shrubland
___Mixed evergreen - cold-deciduous	___Graminoid	___Herbaceous
___Mixed evergreen - drought-deciduous	___Forb	___Nonvascular
	___Pteridophyte	___Sparsely Vegetated
Herbs		
___Annual		
___Perennial		

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 any 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.”

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.)*

Appendix G: Accuracy Assessment Contingency Tables

Explanation of the Contingency Matrices

The accuracy assessment contingency matrix for the Fort Sumter National Monument 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).

Sample Contingency Table

		Field Determination								
	Map Units	**A**	**B**	**C**	**D**	**E**	**Totals**	**User's Accuracy**	**90% Confidence Interval**	
									-	**+**
Photointerpreter's Determination	**A**	**2**					2	100%	75%	125%
	B		**6**	1			7	86%	57%	115%
	C			**0**			0	0%	0%	0%
	D				**9**		9	100%	94%	106%
	E					**2**	2	100%	75%	125%
	Totals	2	6	1	9	2				
	Producer's Accuracy	100%	100%	0%	100%	100%		**19 Total Correct Points**		
	90% Confidence Interval **-**	75%	92%	-50%	94%	75%		**20 Total Points**		
	90% Confidence Interval **+**	125%	108%	50%	106%	125%				

Key to Map Class Codes

A= Tallowtree Seasonally Flooded Forest Alliance

B= Wax-myrtle-Carolina Laurel Cherry-Toothache-tree Shrubland

C= Atlantic Coast Interdune Swale

D= Sea-oats Temperate Herbaceous Alliance

E= Southern Atlantic Coast Salt Marsh

Population Contingency Table

Sample Data (Observations Selected Within the Map Class)	Reference Data (Observations Classified as Vegetation Type on Ground) A	B	C	D	E	Row Total	Map Class Area (Ha)	Point Estimate (Users' Accuracy)	Lower Limit, 90% Conf Int.	Upper Limit, 90% Conf. Int.
A	0.0257	0.00	0.00	0.00	0.00	0.0257	0.42	100%	75.0%	100%
B	0.00	0.4674	0.00	0.00	0.00	0.4674	8.90	85.7%	56.8%	100%
C	0.00	0.00	0.0000	0.00	0.00	0.0000	0.00	0%	0%	0%
D	0.00	0.00	0.00	0.3370	0.00	0.3370	5.50	100%	94.4%	100.0%
E	0.00	0.00	0.00	0.00	0.0919	0.0919	1.50	100%	75.0%	100%
Column Total	0.0257	0.4674	0.0000	0.3370	0.0919	**0.9220**	**16.32**			
Estimated True Map Class Area (Ha)	0.42	7.63	1.27	5.50	1.50					
Point Estimate, Mean Producers' Accuracy	100%	100%	0%	100%	100%					
Lower Limit, 90% Conf. Int.	100%	93.7%	0%	100%	100%					
Upper Limit, 90% Conf. Int.	100%	100%	0%	100%	100%					

Point Estimate, Overall Accuracy (with 90% Confidence Interval):
92.2% (80.3% - 104.1%)
Point Estimate, Overall Accuracy Kappa Statistic (with 90% Confidence Interval):
92.6% (80.9% - 104.2%)

Key to Map Class Codes:

A= Tallowtree Seasonally Flooded Forest Alliance
B= Wax-myrtle-Carolina Laurel Cherry-Toothache-tree Shrubland
C= Atlantic Coast Interdune Swale
D= Sea-oats Temperate Herbaceous Alliance
E= Southern Atlantic Coast Salt Marsh