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Vegetation Classification and Mapping at Cape Cod National Seashore, Massachusetts

Natural Resource Technical Report NPS/NER/NRTR—2010/147



ON THE COVER
Northern Beachgrass Dune, Cape Cod National Seashore.
Photograph by: Robert Zaremba.

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Natural Resource Technical Report NPS/NER/NRTR—2010/147

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Executive Summary

Vegetation classification and mapping were conducted at Cape Cod National Seashore, creating a digital geospatial vegetation database for the park. Sixty-one vegetation associations were identified within the park boundary. Nine additional associations were included in the classification, but were not mapped. Seven of these associations occur within close proximity to, but just outside the boundary of the Cape Cod National Seashore; one is a small patch association that occurs in the park but was below the minimum map unit in size; and one is a submerged aquatic vegetation community. All 70 associations are described in detail. In the final vegetation map, 11 associations were mapped individually and 49 associations were aggregated into 18 additional vegetation map classes. Assembling two or more associations into a single map unit increased the accuracy of the map. The final vegetation map consists of 29 vegetation map classes: Beach, Beachgrass Dune, Black Locust, Bog, Buttonbush, Cattail Marsh, Cedar Swamp, Coastal Marsh, Coastal Plain Pondshore, Cranberry Swale, Dune Pine Forest, Dune Shrub, Fen, Freshwater Marsh, Heathland / Grassland, Mixed Forest, Oak / Beech Forest, Old Field, Phragmites, Pitch Pine Barrens, Red Cedar, Red Maple Swamp, Salt Marsh, Salt Shrub, Scrub Forest, Scrub Oak, Shrub Swale, Shrub Swamp, and Wooded Marsh.

The vegetation map covers 10,833 ha (26,769 ac) of Cape Cod National Seashore. The most abundant forest vegetation association is Pitch Pine - Oak Forest, which covers 1,756 ha (4,339 ac). This vegetation type is characteristic of the natural vegetation of the region, that being the Coastal Lowlands subsection of the Oak - Chestnut Forest Region. Pitch Pine - Heath Barrens are also common, covering 1,560 ha (3,855 ac). The most abundant herbaceous association is Northern Beachgrass Dune, at 1,310 ha (3,237 ac). Salt marsh associations are the most common wetland communities in Cape Cod National Seashore, covering 843 ha (2,083 ac). Twelve vegetation associations occurring within Cape Cod National Seashore are globally rare (G1–G3). All of the vegetation associations reflect the varied land use history, ongoing land management, and the diverse and dynamic environmental settings of the park.

A map showing the locations of vegetation map classes in the park was created, following the USGS/NPS Vegetation Mapping Program protocols (TNC and ESRI 1994a,b,c). A dichotomous field key was developed for these vegetation map classes to assist with field recognition and classification. This project documents the vegetation associations and map classes of Cape Cod National Seashore based on 2000 and 2001 aerial photography, 2002–03 plot sampling, and 2004 accuracy assessment. It completes one of twelve basic inventory data sets for the park.

Keywords: vegetation association, vegetation classification, vegetation mapping, Cape Cod National Seashore

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Introduction

Cape Cod National Seashore (CACO) is a 17,645 ha (43,604 ac) national park unit that occupies the sandy peninsula of outer Cape Cod, east of Boston, Massachusetts in the temperate northeastern United States. It was designated a national park in 1961 for recreational purposes and natural resource protection. Terrestrial vegetation associations comprise approximately 72% of the park area, intertidal vegetation associations comprise 15%, and freshwater associations cover 8% of the area.

The purpose of this project was to produce a standardized map and classification of the terrestrial and intertidal vegetation associations and land cover of the Cape Cod National Seashore and to provide thorough baseline data on the park's vegetation. These products will inform natural resource decision-making, for example in the development and implementation of the park management plan. This project is part of an effort by the National Park Service to map and describe the national parks across the country using the U.S. National Vegetation Classification, through agreements with NatureServe and its member natural heritage programs.

NatureServe ecologists planned the vegetation sampling, oversaw the field effort, integrated the plot data, accuracy assessment data, and field information into the U.S. National Vegetation Classification (USNVC) and worked with Cape Cod National Seashore staff to develop the vegetation map to produce a standardized product for the National Park Service.

Vegetation Mapping Program

The USGS-NPS Vegetation Mapping Program (VMP) is a cooperative effort by the U.S. Geological Survey (USGS) and the National Park Service (NPS) to classify, describe, and map vegetation in more than 270 national park units across the United States. The goal of the VMP is to meet specific information needs identified by NPS. The VMP, managed by the USGS Center for Biological Informatics in Denver, Colorado, is part of the NPS Inventory and Monitoring Program, a long-term effort to acquire the information needed by park managers in their efforts to maintain ecosystem integrity for all national park units that have a significant natural resource component (NPS 2003). Vegetation maps and associated information support a wide variety of resource assessment, park management, and planning needs, and provide a structure for framing and answering critical scientific questions about vegetation associations and their relation to environmental processes across the landscape.

Three major components essential to every mapping project include vegetation classification, vegetation mapping, and map accuracy assessment. Ecology and mapping teams work together to share knowledge and data and to resolve issues as they carry out the procedures. Program products meet Federal Geographic Data Committee (FGDC) standards for vegetation classification and metadata and national standards for spatial accuracy and data transfer (FGDC 1996). Spatial data products include digital aerial photography (MassGIS), map classification, spatial database of vegetation associations, maps of vegetation associations, metadata for spatial databases, and complete accuracy assessment of the vegetation map. Vegetation information includes vegetation classification, dichotomous field key of vegetation classes, formal description of each vegetation class, ground photos of vegetation classes, and field data in database format.

U.S. National Vegetation Classification

The U.S. National Vegetation Classification (USNVC) is a hierarchical system with physiognomic features at the highest levels of the hierarchy and floristic features at the lower levels. The physiognomic units have a broad geographic perspective and the floristic units have local and site-specific perspective (Grossman et al. 1998).

The USNVC includes most existing vegetation, whether natural or cultural, but attention is focused on natural vegetation types. “Natural vegetation,” as defined in The Nature Conservancy and Environmental Systems Research Institute (TNC and ESRI 1994a), includes types that “occur spontaneously without regular management, maintenance, or planting and have a strong component of native species”. “Cultural” vegetation includes planted/cultivated vegetation types such as orchards, pastures, and vineyards.

The physiognomic-floristic classification includes all upland terrestrial vegetation and all wetland vegetation with rooted vascular plants. The hierarchy has five physiognomic levels and two floristic levels.[1] The physiognomic portion of the classification is based upon the United Nations Educational, Scientific, and Cultural Organization (UNESCO) world physiognomic classification of vegetation, which was modified to provide greater consistency at all hierarchical levels and to include additional types (Drake and Faber-Langendoen 1997). At the uppermost level, the USNVC is divided into seven broad physiognomic classes: Forest, Woodland, Shrubland, Dwarf-shrubland, Herbaceous, Sparse (vascular), and Non-vascular. The lowest unit of the physiognomic portion of the classification is the Formation, a type defined by dominance of a given growth form in the uppermost stratum and characteristics of the environment (e.g., cold-deciduous alluvial forests).

The two floristic levels are alliances and associations. The alliance is a physiognomically uniform group of plant associations that share dominant or diagnostic species, usually in the uppermost stratum of the vegetation. For forested types, the alliance is roughly equivalent in scale to the “cover type” of the Society of American Foresters. Alliances also include non-forested types. The basic unit of the classification system, the association, is roughly equivalent in scale to the plant association of European phytosociologists. The association is a unit of vegetation that is more or less homogeneous in composition and structure and occurs on uniform habitat. Alliances are generally more wide-ranging geographically than are associations, although many monotypic alliances have been classified.

Although associations are defined by the plants that comprise them, they are in fact communities of all the component organisms of that association, including animals, protozoans, bacteria, and fungi. Associations are classified from a rangewide perspective (termed "global" although in fact any association only ranges over part of a continent), and are assigned global rarity ranks as well as ranking specifications to be applied to individual occurrences of associations across their range. A map of associations occurring at a site can provide information about the abundance and distribution of each type, the significance of the individual occurrences, as well as providing

[1] The upper levels of the NVC have been recently redesigned (i.e. after the classification phase of this project was complete) and accepted as an FGDC standard (FGDC 2008, available here). The Association and Alliance levels remain the same. Work is underway to place NVC associations appropriately in the revised hierarchy.

surrogate information about the location and abundance of individual species characteristic of the association.

The USNVC has been revised and refined since 1998, and is managed by NatureServe and member natural heritage programs. The classification is housed in the Biotics database and is updated regularly. The USNVC was adopted as a standard by the Federal Geographic Data Committee to support the production of uniform statistics on vegetation at the national level (FGDC 1996 and version 2 in 2008). The USGS/NPS Vegetation Mapping Program adopted the alliance level, and where possible, the association level, as the mapping unit for national parks.

Project Area

Cape Cod National Seashore occurs on the outer peninsula of Cape Cod, Massachusetts and extends 64 km from Provincetown to Chatham. It is located in Barnstable County and extends across multiple 1:24,000 USGS topographic quadrangles including Provincetown, North Truro, Wellfleet, Orleans, and Chatham (Figure 1). This area of the country occurs within the Coastal Lowlands section of the North Atlantic Coast Ecoregion (Cleland 2007).

The Cape Cod Coastal Lowlands and Islands are composed of rolling uplands and marshes occurring on well-drained, nutrient poor sands. The underlying glacial and beach deposits support vegetation of beaches and dunes, barrier islands, salt marshes, maritime forests, pine barrens, and a variety of freshwater wetlands. The vegetation is influenced by its maritime setting, which exposes it to salt spray and coastal storms. Cape Cod National Seashore is the largest protected coastal landscape and area of sand-plain vegetation in New England (Eberhardt et al. 2003).

Many environmental factors such as geology, topography, soils, and hydrology affect the types and distribution of vegetation within Cape Cod National Seashore. The surficial geology consists of outwash plain deposits including sand, gravel, and occasional boulders that were deposited by the retreat of the glaciers up to 10,000 years ago. Kettle ponds are common depressional features on the landscape. These ponds intersect the groundwater table. They formed from the collapse of melting ice blocks left behind the glaciers (Godfrey et al. 1978; Roman et al. 2000). Kame topography is also present on the Cape Cod Bay side of the National Seashore. Kames are mounds of glacially deposited gravel, sand and rock. These isolated land features became reconnected to the landscape through sand deposition and marsh deposits following deglaciation. Dunelands, bluffs, and beaches are also prominent landscape features shaped by aeolian and marine processes.

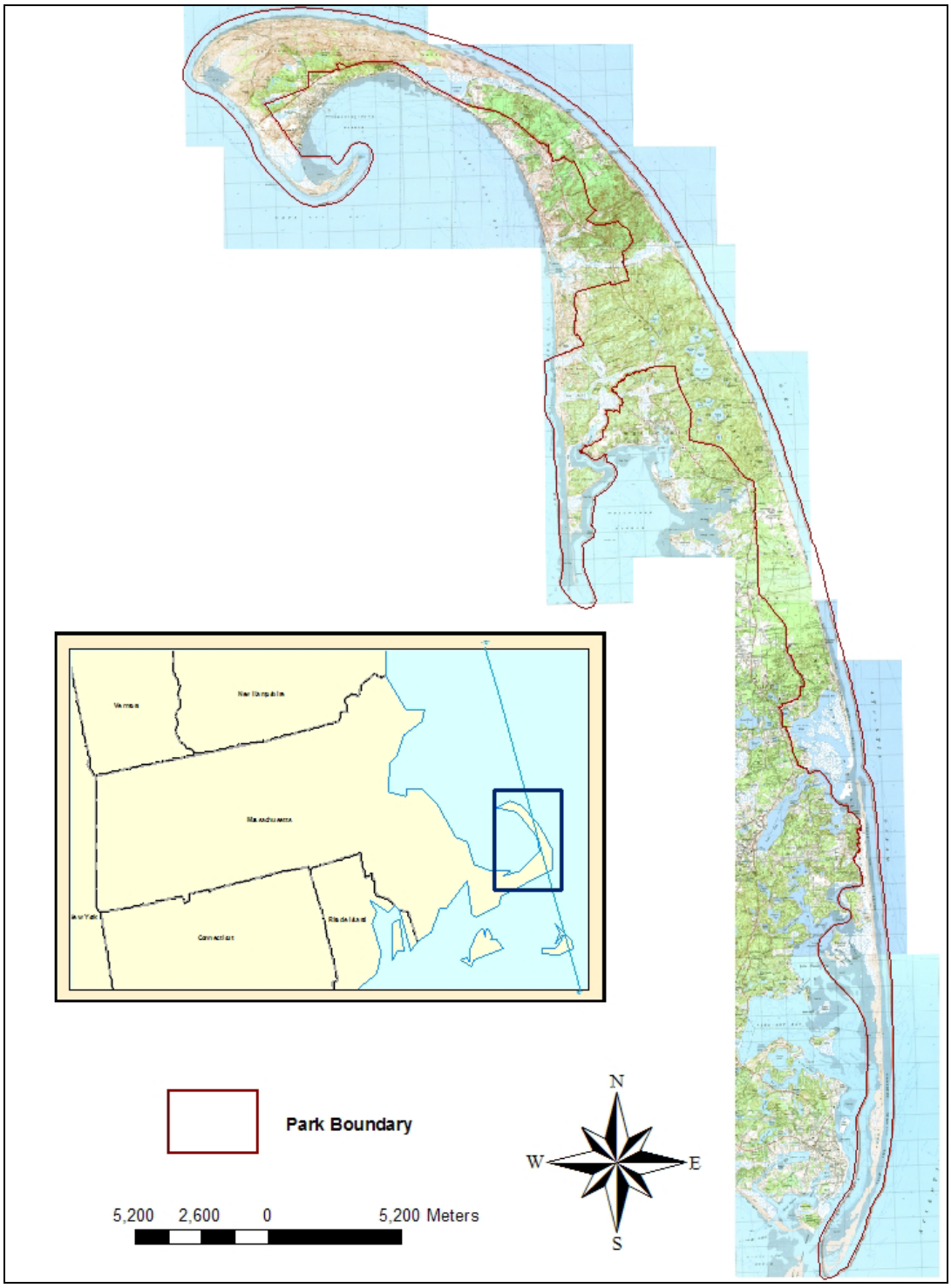


Figure 1. Location of Cape Cod National Seashore, Barnstable County, Massachusetts, on the Provincetown, North Truro, Wellfleet, Orleans, and Chatham, MA 1:24,000 USGS topographic quadrangles.

Elevation within the park ranges from approximately 0 to 54 m (0 to 177 ft). Soils at Cape Cod National Seashore include Carver soil, a coarse, sandy, highly permeable, nutrient poor soil characteristic of outwash deposits. Hooksan - Beaches - Dune Land soils, wind-blown sand deposits, are found in the Province Lands and on beaches; and Ipswich - Pawcatuck - Matanuck soil, occurs in lowland and wetland areas (NPS 2007). The outer Cape has small rivers and streams, including the tidally influenced Herring and Pamet rivers.

The coastal climate plays a primary role in shaping the vegetation associations occurring within Cape Cod National Seashore. The eastern side of the park consists of steep sandy northeast- and east-facing 100-ft bluffs adjacent the Atlantic Ocean. Large high energy ocean waves, tides and current continually reshape and erode the coastline. Winds and salt spray are constant influences on the drought-prone vegetation, creating a distinct gradient of vegetation associations occurring from the windward edge of the bluff to the more protected inland. Along the bluff edge, Northern Beachgrass Dune dominated by American beachgrass (*Ammophila breviligulata*) grades back into Sandplain Heathlands. With increased distance from the bluff, Sandplain Heathlands grade into Outwash Scrub Oak (*Quercus ilicifolia*) Barrens and eventually Pitch Pine (*Pinus rigida*) - Heath Barrens and Pitch Pine - Oak Forests. The environmental conditions are more benign on the western side of Cape Cod National Seashore. Salt marshes are more common along the protected waters of Cape Cod and Welfleet Bays, and Sandplain Heathlands and Pitch Pine Dune Woodlands occur on stabilized and secondary dunes. Extensive dune fields occur in the Provincelands area of Cape Cod National Seashore.

Cape Cod National Seashore has experienced a long history of land use that has influenced the present-day vegetation patterns. The majority of Cape Cod was forested at the time of European settlement, with the exception of small patches of the landscape that were burned by Native Americans. English colonists cleared the woodlands in the late 1600s for farming, timber and maritime products. Salt marshes were hayed for livestock feed. Throughout the 1700s and early 1800s, thousands of sheep grazed the land that now makes up the Cape Cod National Seashore. Oak (*Quercus* spp.) and pitch pine trees were cut to fire brick kilns. These land uses maintained a relatively open patchwork of vegetation communities across the landscape with extensive sandplain grasslands and heathlands amongst pitch pine woodlands and pine-oak forests (Godfrey and Alpert 1985; Dunwiddie and Adams 1985, Vickery and Dunwiddie 1997).

As people moved west in the late 1800s, farms and pastures were abandoned. In the absence of disturbance such as grazing, plowing, and burning old fields, sandplain grasslands and heathlands hat were also historically kept open by these disturbances, became less common across the landscape as they reverted to woodlands and forests. The 1900s brought increase land development, tourism, and the establishment of military camps to the outer peninsula. Land protection and national park designation of the Cape Cod National Seashore came in 1961 (Eberhardt et al. 2003).

Materials and Methods

Planning and Scoping

Cape Cod National Seashore is considered to be a "medium size" park, one in which the sample area includes the entire park according to the United States Geological Survey (USGS)/NPS Vegetation Mapping Program (TNC and ESRI 1994 a,b,c). By comparison, in large parks, the plot placement and stratification is focused on only a section of the park, and results extrapolated to the whole.

Several steps were taken to prepare for the mapping and classification of vegetation at Cape Cod National Seashore. When this project began in 2002, no classification scheme existed that met national standards for Cape Cod National Seashore. Cape Cod National Seashore's vegetation was previously mapped in 1977 and 1991. The 1977 mapping exercise was completed manually with very little documentation. The 1991 mapping benefited from newly acquired digital mapping capabilities of the NPS Denver Service Center but still lacked a rigorous vegetation classification system and had no quantitative accuracy assessment. These previous efforts used a descriptive classification system with 26 categories (Appendix A).

Cape Cod National Seashore contracted Sewell Company in 2000 to take aerial photos of the Cape Cod National Seashore which were used for photointerpretation and preliminanry vegetation classification in 2000. These photos were determined to be unsatisfactory and the 2001 Mass GIS photo mosaics were instead used as a basemap for digitizing vegetation polygons. These efforts produced a preliminary vegetation classification (Appendix A).

NatureServe entered into a cooperative agreement with the National Park Service in 2002 to develop a Cape Cod National Seashore vegetation classification compatible with the U.S. National Vegetation Classification (USNVC). A planning and review meeting was held in 2002 with ecologists and GIS specialists from the Cape Cod National Seashore and NatureServe staff. The project timeline, access issues, park resource management needs, current vegetation management, vegetation types of special interest, and applicable previous research conducted at the park were discussed. The preliminary vegetation classification from the 2000 photointerpretation efforts was provided for crosswalking to the USNVC. In addition, reconnaissance of the park's vegetation types was conducted to estimate the number and distribution of vegetation associations in the park.

To determine a set of preliminary USNVC types in Cape Cod National Seashore, a subset of associations was reported from the NatureServe Biotics database (NatureServe 2002). Associations that were attributed to Cape Cod and Coastal Lowlands subsection, 221Ab, (Keys et al. 1995) were initially reported. Associations attributed to surrounding subsections were also evaluated for inclusion and added to the report as appropriate.

Other resources used to identify associations at Cape Cod National Seashore included the APCC (Association for the Preservation of Cape Cod) inventory of significant habitats on Cape Cod (VanLuven 1990), historical and current records for rare plants which might be indicators for unusual community types, air photos, topographic maps and expert opinion. The APCC inventory was particularly helpful for locating Atlantic white cedar (*Chamaecyparis thyoides*) stands, salt marshes, and bogs and other wetland shrub thicket communities.

Preliminary Data Collection and Review of Existing Information

Existing plot data were assessed and adopted for their use in this project. Gwilliam (1998) unpublished plot data on heathlands was adopted and analyzed as a separate data set. Motzkin and Foster (2002) characterized upland forests with vegetation and environmental data collected in plots to assess the impact of different land uses on vegetation types; these data were also analyzed as a separate data set. Sneddon et al. (1999) produced a classification of coastal plain pondshores using compatible field and analytical methods, so these previously classified associations were included in this classification without need for further sampling. Motzkin (1991) included plot data from Cape Cod National Seashore and was the source for Atlantic white cedar wetlands associations. The preliminary vegetation classification from the 2000 photointerpretation efforts was crosswalked to the USNVC (Appendix A).

From these assessments, it was determined that the principle focus of field sampling for this project should be all tidally-influenced communities (salt marshes and brackish tidal communities); all wetland communities except coastal plain ponds, including swamps, shrublands, and herbaceous wetlands; beaches and dunes, upland shrub thickets and woodlands, and communities dominated by non native species. Particular attention was paid to interdunal swales, bogs, and wetland thickets because these communities are highly variable although they are present in apparently consistent environmental settings.

Aerial Photography Acquisition and Processing

Prior to NatureServe's involvement with the project, Cape Cod National Seashore contracted the James Sewall Company (Old Town, Maine) for fall "leaf-on" color infrared aerial photography in the fall of 2000. A flight plan chosen was identical to one used previously by the Commonwealth of Massachusetts Department of Environmental Protection Wetlands Program to produce photos at a scale of 1:12000. The plan allowed for the standard 60% overlap between frames and 30% overlap between flight lines resulting in stereo photo pairs for interpretation. Color IR (infrared) photography was chosen to maximize distinctions between green wavelengths in upland vegetation. Aerial photography was completed for the entire flight plan on October 4, 2000 and delivered as both positive transparencies and prints.

Color IR transparencies from the October 2000 aerials were scanned at 600 dpi on a large format flatbed scanner at the University of Rhode Island Remote Sensing Lab in Kingston, Rhode Island in 2000. Some of the resulting tif images were mosaicked and georeferenced using ERDAS Ortho Mosaic software by Cape Cod National Seashore GIS staff in consultation with the GIS technicians at North Carolina State University, Raleigh. About half of the aerials were scanned and ortho-mosaicked by Bill Frament of the U.S. Forest Service in Durham NH. Ground control points were selected and matched to 1994 black and white digital ortho photos (DOQs) from MassGIS.

Photo Interpretation

Aerial photograph interpretation is the act of examining aerial photographs to identify vegetation types (Avery 1978). Photo interpretation was accomplished in 2000, using the 2000 photo mosaics through a Cooperative Agreement with the University of Massachusetts - Amherst Department of Forestry, Resource Mapping Office (UMass). UMass photo interpreter Donna Peterson developed a preliminary classification system and completed photo interpretation in consultation with Janice Stone, an experienced photo interpreter who completed many photo

interpretation projects for the Commonwealth of Massachusetts, including several statewide decadal land cover mapping projects (Appendix A).

The digital orthophoto mosaic and preliminary polygon coverage created from the 2000 photography were examined onscreen in ArcView 3.2 (ESRI 1992–2000). In addition, digital topographic quadrangle maps were examined in ArcView 3.2. Using information gathered from the diapositives, the mosaic, and the topographic maps, polygons representing different vegetation types and land uses were identified and digitized onscreen. Minimum mapping units were adopted of 0.4 ha (1.0 ac) for upland forest types and 0.2 ha (0.5 ac) for shrub and grassland types. However, the photointerpreter designated polygons of much smaller areas. The resulting GIS layer included polygons as small as 0.04 ha (0.1 ac.). Stereo pairs were used to double check photosignatures during the digitizing process.

Digital polygon coverages were delivered by the UMass contractor in tiles by town and then merged into one coverage by NPS GIS staff in 2000. At this point it was decided that the 2000 photo mosaics were considered unsatisfactory as a digital base map due to color distortions and uneven horizontal accuracy -- although they were still useful as a cross-reference. An alternative digital base map (2001 MassGIS digital ortho photo quarter quads (DOQs) from the Commonwealth of Massachusetts) provided a more consistent base map than the 10/04/2000 interpreted photography and was used to digitize vegetation polygons.

The digital reference for the spatial component of the vegetation map became the MassGIS 2001 orthophoto quads which MassGIS reported spatial accuracy for 2001 imagery as follows: “Image horizontal accuracy is +/-3 meters at the 95% confidence level at the nominal scale of 1:5,000 (MassGIS 2007).” The photography for the entire commonwealth was captured in April 2001 when deciduous trees were mostly bare and the ground was generally free of snow. The image type is 4-band (RGBN) natural color (Red, Green, Blue) and Near infrared in 8 bits (values ranging 0–255) per band format. A true color orthophoto mosaic was developed from a set of digital 1:5,000 scale medium resolution true color aerial images that are considered the new "basemap" for the Commonwealth of Massachusetts by MassGIS and the Executive Office of Environmental Affairs (EOEA) until 2005 DOQs became available in 2006 (MassGIS 2007). Key information for the mosaic is summarized in Table 1. Appendix B contains additional detailed information regarding the aerial photography acquired from MassGIS.

The preliminary classification system used for photointerpretation was crosswalked to USNVC associations and Anderson Level II (modified) Land Use map classes in 2002 (Appendix A). Polygons that represented other land uses, such as buildings and roads, were attributed with names modified from the Anderson Level II categories (Anderson et al. 1976). Areas with unidentified signatures were visited in the field and identified by the Cape Cod National Seashore plant ecologist, Stephen Smith, and his field crew. In addition, NatureServe ecologists accompanied the photointerpreter in the field to aid in matching photosignatures with potential associations.

Table 1. Summary of key information for Cape Cod National Seashore mosaic.

Title of metadata record:	Cape Cod National Seashore True Color Orthorectified Photomosaic-developed from MassGIS tiles (ERDAS MrSID formats)
Publication date of mosaic (from metadata):	April 01, 2001
Date aerial photography was acquired:	April 2002
Vendor that provided aerial photography:	Keystone Aerial Surveys Inc. of Philadelphia, PA to MassGIS
Scale of photography:	1:5,000
Type of photography:	true-color leaf-off conditions
Archive location of air photos, airborne GPS/IMU files, camera calibration certificate hard copy flight report:	MassGIS, Executive Ofice of Environmental Affairs; original 2000 aerials flown by Sewell Company are housed at Cape Cod National Seashore, National Park Service
Scanning specifications:	The color negatives were scanned at 14 (12.5 Sells) microns and then inverted; Image type is 4-band (RGBN) natural color (Red, Green, Blue) and Near infrared in 8 Bits (values ranging 0–255) per band format.
Horizontal positional accuracy of mosaic:	+/- 3m at 95% confidence level
Number of ground control points and method upon which estimated accuracy is based:	See Appendix A for details
Archive location of mosaic and metadata:	Cape Cod National Seashore, National Park Service
Formats of archived mosaic:	.img (uncompressed); MrSID (20:1 compression)

Photo interpretation extended outside the NPS boundary, especially where wetland systems were arbitrarily truncated by the boundary. However, much of the area outside NPS boundary is disturbed or developed and identification is challenging.

Field Data Collection and Classification

NatureServe developed a vegetation plot sampling design in spring 2002, following USGS/NPS Vegetation Mapping Program guidelines (TNC and ESRI 1994b). The sampling design was restricted to vegetation not previously classified (e.g. Gwilliam 1998; Motzkin and Foster 2002, Sneddon et al. 1999, and Motzkin 1991), and was iteratively developed from several sources: a list of draft cover types developed by the photointerpreter with sampling locations identified from the aerial photography which were then crosswalked to the USNVC; the list of associations previously attributed to this region in NatureServe's Biotics database; the experience of the field contractor and NatureServe ecologists; and reconnaissance. Air photos were an important asset in field work to understand the full extent of communities otherwise only visible along roads, trails, or from the water's edge. Expert opinion was useful to locate the best location for sampling representative examples of communities.

Plots were allocated to associations known to occur in the park that were not previously sampled and/ or to unique signatures, with replicate plots assigned over the type's environmental range to the extent possible[2]. The sampling design called for an average of three plots per targeted

[2] Sampling over a range of environments usually entails a GIS analysis of slope, aspect, bedrock, soil type, and other abiotic factors influencing vegetation. However, the general absence of topographic macrorelief and general homogeneity of the surficial geology at Cape Cod National Seashore provided no easily mappable gradients from which to stratify sampling. Instead, replicate samples were placed in geographically separate portions of the park, or in obviously different habitats that were discerned from photography or reconnaissance.

association where possible and one plot per association where the type was restricted by number of occurrences, for a minimum of 125 plots (Table 2). One hundred nineteen plots were assigned to targeted vegetation types, with eight additional plots reserved for unusual or previously undocumented vegetation discovered in the field during sampling. Areas classified as Anderson Level II (modified) categories were not sampled.

Field Survey

Sample plots were initially established at two locations to familiarize the field contractor with the sampling protocol used in this project. Expert opinion was sought from Cape Cod National Seashore staff, as well as consultation with the photointerpreter, to determine the best locations for plots. Attempts were made both to sample the floristic and physical setting variations of a community type and its geographic range within Cape Cod National Seashore. Whenever possible, at least three examples were sampled. In a few cases, a community was selected and sampled because it was apparently natural or abundant and it was unclear which USNVC association was the most appropriate. Additional effort was made to locate examples of expected types not readily known from or located during previous work. Particular attention was focused on vegetation characterized by somewhat uncommon species on Cape Cod: *Fagus grandifolia* (American beech), *Carya* spp. (hickory), *Zizania* spp (wildrice), *Gaylussacia dumosa* (dwarf huckleberry), *Myrica gale* (sweetgale), *Carex lasiocarpa* (woollyfruit sedge), and *Toxicodendron vernix* (poison sumac).

The plot sampling data form used in this project is included as Appendix C. Abbreviated instructions for completing this form and definitions of the fields can be found in the USGS/NPS Vegetation Mapping Program: Field Methods for Vegetation Mapping manual (TNC and ESRI 1994b). Within each polygon selected for sampling, a plot was established in an area that was most representative of the stand (Mueller-Dombois and Ellenberg 1974). All vegetation data were collected in 2002 and 2003 following NatureServe's accepted natural heritage sampling protocols (Strakosch-Walz 2000), with 20×20-m plots in forests and woodlands, 10×10-m plots in shrublands, and 5×5-m plots in herbaceous vegetation. In some cases, where the polygons were too narrow to reasonably accommodate standard plot sizes, the plots were adjusted accordingly, e.g., rectangular plots rather than square plots.

The vegetation was visually divided into a maximum of eight strata: emergent trees (variable height), tree canopy (variable height), tree subcanopy (>5m in height), tall shrub (2–5m), short shrub (<2m), herbaceous, non-vascular, and vines. The percent cover was estimated for each species in each stratum (Strakosch-Walz 2000). Additional species within the vegetation polygon that occurred outside of sampled plots were listed separately. Specimens of species that were not identifiable in the field were collected for later identification. In some cases, identification could be made only to genus because plants were sterile or not in a condition for accurate identification. In addition to floristic information, the following environmental variables were recorded at each plot: slope, aspect, topographic position, hydrologic regime, soil stoniness, average soil texture, and soil drainage. Any unvegetated area of the plot was characterized by the exposed substrate with categories drawn from a standardized list (bare soil, woody debris, etc.).

Table 2. Number of plots in sampling design at Cape Cod National Seashore based on the preliminary classification system.

USNVC Common Name	USNVC Code	Number of Plots
Alkali Bulrush Brackish Marsh	CEGL006416	3
Atlantic Coast Wild Rice Tidal Marsh	CEGL004202	1
Atlantic Giant Cordgrass Marsh	CEGL004195	1
Atlantic White-cedar Bog	CEGL006321	1
Bayonet Rush Pondshore	CEGL006345	1
Black Locust Successional Forest	CEGL007279	2
Blueberry Wetland Thicket	CEGL006371	3
Brackish Meadow	CEGL006150	4
Brackish Tidal Low Marsh	CEGL004193	1
Cattail Brackish Tidal Marsh	CEGL004201	4
Coastal Freshwater Marsh	CEGL006935	1
Coastal Salt Pond Marsh	CEGL006398	4
Eastern Cattail Marsh	CEGL006153	2
Hairgrass Backdune Grassland	CEGL006621	4
Highbush Blueberry Bog Thicket	CEGL006190	1
Irregularly Flooded Eastern Tidal Salt Shrub	CEGL003921	3
Lower New England Red Maple - Blackgum Swamp	CEGL006156	4
North Atlantic Coastal Plain River Brackish Intertidal Mudflat	CEGL004473	1
North Atlantic Coastal Plain Vine Dune	CEGL003886	4
North Atlantic Fresh Tidal Shrub Swamp	CEGL006337	1
North Atlantic High Salt Marsh	CEGL006006	3
North Atlantic Low Salt Marsh	CEGL004192	3
North Atlantic Upper Ocean Beach	CEGL004400	4
Northeastern Buttonbush Shrub Swamp	CEGL006069	3
Northeastern Dry Oak - Hickory Forest	CEGL006336	1
Northeastern Leafy Forb Marsh	CEGL006191	1
Northeastern Old Field	CEGL006107	1
Northern Bayberry Dune Shrubland	CEGL006295	7
Northern Beachgrass Dune	CEGL006274	5
Northern Brackish Meadow	CEGL006368	5
Northern Coastal Shrub Swale	CEGL006339	2
Northern Interdunal Cranberry Swale	CEGL006141	5
Northern Tall Maritime Shrubland	CEGL006379	2
Medium Fen	CEGL006302	1
Old-field Eastern Red-cedar Forest	CEGL006024	4
Pitch Pine - Oak Forest	CEGL006381	1
Pitch Pine / Cranberry Interdunal Swale	CEGL006127	1
Red Maple / Tussock Sedge Wooded Marsh	CEGL006119	1
Reed-grass Tidal Marsh	CEGL004187	1
Salt Hay Dune	CEGL006149	3
Salt Panne (Salicornia Type)	CEGL004308	4
Seasonally Flooded Atlantic White-cedar Swamp	CEGL006364	1
Southern New England Bog	CEGL006008	5
Spikerush Lawn Tidal Marsh	CEGL006611	1
Successional Maritime Forest	CEGL006145	3
Threeway Sedge Acidic Fen	CEGL006077	1
Woolgrass Marsh	CEGL006349	4
Total		119*

*An additional eight plots were collected for unusual or previously undocumented vegetation discovered in the field during sampling for a total of 127 plots collected.

Notes were taken on the plot representativeness of the surrounding vegetation and any other significant environmental information, such as landscape context, herbivory, stand health, recent disturbance, or evidence of historic disturbance. The vegetation profile and topographic position were sketched in cross-section to represent the location and setting of the plot. A digital photograph of each vegetation association was also taken. The location of each plot was recorded with a Trimble GeoXM global positioning system (GPS) unit, with the datum set to North American 1983 (Conus) and the coordinate system set to Universal Trans-Mercator (UTM) zone 19. The GPS unit was WAAS (Wide-Area Augmentation System) enabled and provided real-time differential correction.

Vegetation Classification and Characterization

Data from a total of 127 vegetation plots (not including existing data sets for coastal plain ponds, forests, and heathlands analyzed separately) were entered into PLOTS 2.0 Database System on a Microsoft Access platform. Plot locations are shown on Figure 2. In the PLOTS 2.0 database, species were assigned standardized codes and names based on the PLANTS 3.5 database developed by Natural Resources Conservation Service (NRCS) in cooperation with the Biota of North America Program (2006). The common and scientific names of plants observed during the vegetation plot sampling are listed in Appendix D. Some tree and shrub seedlings and immature herbaceous plants could only be identified to the genus level and are therefore listed as such in the appendix.

Species and plot data used for vegetation classification were formatted into an Excel spreadsheet for use in the PC-ORD version 4.0 Multivariate Analysis package (McCune and Mefford 1999). Because the data were collected in a way that would facilitate the structural description of the types, some species occurred in both short shrub and tall shrub layers, or in tree subcanopy and canopy layers. The data were modified to collapse species that were separated into two or more shrub, tree, or herb strata into single shrub, tree, or herb layers based on the most appropriate physiognomic characterization. However, species that occurred in separate tree or shrub or herb layers were retained.

Plot data were analyzed a Bray-Curtis ordination, using Relative Sorensen distance measure, Bray-Curtis original end-point selection, with Euclidean axis projection (McCune and Grace 2002). Results were graphed as a cluster diagram. From our initial inspection of plots against existing USNVC types, as well as our initial Biotics report of associations reported from the Coastal Lowlands subsection, we estimated 45–50 USNVC associations could be identified in the data set. However, an average of three plots per type was targeted for data collection, and selection of 45 groups in the analysis would likely obscure larger patterns in the data. Therefore, we selected 25 groups as a reasonable number that would likely reveal larger patterns, but also reveal groups of associations that could be easily identified. Data were also analyzed using Two-Way Indicator Species Analysis TWINSPAN (Hill and Gauch 1979), a program that successively divides the plots into groups that are similar in species composition.

In addition to the data collected in 2002 and 2003 by NatureServe, two existing data sets, Gwilliam (1998) unpublished data on heathlands, and Motzkin and Foster (2002) data on forests, were analyzed separately. The results of each of the three data sets were compared with the U.S. National Vegetation Classification subset (NatureServe 2003). Plots from Gwilliam (1998) and Motzkin and Foster (2002) were matched to existing associations or if no association existed,

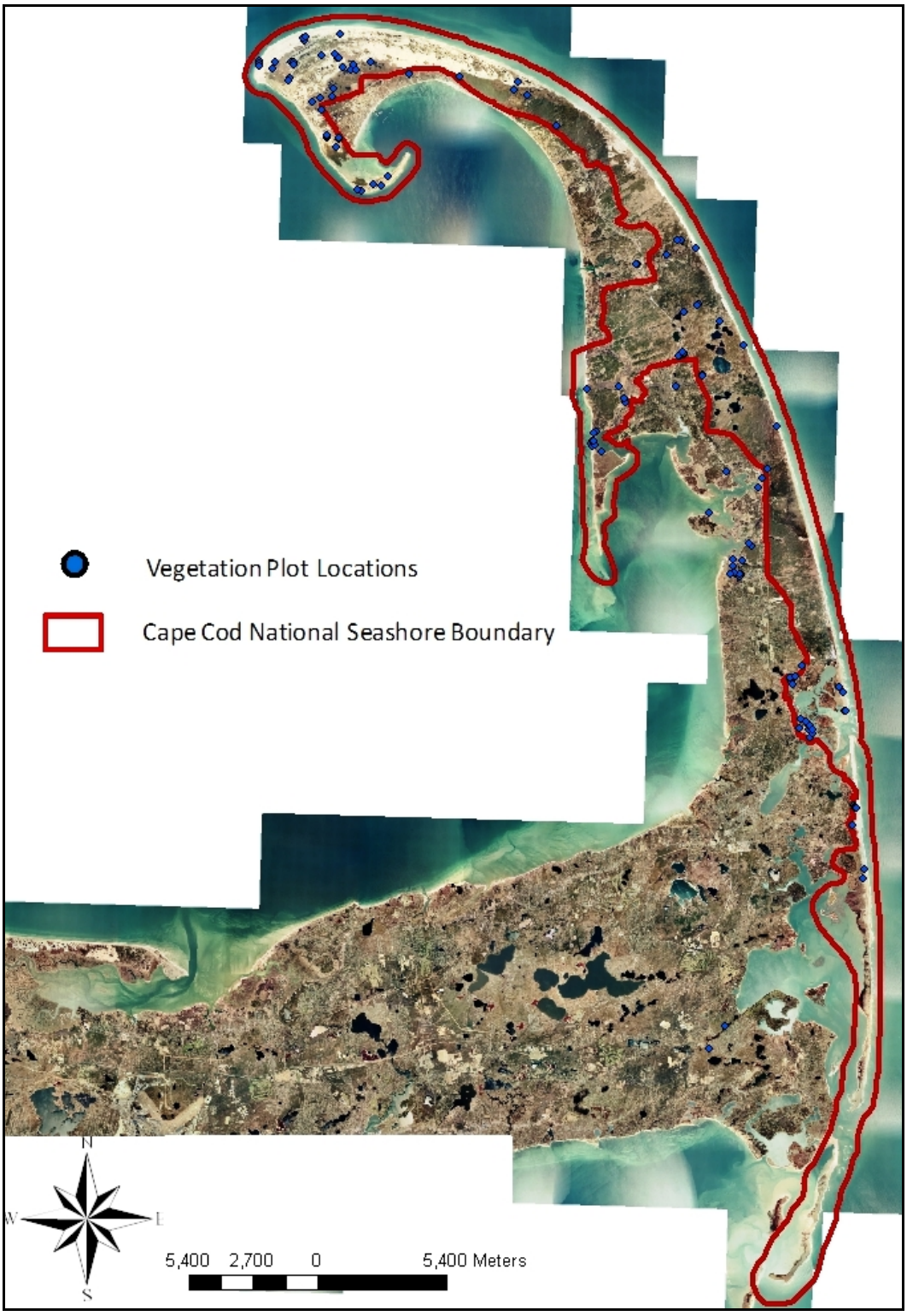


Figure 2. Location of the 127 vegetation plots sampled in 2002 and 2003 in Cape Cod National Seashore for vegetation classification and mapping.

new types were created. Environmental data on soil characteristics and flooding regime for each plot were used to interpret the results. Examples are provided in the Results section. The soil survey, topographic maps and air photos were also used in the interpretation. Plots derived from coastal plain pond analysis (Sneddon et al. 1999) were not reanalyzed, but the associations classified in that analysis were included in this report.

Based on the aforementioned analyses, preliminary assignment to existing USNVC associations were confirmed by qualitatively comparing the groups of plots to existing associations in the USNVC. Further discussion of this process is described in the Results section. Because the global description includes species from across the range of the association, a park-specific description was included. Any new information about the association was incorporated into the global description as appropriate. Global information was then appended to the local descriptions to provide resource managers with a broader context for the vegetation in the park. Each vegetation association was assigned a park-specific common name which is listed as the first name in the Vegetation Descriptions section of this report; it is the first name listed in the dichotomous field key (Appendix E); and it is included as an attribute in the final vegetation map. If none existed, the U.S. National Vegetation Classification common name was used. A park-specific common name was created for successional and cultural vegetation types not easily handled by the USNVC.

A park-specific dichotomous key (Appendix E) was created for the vegetation associations to guide accuracy assessment and for use by park natural resource managers and others. A dichotomous key is a tool structured by a series of couplets, two statements that describe different, mutually exclusive characteristics of the associations. Choosing the statement that best fits the association in question leads the user to the correct association. The dichotomous key should be used in conjunction with the detailed vegetation association descriptions to confirm that the association selected with the key is appropriate.

Draft Association-level Vegetation Map Preparation

Following the vegetation data analysis, the 2000 preliminary vegetation map was further edited by the Cape Cod National Seashore GIS Specialist, Mark Adams. Using ArcView 3.2, polygon boundaries were revised onscreen, based on the plot data and additional field observations, in 2003. Each polygon was attributed with the name of an USNVC association or an Anderson Level II (modified) land use/land cover map class based on plot data, field observations, aerial photography signatures, and topographic maps. The shapefile was projected in Universal Transverse Mercator Zone 19 North, North American Datum 1983. After the draft association - level vegetation map was completed; the thematic accuracy of this map was assessed.

Accuracy Assessment

Two sources of potential error in the vegetation map include: 1) horizontal positional accuracy, in which a location on the photomosaic does not accurately align with the same location on the ground due to errors in orthorectification or triangulation; and 2) thematic accuracy, in which the vegetation type assigned to a particular location on the map does not correctly represent the vegetation at the same location in the park. The USGS/NPS Vegetation Mapping Program protocols (TNC and ESRI 1994c) were followed to assess the positional and thematic accuracy of the Cape Cod National Seashore vegetation map.

Positional Accuracy Assessment

MassGIS quality assurance for the aerial photography included rigorous independent checks of the spatial accuracy using other datasets of significantly higher accuracy, and field work that included the capture of highly accurate GPS points that were compared to the same locations appearing on the deliverables. MassGIS also assessed the visual quality and appearance of the images (MassGIS 2007). See Appendix A for more detailed information on positional accuracy and image quality assurance.

Thematic Accuracy Assessment

The thematic accuracy of the vegetation map was assessed by NatureServe in the summer of 2004. Accuracy assessment was limited to natural or semi-natural vegetation of uplands and emergent wetland vegetation. Highly managed vegetation such as lawns, as well as non-vegetated developed areas, are not covered by the USNVC, and were not included in the assessment. Submerged aquatic vegetation was also not sampled in this effort. More detail on the procedures for thematic accuracy assessment are described in the following sections.

Accuracy Assessment Point Selection

For each association, the number of points to be assessed was determined by first evaluating the total number of mapped polygons as well as the total acreage of the type. These calculations were made using GIS. The number of points was determined using a slightly modified version of the accuracy assessment methodology outlined by the Vegetation Mapping Program (ESRI and NCGIA 1994) as follows, quoted directly from the document:

"…it is recommended that 30 samples be specified as the maximum sample size for abundant classes, and that 5 samples be specified as the sample size for the rarest classes. Any class too rare for 5 sample sites to be selected should be observed in its entirety. Since a number of classes are intermediate in abundance between abundant and rare, five scenarios are based on class abundance and frequency have been defined:

Scenario A: The class is abundant. It covers more than 50 hectares of the total area and consists of at least 30 polygons. In this case, the recommended sample size is 30.

Scenario B: The class is relatively abundant. It covers more than 50 hectares of the total area but consists of fewer than 30 polygons. In this case, the recommended sample size is 20. The rationale for reducing the sample size for this type of class is that sample sites are more difficult to find because of the lower frequency of the class.

Scenario C: The class is relatively rare. It covers less than 50 hectares of the total area but consists of more than 30 polygons. In this case, the recommended sample size is 20. The rationale for reducing the sample size is that the class occupies a small area. At the same time, however, the class consists of a considerable number of distinct polygons that are possibly widely distributed. The number of samples therefore remains relatively high because of the high frequency of the class.

Scenario D: The class is rare. It has more than 5 but fewer than 30 polygons and covers less than 50 hectares of the area. In this case, the recommended number of samples is 5. The rationale for reducing the sample size is that the class consists of small polygons and the frequency of the polygons is low. Specifying more than 5 sample sites will therefore probably result in multiple sample sites within the same (small) polygon. Collecting 5 sample sites will allow an accuracy estimate to be computed, although it will not be very precise.

Scenario E: The class is very rare. It has fewer than 5 polygons and occupies less than 50 hectares of the total area. In this case, it is recommended that the existence of the class be confirmed by a visit to each sample site. The rationale for the recommendation is that with fewer than 5 sample sites (assuming 1 site per polygon), no estimate of level of confidence can be established for the sample (the existence of the class can only be confirmed through field checking)."

Seven hundred eighty nine accuracy assessment points were generated using this methodology. This total was modified for project efficiency and cost-effectiveness and the sample size was reduced to 516. The random number generator function in Microsoft Excel was used to create 516 sets of random x,y coordinates that fell within the boundaries of Cape Cod National Seashore. These points were assessed by Field Ecologist, Robert Zaremba to determine whether any points were inaccessible or otherwise problematic. Sixteen points were eliminated prior to field work based on these criteria. Points were then buffered at a distance of 10 meters from the polygon border to exclude ecotonal areas that may be of ambiguous classification. Once in the field, eight points were found to be poorly accessible by kayak or on foot or were located in areas with poor GPS reception, and thus were not sampled. A total of 492 accuracy assessment plots were collected. Areas classified as Anderson Level II (modified) categories and ruderal vegetation associations were not sampled. Table 3 shows the allocation of the accuracy assessment points among the vegetation associations and Figure 3 depicts the locations of the points in the park.

Field Methods

Field work was conducted between July and October 2004. A Garmin 76S GPS unit was programmed with coordinates of the selected sampling locations. Using the GPS and the aerial photos with unlabeled polygons, the researcher navigated to each point. In rare cases, points were found to be in anomalous manmade features, such as roads, lawns or parking lots. These points were assumed to have been selected to indicate the adjacent vegetation type, and thus were offset to the adjacent polygon. Examples are described in the Results and Discussion sections. If a point fell within a distinct community type that was an obvious inclusion within a larger polygon, the point was offset to record the larger polygon.

Data were collected using a standardized field form (Appendix F). Vegetation data included average height and percent cover was also recorded for bare soil, leaf litter, rocks, and downed woody debris. Other environmental data, such as topographic position, hydrologic regime, or unusual features that further aided identification to assocciation, were collected. Using the dichotomous key to associations, the stand was assigned to the appropriate association (hereafter

Table 3. Thematic accuracy assessment (AA) sampling strategy for Cape Cod National Seashore based on the 2003 draft association-level vegetation map.

USNVC Association or Map Class	Number of Polygons[a]	Mapped Hectares	Number of AA Points Sampled
Alkali Bulrush Brackish Marsh	0	0	0
Atlantic Coast Wild Rice Tidal Marsh	9	2.5	0
Atlantic Giant Cordgrass Marsh	0	0	0
Atlantic White-cedar Bog	0	0	0
Bayonet Rush Pondshore	38	19.3	1
Black Locust Successional Forest	78	58.8	14
Blueberry Wetland Thicket and Highbush Blueberry Bog Thicket[b]	185	228.8	19 (8 and11)
Bluejoint Pondshore Margin	0	0	0
Brackish Meadow	0	0	0
Bulblet Flatsedge Coastal Plain Sandy Pondshore	0	0	0
Cattail Brackish Tidal Marsh	14	6.4	0
Coastal Freshwater Marsh	0	0	1
Coastal Pitch Pine / Scrub Oak Barren	66	390.0	15
Coastal Plain Atlantic White-cedar Swamp	1	4.3	1
Coastal Plain Pond	18	18.6	18
Coastal Salt Pond Marsh	13	126.4	0
Eastern Cattail Marsh	135	130.1	19
Eastern Reed Marsh	87	38.4	0
Estuarine Open Water	1	11.7	1
Hairgrass Backdune Grassland	51	107.0	18
Irregularly Flooded Eastern Tidal Salt Shrub	15	9.6	4
Little Bluestem Old Field	0	0	2
Lower New England Red Maple - Blackgum Swamp	170	223.1	10
Medium Fen	1	0.16	1
North Atlantic Coast Estuarine Intertidal Mudflats	14	42.7	1
North Atlantic Coastal Plain River Brackish Intertidal Mudflat	0	0	0
North Atlantic Coastal Plain Vine Dune	4	1.8	5
North Atlantic Fresh Tidal Shrub Swamp	0	0	0
North Atlantic High Salt Marsh	146	249.0	7
North Atlantic Low Salt Marsh	104	462.9	36
North Atlantic Upper Ocean Beach and Beach[b]	80	646.6	8 (2 and 6)
Northeastern Atlantic Coastal Oak - Beech Forest	8	27.9	1
Northeastern Buttonbush Shrub Swamp	0	0	3
Northeastern Coastal Oak - Heath Forest	310	871.8	21
Northeastern Dry Oak - Hickory Forest	0	0	0
Northeastern Leafy Forb Marsh	0	0	1
Northeastern Old Field	8	19.4	4
Northern Atlantic Coast Beaked Ditch-grass Bed	0	0	0
Northern Bayberry Dune Shrubland	302	174.2	16
Northern Beach-heather Dune Shrubland	30	105.9	6
Northern Beachgrass Dune	220	1,195.2	15
Northern Brackish Meadow	0	0	0

USNVC Association or Map Class	Number of Polygons[a]	Mapped Hectares	Number of AA Points Sampled
Northern Coastal Plain Pondshore Margin	0	0	0
Northern Coastal Shrub Swale	0	0	4
Northern Interdunal Cranberry Swale	157	26.2	17
Northern Tall Maritime Shrubland	116	115.6	31
Old-field Eastern Red-cedar Forest (formerly Maritime Red-cedar Woodland)	80	260.7	8
Outwash Scrub Oak Barrens	70	227.1	17
Pipewort Sandy Pondshore	77	175.0	0
Pitch Pine - Heath Barrens	162	1,177.7	39
Pitch Pine - Oak Forest	281	2,157.1	39
Pitch Pine / Cranberry Interdunal Swale	77	35.1	9
Pitch Pine Dune Woodland	241	725.2	19
Red Maple / Tussock Sedge Wooded Marsh	0	0	1
Reed-grass Tidal Marsh	34	43.1	9
Salt Hay Dune	0	0	4
Salt Panne (Salicornia Type)	1	3.3	5
Sandplain Grassland	6	5.5	1
Sandplain Heathland	195	204.3	30
Seasonally Flooded Atlantic White-cedar Swamp	0	0	0
Southern New England Bog	0	0	4
Spikerush Lawn Tidal Marsh	0	0	0
Successional Maritime Forest	24	35.9	3
Swamp-loosestrife Coastal Plain Pond	0	0	1
Swamp-loosestrife Shrub Swamp	0	0	0
Threeway Sedge Acidic Fen	0	0	1
Transitional Tidal Marsh	0	0	0
Successional Wet Meadow	0	0	3
Woolgrass Marsh	21	11.1	0
Developed Land	356	496.5	0
Disturbed	60	94.8	0
Pond / Open Water	1	0.3	0
Total	4,067	10,867.2	492

[a]Polygons with a 0 indicate associations that were not mapped in the 2003 draft association-level vegetation map but were identified during plot and/or accuracy assessment sampling and were included in the final classification and 2004 vegetation map where possible.
[b]Associations and/or land use map classes were lumped in the vegetation map under first association name listed.

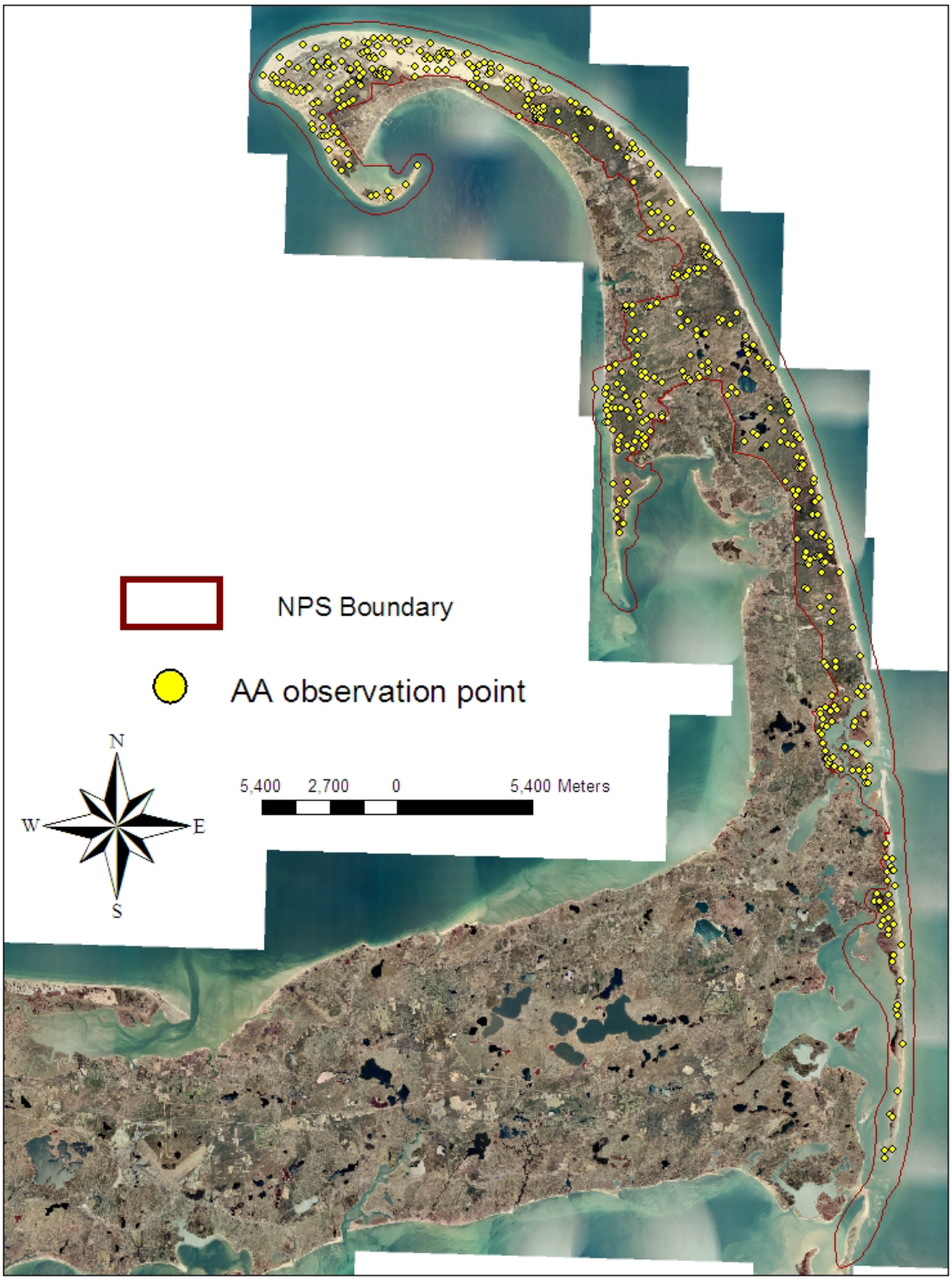


Figure 3. Locations of the 492 thematic accuracy assessment sampling points at Cape Cod National Seashore.

referred to as the “first call”). If the classification decision was ambiguous, a comments field was completed to describe he reason for ambiguity, and a second, or in some cases, third possible choice (hereafter referred to as “second call” and “third call,” respectivly). The researcher also noted whether the sampling point was characteristic of the polygon as a whole or whether the point was atypical of the polygon. In numerous cases, the polygon included multiple associations, often occurring as a mosaic of small patch communities. These associations were also recorded.

Data Analysis

Data from the 492 accuracy assessment points were then entered into the NatureServe PLOTS 2.0 Database System on a Microsoft Access platform during the fall of 2005. In the PLOTS database, species were assigned standardized codes based on the PLANTS 3.5 database (USDA, NRCS 2006). For this report, some common names listed in the PLANTS database were changed to reflect the common names typically used by ecologists and resource managers in this region. The common and scientific names of plants observed during thematic accuracy assessment sampling are listed in Appendix D. Some tree and shrub seedlings and immature herbaceous plants could only be identified to the genus level and are therefore listed in the appendix as such.

GPS data points were downloaded to an ArcGIS shapefile to compare the field identification of each point to the mapped identity. The point coverage was overlain on the vegetation layer and comparisons were made between the association name on the field form and the corresponding association name on the vegetation map. An Excel table was produced, illustrating the comparisons for every plot. The NatureServe Senior Regional Ecologist, Lesley Sneddon, also reviewed every field data sheet to ensure that the classification concept was correctly applied. Additional columns were added to the table to record 2nd and 3rd calls where the initial identification was ambiguous.

The thematic accuracy was then tabulated using a contingency matrix that compared the mapped vegetation communities with the actual vegetation communities observed in the field. Matrices can be reviewed in the Results section of this report. Overall percent accuracy and the Kappa index were calculated (TNC and ESRI 1994c). Overall percent accuracy was calculated by dividing the number of correctly classified accuracy assessment points by the total number of accuracy assessment points. The Kappa index is the preferred method of reporting overall thematic accuracy because it takes into account that a certain number of correct classifications will occur by chance (Foody 1992). The USGS/NPS vegetation mapping protocol requires that the Kappa index of each map class exceeds 80% (TNC and ESRI 1994c).

Additional analyses were performed to evaluate the appropriate level of data presentation, i.e. a reasonable compromise between a higher degree of detail but lower accuracy and a lower degree of detail with higher accuracy. The first analysis, or binary analysis, strictly compares the first call to the map corresponding map label. The analysis is binary in that the polygon is either correct or incorrect.

The second analysis using “fuzzy logic” (Gopal and Woodcock 1994) was also conducted. Fuzzy logic takes into account the variable and continuous nature of vegetation, and accepts as valid other possible choices beyond the initial field identification. In this analysis calls may be correct,

incorrect, or "acceptable". In those cases in which a second or third call was made in the field, it was assumed that there was more than one possible acceptable option and the alternate label would not pose a problem for the user. If the label for the first call was incorrect, but either the second or third calls were in agreement, the point was changed to correct.

A third analysis was conducted in which associations that were often confused with each other on the map were aggregated into map units. Map units were derived by examining the contingency matrix and highlighting cells off the diagonal with proportionately higher numbers than the diagonal cells. These higher numbers indicated that two associations were regularly mistaken for each other. Where the accuracy of each individual association was unacceptably low, aggregating the associations into a single map unit yielded a higher degree of accuracy, but one with somewhat lower detail. In most cases, map units combined two associations, but in several cases more than two associations were aggregated. Those associations that achieved 80% accuracy or better were not aggregated. All results of these analyses are discussed in the Results section of this report.

User's accuracy and producer's accuracy were calculated for each map class for all three analyses. [3]The former reflects errors of commission (errors of inclusion) and is calculated by dividing the number of correctly classified samples of a map class by the total number of accuracy assessment points that were attributed to that map class. Producer's accuracy reflects errors of omission (errors of exclusion) and is calculated by dividing the number of correctly classified samples of a map class (same numerator as in user's accuracy) by the total number of accuracy assessment points in polygons of that map class. User's accuracy reflects the degree to which the map reflects what is actually on the ground, while producer's accuracy reflects the probability that field samples have been correctly attributed. Confidence intervals were derived for associations or map units having sample sizes greater than 2. Overall accuracy (all classes) was also calculated for each of the tables.

Final Association-level Vegetation Map Preparation

Additional field work and an accuracy assessment was completed in 2004. Based on the accuracy assessment sampling points, the 2003 draft association-level map was revised to correct errors. In the final 2004 revision, accuracy assessment data, plot data, field observations, aerial photography signatures, and topographic maps were used to revise polygon boundaries and attributes. An aggregated map class column was added to the attribute table in the shapefile. 60 associations are mapped in this version. A shapefile of the park's boundary was obtained from the National Park Service in 2004. All maps in this report used that shapefile to depict the park's boundary.

[3]Map class usually refers to association, but in cases in which two associations are indistinguishable on aerial photography, a map unit is devised that indicates that both, or either, association is present. A map class is either an association or unit.

Results

Vegetation Classification and Characterization

NatureServe contract ecologist Robert Zaremba completed sampling of 127 plots at Cape Cod National Seashore in 2002 and 2003 (Figure 2). Twenty plots were located outside of the Cape Cod National Seashore boundary but were included in the vegetation classification because they occur in close proximity to the park, provide additional data for analysis, and describe vegetation previously undescribed in the USNVC. The vegetation associations of Cape Cod National Seashore were classified using a Bray-Curtis ordination and TWINSPAN analysis. The results were evaluated and compared to vegetation classifications at nearby national parks, and ecologists' field experiences at Cape Cod National Seashore . Based on this evaluation, the Bray-Curtis ordination (Figure 4) and the dendrogram of the TWINSPAN results were interpreted (Appendix G).

2002–2003 PLOTS Data

The 25 groups identified in the ordination were divided in the analysis as follows into four major divisions. The first major division split four groups (123, 2, 32, and 14) from the remainder of the data. This major group represented most of the freshwater wetland types.

- Group 123 was a clean group comprised of three plots classified as Northeastern Buttonbush Shrub Swamp.
- Group 2 was made up of bogs and fens with four and two associations, respectively: Southern New England Bog, Atlantic White-cedar Bog, Highbush Blueberry Bog Thicket, a single plot of Northern Interdunal Cranberry Swale, and two acidic fen associations, Medium Fen and Threeway Sedge Acidic Fen, each comprised of a single plot. The Northern Interdunal Cranberry Swale plot was atypical of this association, as it contained a low cover of *Vaccinium macrocarpon* (cranberry) and has a greater diversity and cover of bog species than the norm.
- Group 32 in general contained freshwater marshes of mucky substrates. This was a weakly affiliated group made up of six associations. Woolgrass Marsh contained three plots, Eastern Cattail Marsh contained two plots, and the remaining four associations were dominated by freshwater species containing one plot each: Northeastern Leafy Forb Marsh, Coastal Freshwater Marsh, North Atlantic Coastal Plain River Brackish Intertidal Mudflat which occupied the upper tidal border of a river where freshwater seepage from the outwash-deposit uplands mixed with brackish water, and another atypical Northern Interdunal Cranberry Swale plot having high cover of *Thelypteris palustris* (eastrn marsh fern) and *Schoenoplectus americanus* (chairmaker's bulrush), thus explaining the clustering of this plot with Coastal Freshwater Marsh.

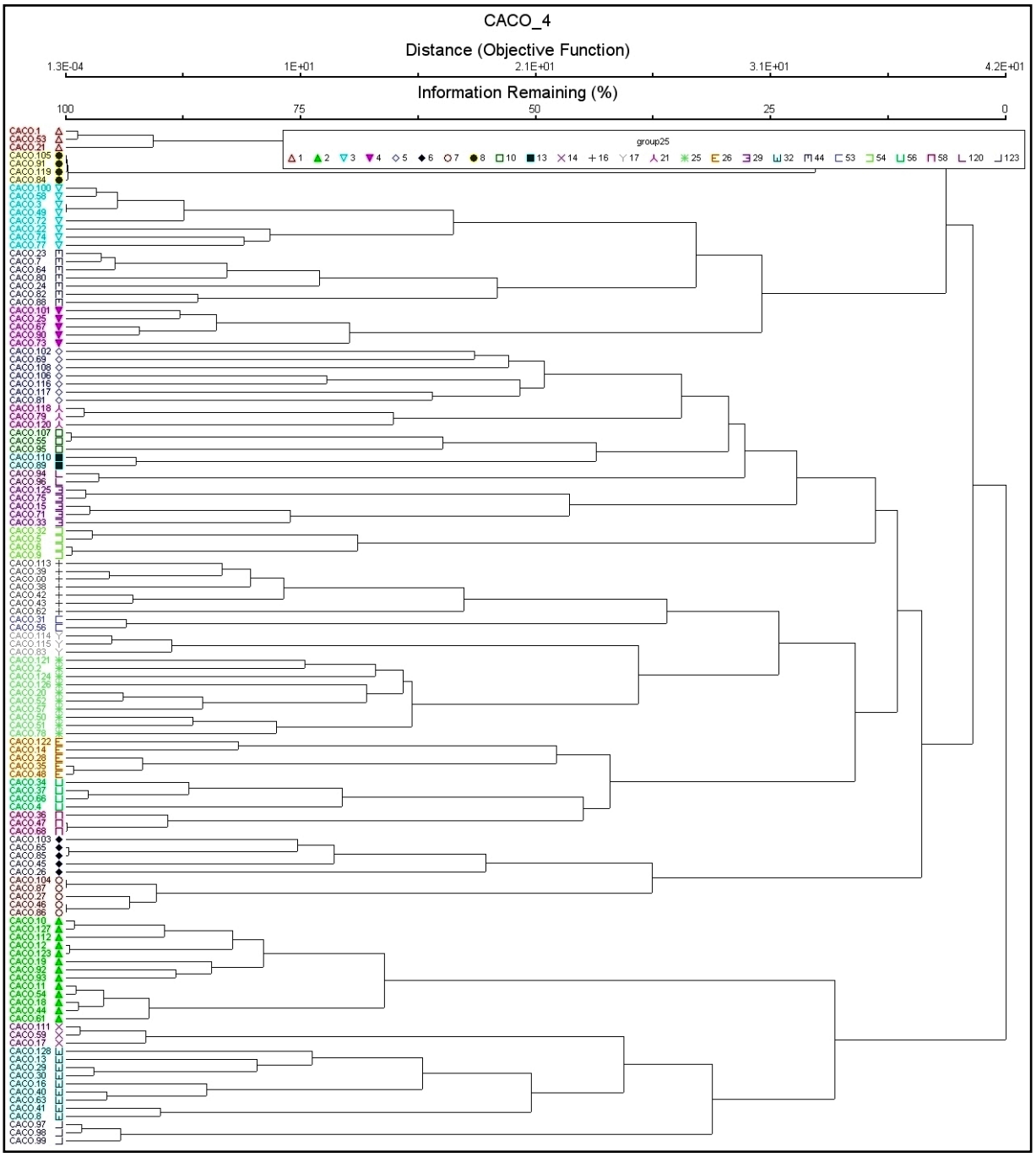


Figure 4. Bray-Curtis ordination cluster diagram identifying 127 plot assignments into 25 groups.

The second major division included a variety of salt and brackish vegetation ranging from low salt marshes to upper salt marsh borders.

- Groups 1 and 8 were comprised of low salt marsh vegetation. Group 1 contained three plots representing Salt Panne, and Group 8 was comprised of two associations characterized by *Spartina alterniflora* (smooth cordgrass): North Atlantic Low Salt Marsh (3 plots) and Brackish Tidal Low Marsh (1 plot).
- Group 3 was comprised of five associations occurring on high salt marshes or on the upper border of high salt marshes: North Atlantic High Salt Marsh (3 plots), Northern Brackish Meadow (1 plot), Atlantic Giant Cordgrass Marsh (1 plot), Irregularly Flooded Eastern Tidal Salt Shrub (1 plot with high *Spartina patens* (salt meadow cordgrass) cover), and a Salt Panne variant occurring on the ecotone of high salt marsh and high salt marsh (1 plot).
- Group 44 was comprised of 4 loosely related associations of brackish marshes to fresh marshes characterized by variable salinity. Transitional Tidal Marsh is a brackish marsh occurring on the upper edges of salt marshes and was represented by 2 plots. Coastal Salt Pond Marsh comprised of 3 plots, all of which are somewhat atypical of the concept but are best placed within this type. Spikerush Lawn Tidal Marsh consists of a single plot that represents the only known occurrence of this vegetation on Cape Cod National Seashore. Coastal Freshwater Marsh, also comprised of a single depauperate plot, was classified in this group because of its relatively high cover of *Schoenoplectus pungens* (common threesquare).
- Group 4 was also made up of weakly related associations. Irregularly Flooded Eastern Tidal Salt Shrub was comprised of 2 plots. Brackish Meadow was an additional plot which clustered because of high *Panicum virgatum* (switchgrass) cover. An additional plot clustered incorrectly with this group as a result of high cover of *Baccharis halimifolia* (eastern baccharis), but occurs on dunes and was reassigned to Northern Bayberry Dune Shrubland. Group 4 also contained a single plot of Cattail Brackish Tidal Marsh, presumably due to the presence of *Baccharis halimifolia* in the plot.

The third major division was made up of a set of wetland groups and a set of upland groups. The wetland groups were comprised of swamp forests and shrub swamps. The upland groups were made up of five groups of dune vegetation types, and another loosely defined group of weedy vegetation types and other types better represented in the forest and heathland data sets analyzed separately.

- The two wetland groups were made up of five associations: Group 16 was comprised of Seasonally Flooded Atlantic White-cedar Swamp (1 plot), Lower New England Red Maple - Blackgum Swamp (4 plots), Red Maple / Tussock Sedge Wooded Marsh (1 plot), and North Atlantic Fresh Tidal Shrub Swamp (1 plot). Group 53 corresponded to Blueberry Wetland Thicket (2 plots).
- Group 17 was equivalent to Old-field Eastern Red-cedar Forest (3 plots). Group 25 was made up of five tall shrubland or forest types: Northern Tall Maritime Shrubland (2 plots), Successional Maritime Forest (5 plots), Northeastern Dry Oak - Hickory Forest (1 plot), Pitch Pine - Oak Forest (1 plot), and an atypical example of Northern Bayberry

Dune Shrubland that emerged in this group due to an unusually high cover of *Prunus serotina* (black cherry).

- The remaining five groups of this division were made up of dune and beach vegetation types. Group 26 was equivalent to Northern Bayberry Dune Shrubland (4 plots); Group 56 was equivalent to Hairgrass Backdune Grassland (5 plots); Group 58 was equivalent to North Atlantic Coastal Plain Vine Dune (3 plots). Group 6 was essentially equivalent to North Atlantic Ocean Upper Beach (4 plots) and also included one plot with low vegetation cover that we reclassified. Despite lacking *Deschampsia flexuosa* (wavy hairgrass) this plot was otherwise similar to Hairgrass Backdune Grassland in composition. Group 7 was essentially equivalent to Northern Beachgrass Dune (4 plots) but also included a plot with relatively high cover of *Toxicodendron radicans* (eastern poison ivy) that we reclassified as North Atlantic Coastal Plain Vine Dune.

The fourth major division included seven disparate groups made up of fourteen associations, most of which are represented by a single plot. The weak relationships among these groups reflected the lack of redundant sampling.

- Group 54 was made up of two closely related associations: Northern Interdunal Cranberry Swale (3 plots), and Pitch Pine / Cranberry Interdunal Swale (1 plot).
- Group 29 contained two associations both which had high cover of *Spartina patens* (saltmeadow cordgrass)*:* Northern Brackish Meadow (2 plots) and Salt Hay Dune (3 plots). Both associations occurred at the upper edges of salt marshes, but Salt Hay Dune was generally not tidally flooded. The latter association usually occurred on narrow peninsulas where salt marshes and dunes occur in close proximity.
- Group 120 was equivalent to Bayonet Rush Pondshore (2 plots); additional data for this type is described in Sneddon et al. (1999).
- Group 13 was made up of two plots classified together in the analysis based on their high cover of *Pluchea odorata* (sweetscent). Despite this, they represented two different vegetation types, although both plots were somewhat atypical of the types. We classified one plot as Eastern Cattail Marsh based on the relatively high importance of *Typha latifolia* (broadleaf cattail) and *Schoenoplectus tabernaemontani* (softstem bulrush). It was likely this vegetation received occasional pulses of saltwater, hence the presence of *Eleocharis parvula* (dwarf spikerush). The other plot was classified as Salt Panne based on the presence of *Salicornia maritima* (slender glasswort) and other halophytic species.
- Group 10 was equivalent to Eastern Cattail Marsh (3 plots)
- Group 21 contained two associations: Alkali Bulrush Brackish Marsh (2 plots), and Reed-grass Tidal Marsh (1 plot).
- Group 5 was the most disparate group of plots in the analysis, again reflecting the lack of redundant sampling. This group contained two weedy upland associations: Black Locust Successional Forest (2 plots) and Northeastern Old Field (1 plot). It also includes Brackish Meadow (1 plot), Atlantic Coast Wild Rice Tidal Marsh (1 plot), Alkali Bulrush Brackish Marsh (1 plot), and a somewhat atypical example of Coastal Salt Pond Marsh dominated by *Schoenoplectus maritimus* (cosmopolitan bulrush).

Analysis in TWINSPAN first separated salt marsh vegetation from all other vegetation (Appendix G). Within salt marshes, high marsh associations characterized by *Spartina patens*

(saltmeadow cordgrass) were separated from low marsh associations characterized by *Spartina alterniflora* (smooth cordgrass). The remaining plots split off dune and beach vegetation from all other vegetation. Within dunes, further divisions were based broadly on physiognomy: grass and forb vegetation, shrub-dominated vegetation, and forest or woodland vegetation of dunes. The next remaining division in the remaining plots separated wetland forests, and successive divisions then separated other wetlands. Forty-six associations were identified in this analysis.

Heathland data

The 44 plots collected as part of the heathland study (Gwilliam 1998) initially separated out 17 plots that NatureServe classified as the Sandplain Heathland association characterized by *Corema conradii* (broom crowberry), *Arctostaphylos uva-ursi* (kinnikinnick), *Hudsonia ericoides* (pinebarren goldenheather), and *Schizachyrium scoparium* (little bluestem). The remaining plots divided into three dune associations: Pitch Pine Dune Woodland, Hairgrass Backdune Grassland, and Northern Beach-heather Dune Shrubland.

Forest data

The 87 forest plots were re-analyzed from Motzkin and Foster (2002) and supported the investigators' conclusions revealing a major difference based primarily on land use. This difference was reflected in the abundance of *Gaultheria procumbens* (eastern teaberry) and *Epigaea repens* (trailing arbutus), associated with land used as woodlots with relatively little soil disturbance vs. the abundance of *Deschampsia flexuosa* (wavy hairgrass), indicating a plow line or other soil disturbance. In our analysis, five associations were identified: Northeastern Coastal Oak - Heath Forest (11 plots); Coastal Pitch Pine / Scrub Oak Barren (21 plots); Pitch Pine - Oak Forest (44 plots); Outwash Scrub Oak Barrens (1 plots); and Pitch Pine - Heath Barrens (8 plots). One plot was placed in the Lower New England Red Maple - Blackgum Swamp association, although the plot appears to be transitional between wetland and upland, having wetland species such as *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), *Clethra alnifolia* (coastal sweetpepperbush), *Lyonia ligustrina* (maleberry), *Osmunda cinnamomea* (cinnamon fern), *Rhododendron viscosum* (swamp azalea), and *Kalmia angustifolia* (sheep laurel) in addition to *Quercus alba* (white oak), *Quercus velutina* (black oak), and *Pinus rigida* (pitch pine). Soils in this plot had a high percentage of organic matter and higher percentage of silt as compared to the remaining upland plots in this data set, but had lower amounts of organic matter in comparison to the wetland soils of this association.

Plots outside park boundary

Seven associations were located outside but within close proximity to the park boundary on adjacent protected lands. These were included in the analysis and classification because they are unique associations with minimal data in the USNVC, they created a more robust data analysis, and they could occur within the park. These associations included: Northeastern Dry Oak - Hickory Forest, Seasonally Flooded Atlantic White-cedar Swamp, Atlantic White-cedar Bog, Brackish Tidal Low Marsh, Atlantic Giant Cordgrass Marsh, North Atlantic Fresh Tidal Shrub Swamp, and North Atlantic Coastal Plain River Brackish Intertidal Mudflat. They were not mapped because mapping was limited to the geographic extent within the park boundary. Three additional associations were not mapped, but are known to occur in the park: Northern Atlantic Coast Beaked Ditch-grass Bed, a subtidal association, and Alkali Bulrush Brackish Marsh and Swamp-loosestrife Shrub Swamp, both identified in the park as very small examples below the mmu.

Draft Association-level Vegetation Map Production

The 2000 preliminary vegetation map was crosswalked to the USNVC in 2003 by Cape Cod National Seashore science staff, GIS specialist Mark Adams and Vegetation Ecologist, Stephen Smith. Fifty-one associations were mapped in this version and 66 associations were identified for the preliminary classification. Each polygon containing natural vegetation was assigned one of the vegetation association types. The vegetation types were assigned using information from plot data, field observations, aerial photography signatures, and topographic maps. An aerial photograph interpretation table for most of the vegetation associations and Anderson Level II (modified) categories is located in Appendix A. Polygon boundaries were also revised based on these four information sources. Polygons that had previously been attributed with modified Anderson Level II (modified) land use categories retained their attributes. The thematic accuracy of this 2003 draft vegetation association-level vegetation map was then assessed in 2004.

Seven associations sampled in plot sampling were not mapped because they fell just outside the park boundary, but within close geographic proximity to the park. These include Northeastern Dry Oak - Hickory Forest, Seasonally Flooded Atlantic White-cedar Swamp, Atlantic White-cedar Bog, Brackish Tidal Low Marsh, Atlantic Giant Cordgrass Marsh, North Atlantic Fresh Tidal Shrub Swamp, and North Atlantic Coastal Plain River Brackish Intertidal Mudflat. One association, Northern Atlantic Coast Beaked Ditch-grass Bed, occurs under water and was not mapped. Twelve associations were too small-patch to map in the 2003 draft association-level vegetation map and did not have distinct aerial photography signatures. These include Alkali Bulrush Brackish Marsh, Bluejoint Pondshore Margin, Bulbet Flatsedge Coastal Plain Sandy Pondshore, Northern Coastal Plain Pondshore Margin, Spikerush Lawn Tidal Marsh, Threeway Sedge Acidic Fen, Swamp-loosestrife Coastal Plain Pond, Swamp-loosestrife Shrub Swamp, Salt Hay Dune, Transitional Tidal Marsh, Red Maple / Tussock Sedge Wooded Marsh, and Northeastern Leafy Forb Marsh.

Accuracy Assessment

Positional Accuracy

Ground and photogrammetric control (elevation model) for the orthorectification of the aerial photography was available statewide from the previous black-and-white 1:30,000 digital orthophotography program conducted from 1992–2000. Ground control targets were set out prior to the flight and photo recognizable points were substituted for targets that were lost. Horizontal control (referenced to NAD83) conforms to the Federal Geodetic Control Committee specifications for Second Order Class 2 GPS surveys. Vertical control (referenced to NAVD88) is within 10 cm. It is tied to second order Class II NGRS benchmarks. In addition the latitude, longitude and ellipsoidal heights of continuously operating GPS reference stations were incorporated into the control adjustment. Orthometric heights were directly measured or estimated from GPS derived ellipsoidal heights. The transfer of control from that project made the creation of these new data much more efficient, and assured a very high level of accuracy and compatibility. Horizontal positional accuracy of the final mosaic was+/- 3m at 95% confidence level.

Thematic Accuracy

Two associations, Little Bluestem Old Field and North Atlantic Coast Estuarine Intertidal Mudflats, not previously identified and thus not mapped in the 2003 draft association-level vegetation map were encountered in the field during accuracy assessment. Also not mapped

were 17 known associations that were underwater, located outside the park boundary, or small-patch associations that occurred below the minimum mapping unit.

Analysis 1: The initial analysis comparing strictly the first field identification with the mapped polygon resulted in an overall accuracy of 40.4%, only half the recommended level of accuracy. Two associations (Coastal Plain Atlantic White-cedar Swamp and Medium Fen) had only one mapped polygon, were sampled only once, and achieved both 100% producer's and 100% user's accuracy, indicating that polygons of each type were correctly identified, and there are not likely to be other unmapped occurrences encountered in the park. Three other associations were found only once in the field but were mapped erroneously in additional polygons, resulting in a user's accuracy ranging from 7% to 50%. These associations were Bayonet Rush Pondshore, Northeastern Atlantic Coastal Oak - Beech Forest, and Coastal Freshwater Marsh. The remainder of the associations were encountered at least twice in the field and mapped with multiple polygons.

Eight associations reached 80% accuracy from either the producer's or user's perspective (Table 4). Only one association, Southern New England Bog, was 100% accurate from both the producer's and user's perspective. This association is infrequent in the park, however, and accuracy is based on only four samples. This was the only association to achieve the recommended accuracy of 80%. The other seven other associations reached 80% in either user's or producer's accuracy, but the wide discrepancy between the two measures means either a) while most of the polygons of the type are correctly labeled, there is considerably more of the type on the ground than the map suggests, or b) the proportion of the type on the map correctly reflects the proportion on the ground, but that a large proportion of the polygons are incorrect.

If the accuracy threshold is lowered to 60%, but hold that both producer's and user's accuracy achieve this accuracy, two additional associations may be included: Northern Interdunal Cranberry Swale and Eastern Cattail Marsh.

Table 4. Associations that reached 80% accuracy from either the producer's or user's perspective in the initial accuracy assessment analysis comparing the first field identification with the mapped polygon.

USNVC Association	Code	Producer's accuracy	User's accuracy
Southern New England Bog	CEGL006008	100%	100%
Irregularly Flooded Eastern Tidal Salt Shrub	CEGL003921	100%	60%
North Atlantic Upper Ocean Beach	CEGL004400	100%	11%
Northeastern Buttonbush Shrub Swamp	CEGL006069	67%	100%
North Atlantic Low Salt Marsh	CEGL004192	53%	100%
Northern Coastal Shrub Swale	CEGL006339	50%	100%
Coastal Plain Pond	CEGL006086	29%	100%
Pitch Pine Oak Forest	CEGL006381	44%	80%

Analysis 2: If we allow for the fact that vegetation types are not discrete units with hard boundaries and that there is some inherent variability, then more than one type may be considered correct. Fuzzy analysis (accepting second and third calls as also correct) yielded a higher overall accuracy of 56.9%, still well below the desired target of 80% recommended by the Vegetation Mapping Program, but considerably higher than the accuracy achieved in Analysis 1. A greater proportion of individual types reached 80% accuracy or higher (either user's or producer's) in this analysis, as expected. The contingency table with accuracy assessment Analysis 2 results is included as Table 5. Nineteen associations met or exceeded 80% in either user's or producer's accuracy in Analysis 2 (Table 6; due to page size, Table 6 appears after Tables 5 and 7). Of these nineteen, the f irst six associations surpassed 80% in both producer's and user's accuracy; Black Locust Successional Forest is just below this threshold at 79%.

Analysis 3: The third analysis is a reduction of the number of classes as a result of aggregating associations that were regularly confused with each other on the photography. Using the results of Analysis 2 as a starting point, twenty-nine map classes were developed from the original fifty-one mapped associations. Fifteen associations did not require aggregating because they exceeded 80%. Table 7 illustrates the contingency table and accuracy results for Analysis 3. Table 8 summarizes the map unit aggregations and their component associations. Overall map accuracy from the resulting aggregations was 70.7%. Further combining of associations to reach the recommended 80% accuracy was initially attempted, but was abandoned because the resulting loss of detail far surpassed the insignificant incremental gains in accuracy. Seven map units achieved 80% or better accuracy from both producer's and user's perspective (Table 9). Nine additional map units met both user's and producer's accuracy of greater than 60% using this analysis (Table 10).

Final Vegetation Map Production

Based on the accuracy assessment sampling points, the 2003 draft vegetation association-level map was revised to correct errors and create more accurate vegetation association polygon boundaries. In this final revision, accuracy assessment data, plot data, field observations, aerial photography signatures, and topographic maps were used to revise polygon boundaries and attributes. Polygons were attributed to vegetation associations identified during accuracy assessment (but not identified during plot sampling) where possible after the accuracy assessment analysis in the final 2004 association-level vegetation map. This increased the number of mapped associations from 51 in the draft 2003 association-level vegetation map to 61 in the final 2004 association-level vegetation map (Tables 11 and 12).

Nine associations are included in the final 2004 vegetation classification that are not mapped (Table 13). One is a small patch association below the minimum map unit size (0.5 ha); one is a submerged aquatic vegetation association; and seven are located outside the Cape Cod National Seashore boundary, but within close proximity to the park and witin protected lands on the outer peninsula of Cape Cod. Plots were sampled in this vegetation and rather than exclude the data, it was included in the vegetation classification as there is potential for some or all of these associations to occur within the park boundary and have not yet been identified. These nine associations are included in the key.

Table 5. Contingency table for accuracy assessment Analysis 2, second and third field calls also correct.

Map Class	Map Class	North Atlantic Coastal Plain Vine Dune	Irregularly Flooded Eastern Tidal Salt Shrub	Eastern Reed Marsh	Reed-grass Tidal Marsh	North Atlantic Low Salt Marsh	Cattail Brackish Tidal Marsh	Atlantic Coast Wild Rice Tidal Marsh	Salt Panne (Salicornia Type)	North Atlantic Upper Ocean Beach	Pitch Pine - Heath Barrens	North Atlantic High Salt Marsh	Southern New England Bog	Old-field Eastern Red-cedar Forest	Sandplain Heath land	Sandplain Grassland	Northeastern Buttonbush Shrub Swamp	Coastal Plain Pond	Swamp-loose strife Coastal Plain Pond	Northeastern Old Field	Outwash Scrub Oak Barrens	Pitch Pine Dune Woodland	Red Maple / Tussock Sedge Wooded Marsh	Pitch Pine / Cranberry Interdunal Swale	Northern Interdunal Cranberry Swale	Northern Beach-heather Dune Shrubland	Successional Maritime Forest	Salt Hay Dune	Eastern Cattail Marsh	Lower New England Red Maple - Blackgum Swamp	Hairgrass Backdune Grassland	Coastal Plain Atlantic White-cedar Swamp	Highbush Blueberry Bog Thicket	Northeastern Leafy Forb Marsh	Northern Beacgrass Dune	Northern Bayberry Dune Shrubland	Medium Fen	Coastal Pitch Pine / Scrub Oak Barren	Northern Coastal Shrub Swale	Bayonet Rush Pondshore	Pipewort Sandy Pondshore	Woolgrass Marsh	Blueberry Wetland Thicket	Northeastern Coastal Oak - Heath Forest	Northeastern Atlantic Coastal Oak - Beech Forest	Northern Tall Maritime Shrubland	Pitch Pine - Oak Forest	Coastal Salt Pond Marsh	Successional Wet Meadow	Spikerush Lawn Tidal Marsh	Coastal Freshwater Marsh	Black Locust Successional Forest	Developed / Disturbed	no veg	Grand Total	User's Accuracy	t-score	Confidence Interval
	CEGL00	3886	3921	4141	4187	4192	4201	4202	4308	4400	5046	6006	6008	6024	6066	6067	6069	6086	6087	6107	6111	6117	6119	6127	6141	6143	6145	6149	6153	6156	6621	6188	6190	6191	6274	6295	6302	6315	6339	6345	6346	6349	6371	6375	6377	6379	6381	6398	6571	6611	6935	7279	none	none				
North Atlantic Coastal Plain Vine Dune	3886	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	n/a	n/a
Irregularly Flooded Eastern Tidal Salt Shrub	3921	0	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	80%	2.132	0.48
Eastern Reed Marsh	4141	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	10	40%	1.833	0.33
Reed-grass Tidal Marsh	4187	1	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	60%	2.132	0.57
North Atlantic Low Salt Marsh	4192	0	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	100%	1.734	0.03
Cattail Brackish Tidal Marsh	4201	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5	40%	2.132	0.57
Atlantic Coast Wild Rice Tidal Marsh	4202	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	0%	2.132	0.1
Salt Panne (Salicornia Type)	4308	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	n/a	n/a
North Atlantic Upper Ocean Beach	4400	0	0	0	0	1	0	0	1	5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	18	28%	1.74	0.21
Pitch Pine - Heath Barrens	5046	0	0	0	0	0	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	20	90%	1.729	0.14
North Atlantic High Salt Marsh	6006	0	0	0	0	5	0	0	3	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	55%	1.729	0.22
Southern New England Bog	6008	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	100%	2.353	0.13
Old-field Eastern Red-cedar Forest	6024	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	1	0	0	16	50%	n/a	n/a
Sandplain Heathland	6066	0	0	0	0	0	0	0	0	0	1	0	0	0	8	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	18	44%	1.74	0.23
Sandplain Grassland	6067	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	60%	2.132	0.57
Northeastern Buttonbush Shrub Swamp	6069	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	100%	n/a	n/a
Coastal Plain Pond	6086	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	100%	2.132	0.1
Swamp-loosestrife Coastal Plain Pond	6087	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	n/a	n/a
Northeastern Old Field	6107	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	20%	2.132	0.48
Outwash Scrub Oak Barrens	6111	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	16	81%	1.753	0.2
Pitch Pine Dune Woodland	6117	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	29%	1.725	0.19
Red Maple / Tussock Sedge Wooded Marsh	6119	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	n/a	n/a
Pitch Pine / Cranberry Interdunal Swale	6127	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	5	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	15	33%	1.761	0.25
Northern Interdunal Cranberry Swale	6141	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	13	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	87%	1.761	0.19
Northern Beach-heather Dune Shrubland	6143	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	31%	1.782	0.27
Successional Maritime Forest	6145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	5	20%	1.729	0.41
Salt Hay Dune	6149	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0%	n/a	n/a
Eastern Cattail Marsh	6153	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	18	83%	1.74	0.18
Lower New England Red Maple - Blackgum Swamp	6156	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	1	0	0	0	0	0	0	0	0	0	1	2	0	4	0	0	0	0	0	2	0	0	19	42%	1.734	0.22
Hairgrass Backdune Grassland	6621	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	70%	1.729	0.2
Coastal Plain Atlantic White-cedar Swamp	6188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100%	n/a	n/a
Highbush Blueberry Bog Thicket	6190	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	n/a	n/a
Northeastern Leafy Forb Marsh	6191	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	n/a	n/a
Northern Beachgrass Dune	6274	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	19	89%	1.734	0.15
Northern Bayberry Dune Shrubland	6295	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	3	1	0	0	0	0	1	0	0	0	1	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	20	50%	1.729	0.22
Medium Fen	6302	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100%	n/a	n/a
Coastal Pitch Pine / Scrub Oak Barren	6315	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	15	67%	1.761	0.25
Northern Coastal Shrub Swale	6339	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	100%	n/a	n/a
Bayonet Rush Pondshore	6345	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	0	0	0	0	1	14	29%	1.771	0.25
Pipewort Sandy Pondshore	6346	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0%	n/a	n/a
Woolgrass Marsh	6349	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	5	40%	2.132	0.48
Blueberry Wetland Thicket	6371	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	6	0	0	0	0	0	1	0	0	0	5	0	0	3	0	0	1	0	0	0	0	0	18	28%	1.74	0.21
Northeastern Coastal Oak - Heath Forest	6375	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	5	0	0	0	0	1	0	0	19	58%	1.734	0.22
Northeastern Atlantic Coastal Oak - Beech Forest	6377	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	1	0	0	0	0	0	0	0	5	20%	2.132	0.48
Northern Tall Maritime Shrubland	6379	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	2	1	1	0	0	1	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	7	1	0	0	0	0	0	0	0	20	35%	1.729	0.21
Pitch Pine - Oak Forest	6381	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	21	95%	1.725	0.1
Coastal Salt Pond Marsh	6398	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0%	n/a	n/a
Successional Wet Meadow	6571	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	n/a	n/a
Spikerush Lawn Tidal Marsh	6611	0	0	0	0	4	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0%	2.132	0.1
Coastal Freshwater Marsh	6935	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	100%	n/a	n/a
Black Locust Successional Forest	7279	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	15	0	0	18	83%	1.74	0.18
Developed / Disturbed	none							0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0%	n/a	n/a
No Vegetation	none	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	n/a	n/a
Grand Total		3	4	4	6	31	2	0	4	5	40	14	4	9	27	3	3	13	1	5	20	17	1	8	16	6	3	2	17	9	18	1	10	1	18	17	1	15	4	4	0	2	9	20	1	27	33	0	1	0	2	19	0	14	492			
Producer's Accuracy		0%	100%	0%	50%	61%	0%	0%	0%	100%	45%	79%	100%	89%	30%	100%	67%	38%	0%	20%	65%	35%	0%	63%	81%	67%	33%	50%	88%	89%	78%	100%	0%	0%	94%	59%	100%	67%	50%	100%	0%	0%	56%	55%	100%	26%	61%	0%	0%	0%	100%	79%	0%	0%				
t-score value		2.92	2.353	n/a	2.015	1.697	n/a	n/a	2.353	2.132	1.684	1.771	2.353	1.943	1.706	2.353	2.353	1.782	n/a	2.132	1.729	1.74	n/a	1.895	1.753	2.015	2.353	n/a	1.746	1.86	1.74	n/a	1.833	n/a	1.74	1.746	n/a	1.761	2.353	2.353	n/a	n/a	1.86	1.729	n/a	1.706	1.686	n/a	n/a	n/a	n/a	1.734	n/a	1.771				
Confidence intervals		0.17	0.13	n/a	0.49	0.16	n/a	n/a	0.13	0.1	0.14	0.23	0.13	0.26	0.17	0.17	0.81	0.28	n/a	0.48	0.21	0.23	n/a	0.39	0.2	0.47	0.81	n/a	0.17	0.25	0.2	n/a	0.05	n/a	0.12	0.24	n/a	0.25	0.71	0.13	n/a	n/a	0.36	0.22	n/a	0.16	0.16	n/a	n/a	n/a	n/a	0.19	n/a	0.04				

Table 7. Contingency table for accuracy assessment Analysis 3, aggregated associations.

Map Class	Map Class	Dune Shrub	Salt Shrub	Phragmites	Salt Marsh	Cattail Marsh	Freshwater Marsh	Beach	Pitch Pine Barrens	Bog	Red Cedar	Heathland / Grassland	Buttonbush	Coastal Plain Pondshore	Old Field	Scrub Oak	Dune Pine Forest	Wooded Marsh	Cranberry Swale	Scrub Forest	Red Maple Swamp	Cedar Swamp	Shrub Swamp	Beachgrass Dune	Fen	Shrub Swale	Oak / Beech Forest	Mixed Forest	Coastal Marsh	Back Locust	No Vegetation	Developed / Disturbed	Open Water	Grand Total	User's Accuracy	t-score	Confidence Interval
	CEGL00	3886 6295	3921	4141 4187	4192 6006 6611 4308 6149 6398	4201 6153	4202 6087	4400	5046 6315	6008	6024	6066 6067 6143	6069	6086 6345 6346 6191	6107	6111	6117 6127	6119 6349	6141	6145 6379	6156	6188	6190 6371 6571	6274 6621	6302	6339	6375 6377	6381	6935	7279	no veg	developed	water				
Dune Shrub	3886 6295	11	0	0	1	0	0	0	0	0	0	2	0	0	0	3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	20	55%	1.73	0.22
Salt Shrub	3921	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0%	2.13	0.01
Phragmites	4141 4187	1	0	8	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	1	0	0	1	0	0	0	0	0	0	0	15	53%	1.76	0.26
Salt Marsh	4192 6006 6611 4308 6149 6398	0	0	0	46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	100%	1.68	0.01
Cattail Marsh	4201 6153	0	0	2	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	23	78%	1.7	0.17
Freshwater Marsh	4202 6087	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	5	20%	2.13	0.48
Beach	4400	0	0	0	2	0	0	5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	9	0	0	18	0%	1.74	0.01
Pitch Pine Barrens	5046 6315	0	0	0	0	0	0	0	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	35	91%	1.69	0.1
Bog	6008	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0%	2.35	0
Red Cedar	6024	0	0	0	0	0	0	0	0	0	8	0	0	0	1	0	0	0	0	6	0	0	0	0	0	0	0	0	0	1	0	0	0	16	50%	1.75	0.25
Heathland / Grassland	6066 6067 6143	2	0	0	0	0	0	0	4	0	0	42	0	0	1	2	2	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	56	75%	1.67	0.11
Buttonbush	6069	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0%	n/a	n/a
Coastal Plain Pondshore	6086 6345 6346 6191	0	0	0	0	0	0	0	0	0	0	0	1	17	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	20	85%	1.73	0.16
Old Field	6107	0	0	0	0	0	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0%	2.13	0.01
Scrub Oak	6111	1	0	0	0	0	0	0	1	0	0	0	0	0	0	13	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0%	1.75	0.01
Dune Pine Forest	6117 6127	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	17	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	36	47%	1.69	0.15
Wooded Marsh	6119 6349	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	5	60%	2.13	0.57
Cranberry Swale	6141	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0%	1.76	0.01
Scrub Forest	6145 6379	3	0	0	0	0	0	0	0	0	0	3	0	0	0	1	2	0	2	10	1	0	0	0	0	0	1	2	0	0	0	0	0	25	40%	1.71	0.19
Red Maple Swamp	6156	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	4	8	0	2	0	0	0	2	0	0	2	0	0	0	19	0%	1.73	0.01
Cedar Swamp	6188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0%	n/a	n/a
Shrub Swamp	6190 6371 6571	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	0	12	0	0	1	0	0	0	0	0	0	0	18	67%	1.74	0.22
Beachgrass Dune	6274 6621	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	1	0	0	19	0%	1.73	0
Fen	6302	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0%	n/a	n/a
Shrub Swale	6339	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0%	n/a	n/a
Oak / Beech Forest	6375 6377	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	15	6	0	1	0	0	0	24	63%	1.71	0.19
Mixed Forest	6381	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	21	0%	1.73	0
Coastal Marsh	6935	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0%	n/a	n/a
Black Locust	7279	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	15	0	0	0	18	0%	1.74	0.01
Unvegetated	None	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	n/a	n/a
Developed / Disturbed	None	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	n/a	n/a
Open Water	None	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	n/a	n/a
Grand Total		20	4	10	51	19	1	5	55	4	9	53	3	18	5	20	25	3	16	30	9	1	20	18	1	4	21	32	2	19	14	0	0	492			
Producer's Accuracy		55%	100%	80%	90%	95%	100%	100%	58%	100%	89%	79%	67%	94%	20%	65%	68%	100%	81%	33%	89%	100%	60%	94%	100%	50%	71%	63%	100%	79%	0%	0%	0%				
t-score value		1.73	2.35	1.83	1.68	1.73	n/a	2.13	1.67	2.35	1.86	1.67	2.92	1.74	2.13	1.73	1.71	2.92	1.75	1.7	1.83	n/a	1.73	1.74	n/a	2.35	1.73	1.68	n/a	1.73	n/a	n/a	n/a				
Confidence intervals		0.22	0.13	0.28	0.08	0.11	n/a	0.1	0.12	0.13	0.25	0.1	0.96	0.12	0.48	0.21	0.18	0.17	0.2	0.16	0.25	n/a	0.21	0.12	n/a	0.71	0.19	0.16	n/a	0.19	n/a	n/a	n/a				

Table 6. The following nineteen types met or exceeded 80% in either user's or producer's accuracy in accuracy assessment Analysis 2 using fuzzy analysis.

USNVC Association Local Name	USNVC Code	Producer's accuracy	User's accuracy
Southern New England Bog	CEGL006008	100%	100%
Coastal Freshwater Marsh	CEGL006935	100%	100%
Irregularly Flooded Eastern Tidal Salt Shrub	CEGL003921	100%	80%
Northern Beachgrass Dune	CEGL006274	94%	89%
Eastern Cattail Marsh	CEGL006153	88%	83%
Sandplain Grassland	CEGL006067	100%	60%
Northern Interdunal Cranberry Swale	CEGL006141	81%	87%
Black Locust Successional Forest	CEGL007279	79%	83%
Bayonet Rush Pondshore	CEGL006345	100%	29%
Old-field Eastern Red-cedar Forest	CEGL006024	100%	13%
North Atlantic Upper Ocean Beach	CEGL004400	100%	11%
Lower New England Red Maple - Blackgum Swamp	CEGL006156	89%	42%
Northeastern Buttonbush Shrub Swamp	CEGL006069	67%	100%
North Atlantic Low Salt Marsh	CEGL004192	53%	100%
Northern Coastal Shrub Swale	CEGL006339	50%	100%
Coastal Plain Pond	CEGL006086	29%	100%
Pitch Pine - Heath Barrens	CEGL005046	45%	90%
Outwash Scrub Oak Barrens	CEGL006111	65%	81%
Pitch Pine Oak Forest	CEGL006381	44%	80%

Table 8. Producer's and user's accuracy using aggregated USNVC associations for accuracy assessment (Analysis 3) at Cape Cod National Seashore.

Aggregated Map Unit	USNVC Association Local Name	USNVC Code	Producer's Accuracy	User's Accuracy
Dune Shrub	North Atlantic Coastal Plain Vine Dune	CEGL003886	55%	58%
	Northern Bayberry Dune Shrubland	CEGL006295		
Salt Shrub	Irregularly Flooded Eastern Tidal Salt Shrub	CEGL003921	100%	80%
Phragmites	Eastern Reed Marsh	CEGL004141	52%	55%
	Reed-grass Tidal Marsh	CEGL004187		
Salt Marsh	North Atlantic Low Salt Marsh	CEGL004192	57%	100%
	Salt Panne (Salicornia Type)	CEGL004308		
	North Atlantic High Salt Marsh	CEGL006006		
	Salt Hay Dune	CEGL006149		
	Spikerush Lawn Tidal Marsh	CEGL006611		
	Coastal Salt Pond Marsh	CEGL006398		
Cattail Marsh	Cattail Brackish Tidal Marsh	CEGL004201	88%	70%
	Eastern Cattail Marsh	CEGL006153		
Freshwater Marsh	Atlantic Coast Wild Rice Tidal Marsh	CEGL004202	40%	40%
	Swamp-loosestrife Coastal Plain Pond	CEGL006087		
Beach	North Atlantic Upper Ocean Beach	CEGL004400	100%	55%
Pitch Pine Barrens	Pitch Pine - Heath Barrens	CEGL005046	58%	86%
	Coastal Pitch Pine / Scrub Oak Barren	CEGL006315		
Bog	Southern New England Bog	CEGL006008	100%	100%
Red Cedar	Old-field Eastern Red-cedar Forest	CEGL006024	89%	50%
Coastal Plain Pondshore	Coastal Plain Pond	CEGL006086	89%	89%
	Bayonet Rush Pondshore	CEGL006345		
	Pipewort Sandy Pondshore	CEGL006346		
	Northeastern Leafy Forb Marsh	CEGL006191		
Heathland / Grassland	Sandplain Heathland	CEGL006066	80%	78%
	Sandplain Grassland	CEGL006067		
	Northern Beach-heather Dune Shrubland	CEGL006143		
Buttonbush	Northeastern Buttonbush Shrub Swamp	CEGL006069	67%	66%
Old Field	Northeastern Old Field	CEGL006107	20%	12%
Scrub oak	Outwash Scrub Oak Barrens	CEGL006111	65%	81%
Dune Pine Forest	Pitch Pine Dune Woodland	CEGL006117	72%	86%
	Pitch Pine / Cranberry Interdunal Swale	CEGL006127		
Wooded Marsh	Red Maple / Tussock Sedge Wooded Marsh	CEGL006119	44%	66%
	Woolgrass Marsh	CEGL006349		
Cranberry Swale	Northern Interdunal Cranberry Swale	CEGL006141	81%	81%
Scrub Forest	Successional Maritime Forest	CEGL006145	31%	38%
	Northern Tall Maritime Shrubland	CEGL006379		
Red Maple Swamp	Lower New England Red Maple - Blackgum Swamp	CEGL006156	91%	52%
Cedar Swamp	Coastal Plain Atlantic White-cedar Swamp	CEGL006188	100%	100%
Shrub Swamp	Highbush Blueberry Bog Thicket	CEGL006190	60%	54%
	Blueberry Wetland Thicket	CEGL006371		
	Successional Wet Meadow	CEGL006571		
Beachgrass Dune	Northern Beachgrass Dune	CEGL006274	95%	95%
	Hairgrass Backdune Grassland	CEGL006621		
Fen	Medium Fen	CEGL006302	100%	100%

Aggregated Map Unit	USNVC Association Local Name	USNVC Code	Producer's Accuracy	User's Accuracy
Shrub Swale	Northern Coastal Shrub Swale	CEGL006339	50%	67%
Oak / Beech Forest	Northeastern Coastal Oak - Heath Forest	CEGL006375	75%	62%
	Northeastern Atlantic Coastal Oak - Beech Forest	CEGL006377		
Mixed Forest	Pitch Pine - Oak Forest	CEGL006381	59%	95%
Coastal Marsh	Coastal Freshwater Marsh	CEGL006935	100%	67%
Black Locust	Black Locust Successional Forest	CEGL007279	79%	88%

Table 9. Seven aggregated association map units which achieved 80% or better from both the producer's and user'saccuracy perspective in accuracy assessment Analysis 3.

Aggregated Map Unit	Producer's Accuracy	User's Accuracy
Salt Shrub	100%	80%
Salt Marsh	90%	100%
Bog	100%	100%
Coastal Plain Pondshore	94%	85%
Cranberry Swale	81%	87%
Beachgrass Dune	94%	89%
Coastal Marsh	100%	100%

Table 10. Nine additional aggregated association map units which achieved less than 80% from either a producer's and user's accuracy perspective but 60% or better from both the user's and producer's perspective in accuracy assessment Analysis 3.

Aggregated Map Unit	Producer's Accuracy	User's Accuracy
Cattail Marsh	95%	78%
Heathland / Grassland	79%	75%
Wooded Marsh	100%	60%
Black Locust	79%	83%
Oak / Beech Forest	71%	63%
Buttonbush	67%	100%
Scrub Oak	65%	81%
Shrub Swamp	60%	67%
Mixed Forest	63%	95%

Table 11. Ten vegetation associations added to the draft 2003 association-level map based on accuracy assessment, plot and observation data.

USNVC Association Local Name	USNVC Code	Comments
Little Bluestem Old Field	CEGL006333	Polygons attributed based on AA data
North Atlantic Coast Estuarine Intertidal Mudflats	CEGL006614	Called Tidal Flat in draft map
Transitional Tidal Marsh	CEGL006612	Small patch polygons not originally teased out in map identified during AA.
Threeway Sedge Acidic Fen	CEGL006077	Small patch association, 1 polygon updated
Northern Brackish Meadow	CEGL006368	Small patch association, 1 polygon updated
Brackish Meadow	CEGL006150	Small patch association, 4 polygons updated.
Bulblet Flatsedge Coastal Plain Sandy Pondshore	CEGL006210	Small patch occurrences in coastal plain ponds.
Bluejoint Pondshore Margin	CEGL006243	Small patch association, 1 coastal plain pond polygon updated
Northern Coastal Plain Pondshore Margin	CEGL006035	Small patch association, 2 coastal plain pond polygons updated
Alkali Bulrush Brackish Marsh	CEGL006416	Small patch association interdigitated with *Phragmites* in 1 polygon

Table 12. Final 61 associations and their assigned aggregated map units in the 2004 final vegetation map.

Aggregated Map Unit Name	USNVC Association Local Name	USNVC Code
Dune Shrub	North Atlantic Coastal Plain Vine Dune	CEGL003886
	Northern Bayberry Dune Shrubland	CEGL006295
Salt Shrub	Irregularly Flooded Eastern Tidal Salt Shrub	CEGL003921
Phragmites	Eastern Reed Marsh	CEGL004141
	Reed-grass Tidal Marsh	CEGL004187
Salt Marsh	North Atlantic Low Salt Marsh	CEGL004192
	Salt Panne (Salicornia Type)	CEGL004308
	North Atlantic High Salt Marsh	CEGL006006
	Alkali Bulrush Brackish Marsh	CEGL006416
	Salt Hay Dune	CEGL006149
	Spikerush Lawn Tidal Marsh	CEGL006611
	Coastal Salt Pond Marsh	CEGL006398
	Transitional Tidal Marsh	CEGL006612
	Brackish Meadow	CEGL006150
Cattail Marsh	Cattail Brackish Tidal Marsh	CEGL004201
	Eastern Cattail Marsh	CEGL006153
Freshwater Marsh	Atlantic Coast Wild Rice Tidal Marsh	CEGL004202
	Swamp-loosestrife Coastal Plain Pond	CEGL006087
	Northeastern Leafy Forb Marsh	CEGL006191
Beach	North Atlantic Upper Ocean Beach	CEGL004400
	North Atlantic Coast Estuarine Intertidal Mudflats	CEGL006614
Pitch Pine Barrens	Pitch Pine - Heath Barrens	CEGL005046
	Coastal Pitch Pine / Scrub Oak Barren	CEGL006315
Bog	Southern New England Bog	CEGL006008
Red Cedar	Old-field Eastern Red-cedar Forest	CEGL006024
Coastal Plain Pondshore	Northern Coastal Plain Pondshore Margin	CEGL006035
	Coastal Plain Pond	CEGL006086
	Bayonet Rush Pondshore	CEGL006345
	Pipewort Sandy Pondshore	CEGL006346
	Bulblet Flatsedge Coastal Plain Sandy Pondshore	CEGL006210

Aggregated Map Unit Name	USNVC Association Local Name	USNVC Code
	Bluejoint Pondshore Margin	CEGL006243
Heathland / Grassland	Sandplain Heathland	CEGL006066
	Sandplain Grassland	CEGL006067
	Northern Beach-heather Dune Shrubland	CEGL006143
Buttonbush	Northeastern Buttonbush Shrub Swamp	CEGL006069
Old Field	Northeastern Old Field	CEGL006107
	Little Bluestem Old Field	CEGL006333
Scrub Oak	Outwash Scrub Oak Barrens	CEGL006111
Dune Pine Forest	Pitch Pine Dune Woodland	CEGL006117
	Pitch Pine / Cranberry Interdunal Swale	CEGL006127
Wooded Marsh	Red Maple / Tussock Sedge Wooded Marsh	CEGL006119
	Woolgrass Marsh	CEGL006349
Cranberry Swale	Northern Interdunal Cranberry Swale	CEGL006141
Scrub Forest	Successional Maritime Forest	CEGL006145
	Northern Tall Maritime Shrubland	CEGL006379
Red Maple Swamp	Lower New England Red Maple - Blackgum Swamp	CEGL006156
Cedar Swamp	Coastal Plain Atlantic White-cedar Swamp	CEGL006188
Shrub Swamp	Highbush Blueberry Bog Thicket	CEGL006190
	Blueberry Wetland Thicket	CEGL006371
	Successional Wet Meadow	CEGL006571
Beachgrass Dune	Northern Beachgrass Dune	CEGL006274
	Hairgrass Backdune Grassland	CEGL006621
Fen	Medium Fen	CEGL006302
	Threeway Sedge Acidic Fen	CEGL006077
Shrub Swale	Northern Coastal Shrub Swale	CEGL006339
Oak / Beech Forest	Northeastern Coastal Oak - Heath Forest	CEGL006375
Mixed Forest	Northeastern Atlantic Coastal Oak / Beech Forest	CEGL006377
	Pitch Pine - Oak Forest	CEGL006381
Coastal Marsh	Coastal Freshwater Marsh	CEGL006935
	Northern Brackish Meadow	CEGL006368
Black Locust	Black Locust Successional Forest	CEGL007279

Table 13. Nine USNVC associations not mapped in the 2004 final vegetation map but included in the final vegetation classification.

USNVC Association Common Name	USNVC CODE	Comments
Northeastern Dry Oak - Hickory Forest	CEGL006336	on Try Island, Mass. Audubon land
Seasonally Flooded Atlantic White-cedar Swamp	CEGL006364	off Paines Hollow Rd. in Wellfleet
Atlantic White-cedar Bog	CEGL006321	in Whistlestop Woods, Provincetown
Brackish Tidal Low Marsh	CEGL004193	along Pamet River outside boundary
Atlantic Giant Cordgrass Marsh	CEGL004195	along Hatches Creek on Mass. Audubon land
North Atlantic Fresh Tidal Shrub Swamp	CEGL006337	off Gull Pond Road, Wellfleet
Northern Atlantic Coast Beaked Ditch-grass Bed	CEGL006167	submerged aquatic vegetation appeared as water in aerial photography
North Atlantic Coastal Plain River Brackish Intertidal Mudflat	CEGL004473	along Monomoy River between Chatham and Harwich; possible along Herring and Pamet Rivers and Hatches Creek
Swamp-loosestrife Shrub Swamp	CEGL005089	below mmu; mapped with other shrub swamps in aggregated map class

The final 2004 vegetation map uses aggregated map unit names for each polygon. A summary of the distribution and abundance of the map classes for the entire park is provided in Table 14. A figure of the vegetation map is provided in Figure 5, with more detail provided in Appendix H. USNVC attributions for 492 polygons sampled in accuracy assessment were updated where needed to match the first or second call generated in the accuracy assessment data. Polygons sampled in vegetation plot sampling were also confirmed to match the USNVC attributions. These data are provided as point shapefiles with the final deliverables.

The final 2004 vegetation map consists of twenty-nine vegetation map classes and three Anderson Level II categories (modified). The vegetation and land cover of Cape Cod National Seashore was divided into a total of 3,340 polygons in the map classes described above. Many of the polygons are smaller than the standard NPS Vegetation Mapping Program minimum map unit (mmu) size of 0.5 ha (1.2 ac) because the original linework was done prior to the establishment of the standard.

Metadata for the vegetation association shapefile, the plot location shapefile, the accuracy assessment sampling point location shapefile, and the digital photomosaic were prepared according to Federal Geographic Data Committee standards and have been provided as deliverables with this report.

Vegetation Association Descriptions

Detailed local descriptions for the 70 vegetation associations were written based on the plot, accuracy assessment data, and the ecologists' field experiences at Cape Cod National Seashore. Sixty-one associations are mapped and aggregated into 29 map classes (Table 12 and Table 14). Nine are not mapped because seven occur just outside the park boundary, one consists of submerged aquatic vegetation (Northern Atlantic Coast Beaked Ditch-grass Bed), and one (Swamp-loosestrife Shrub Swamp) occurs as a small patch inclusion and could not be teased out from surrounding matrix vegetation associations on the map (Table 13). Detailed local and global descriptions of the vegetation associations are presented. Representative photographs of most vegetation types are provided after each description. An index to these photos is provided in Appendix I. Definitions of the data fields, data codes and abbreviations in the global and loal vegetation descriptions are provided in Appendix J. A bibliography for the sources cited in the global vegetation descriptions from the USNVC is provided in Appendix K.

Vascular plant species nomenclature within the local and global descriptions follows the nationally standardized list of Kartesz (1999), with very few exceptions. This nomenclature differs from PLANTS 3.5 in only a very few cases, and when this difference occurs, synonymy is indicated parenthetically in the local description information. English names for associations and alliances use NatureServe Central Ecology-accepted names and may differ slightly from PLANTS 3.5 common names that are used within the local description information and throughout the rest of the report. A total of 460 plant species were recorded in the vegetation plots and accuracy assessment points. A complete list of the scientific names, common names and family for the vascular plant species identified during this project is included in Appendix D. No state-listed or federally listed plants species were encountered in or near the vegetation plots; however, this project was not intended to include a full floristic survey of the park.

Table 14. Number of polygons and total mapped hectares for aggregated vegetation classes and Anderson Level II categories (modified) at Cape Cod National Seashore in the final 2004 vegetation map.

Aggregated Map Class or Anderson Level II Category (modified)	Number of Polygons	Mapped Hectares
Beach	68	670.6
Beachgrass Dune	252	1,332.7
Black Locust	61	54.0
Bog	5	11.0
Buttonbush	4	1.0
Cattail Marsh	118	136.8
Cedar Swamp	1	4.3
Coastal Marsh	4	1.8
Coastal Plain Pondshore	106	216.0
Cranberry Swale	158	25.1
Developed	311	527.0
Disturbed	39	82.7
Dune Pine Forest	266	508.0
Dune Shrub	293	178.7
Fen	2	0.4
Freshwater Marsh	2	0.4
Heathland / Grassland	201	278.9
Mixed Forest	187	2,385.3
Oak / Beech Forest	242	836.1
Old Field	10	22.4
Open Water	4	12.7
Phragmites	81	51.2
Pitch Pine Barrens	199	1,678.6
Red Cedar	30	98.3
Red Maple Swamp	117	172.0
Salt Marsh	231	887.2
Salt Shrub	14	12.5
Scrub Forest	124	200.3
Scrub Oak	67	212.8
Shrub Swale	4	10.1
Shrub Swamp	119	242.1
Wooded Marsh	20	14.1
Total	3,340	10,865

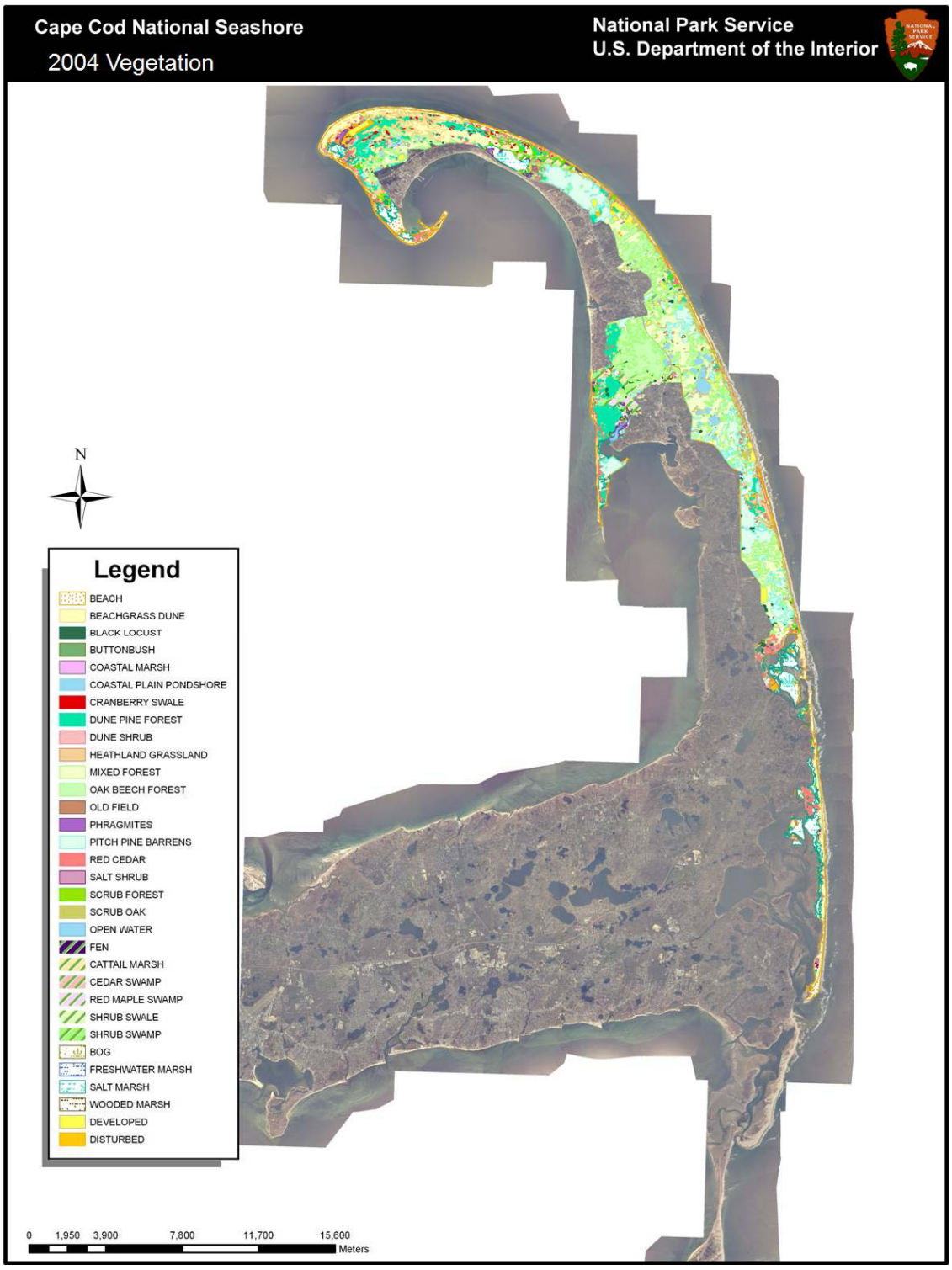


Figure 5. Final 2004 map of aggregated vegetation classes and Anderson Level II categories (modified) for Cape Cod National Seashore.

A dichotomous key was also developed for these vegetation associations (Appendix E). The dichotomous key should be used in conjunction with the detailed vegetation association descriptions to confirm that the association selected with the key is appropriate. These tools were used in the thematic accuracy assessment and may be used by park resource managers and others to identify vegetation associations in the park.

Project Deliverables

Products of the vegetation mapping project are shown in Table 15. All products have been delivered to the National Park Service by NatureServe with this report.

Table 15. Summary of products resulting from the Cape Cod National Seashore vegetation classification and mapping project.

Product	FGCD-complaint spatial metadata
Aerial photos, including flight line map and photoindex*	Yes
Photomosaic in digital format	Yes
Annotated field forms with vegetation plot sampling data*	Not applicable
Vegetation plot sampling data in the PLOTS 2.0 database	Not applicable
Differentially corrected GPS locations of vegetation plots	Yes
Annotated field forms with thematic accuracy assessment data*	Not applicable
Thematic accuracy assessment data in the PLOTS 2.0 database	Not applicable
Differentially corrected GPS locations of thematic accuracy assessment sampling points	Yes
Digital photos representative of vegetation types	Not applicable
Final map of vegetation associations as paper copy and in digital format	Yes
Final report as paper copy and in digital format	Not applicable

*Previously delivered and archived at Cape Cod National Seashore.

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COMMON NAME (PARK-SPECIFIC): OLD-FIELD EASTERN RED-CEDAR FOREST

SYNONYMS
USNVC English Name: **Eastern Red-cedar Forest**
USNVC Scientific Name: ***Juniperus virginiana* Forest**
USNVC Identifier: **CEGL006024**

LOCAL INFORMATION

Environmental Description: This association is found on post-agricultural land on outwash deposits and in a narrow band along outwash bluffs, often bordering salt marshes. Soils are sandy and well-drained.

Vegetation Description: Canopy closure and height can be variable, but generally, because most old fields were abandoned many years ago on Cape Cod, the canopy is nearly closed with a height of 5 to 8 meters. Many occurrences may have remnants of dense stands of *Juniperus* (juniper) with dead branches to the ground that are difficult to walk through. *Juniperus virginiana* (eastern redcedar) is always present and at times the only canopy tree. Other canopy species often include *Acer rubrum* (red maple) and *Prunus serotina* (black cherry) and, less frequently, *Pinus rigida* (pitch pine), *Quercus velutina* (black oak), and *Quercus alba* (white oak). Some occurrences may also include *Robinia pseudoacacia* (black locust). Shrubs are often sparse, but often include *Morella pensylvanica* (northern bayberry), *Viburnum recognitum* (=*Viburnum dentatum* var. *lucidum*, southern arrowwood), and *Lonicera morrowii* (Morrow's honeysuckle). Herbs may be very sparse and include *Carex pensylvanica* (Pennsylvania sedge), *Solidago rugosa* (wrinkleleaf goldenrod), and remnants of old-field grasses, including *Dactylis glomerata* (orchardgrass) and *Anthoxanthum odoratum* (sweet vernalgrass).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus virginiana* (eastern redcedar)
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
		Prunus serotina (black cherry)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Lonicera morrowii* (Morrow's honeysuckle)
		Toxicodendron radicans (eastern poison ivy)
		Viburnum recognitum (=*Viburnum dentatum* var. *lucidum*, southern arrowwood)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Morella pensylvanica* (northern bayberry)
Herb (field)	Forb	*Solidago rugosa* (wrinkleleaf goldenrod)
Herb (field)	Graminoid	*Anthoxanthum odoratum* (sweet vernalgrass)
		Carex pensylvanica (Pennsylvania sedge)
		Dactylis glomerata (orchardgrass)

Characteristic Species: *Juniperus virginiana* (eastern redcedar), *Prunus serotina* (black cherry)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNA	NA	NA	[not crosswalked]	Swain and Kearsley 2001

Local Range: This community type is found throughout the seashore along the upland edges of salt marshes, on old agricultural lands, and in small patches on vacant lots.

Classification Comments: The state classification describes natural vegetation communities and does not include semi-natural and cultural vegetation communities. This is a semi-natural forest community and does not receive a state conservation rank in MA

Other Comments: There are many acres of this community type on a golf course abandoned in the 1940s around the Salt Pond Visitors Center and near Fort Hill. Good examples along bluffs occur at Nauset Heights and around Pochet Island in Orleans.
Local Description Authors: R.E. Zaremba
Plots: CACO.083, CACO.114, CACO.115.
AA (2004) Points: CACO.122, CACO.129, CACO.169, CACO.209, CACO.261, CACO.278, CACO.370, CACO.437.
Cape Cod National Seashore Inventory Notes: Mapped in the Red Cedar aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
Formation	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c.)
Alliance	*Juniperus virginiana* Semi-natural Forest Alliance (A.137)
Alliance (English name)	Eastern Red-cedar Forest Alliance
Association	*Juniperus virginiana* Forest
Association (English name)	Eastern Red-cedar Forest
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This association is a broadly defined old-field early-successional community occurring in a variety of environmental settings in the northeastern states. Canopy closure and height are variable, as are shrub and herbaceous associates. *Juniperus virginiana* (eastern redcedar) dominates the canopy layer. Common associates, typically occurring as scattered individuals, may include *Pinus strobus* (eastern white pine), *Acer rubrum* (red maple), *Liriodendron tulipifera* (tuliptree), *Quercus* (oak) spp., and *Prunus serotina* (black cherry). Shrub cover varies, with the most forested stands having little or no shrub cover. Exotic shrubs such as *Elaeagnus umbellata* (autumn olive), *Lonicera morrowii* (Morrow's honeysuckle), *Ligustrum vulgare* (European privet), and *Rosa multiflora* (multiflora rose) are characteristic, along with *Rubus* (blackberry) spp. Herbaceous cover likewise varies. Common species in the more open-canopy stands include old-field denizens such as *Schizachyrium scoparium* (little bluestem), *Festuca rubra* (red fescue), *Anthoxanthum odoratum* (sweet vernalgrass), *Agrostis gigantea* (redtop), *Andropogon virginicus* (broomsedge bluestem), *Elymus repens* (quackgrass), *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago gigantea* (giant goldenrod), *Euthamia graminifolia* (flat-top goldentop), *Monarda fistulosa* (wild bergamot), *Toxicodendron radicans* (eastern poison ivy), *Achillea millefolium* (common yarrow), and *Daucus carota* (Queen Anne's lace). In dense forest stands, herbs may be absent or limited to scattered shade-tolerant species such as *Alliaria petiolata* (garlic mustard) and *Allium vineale* (wild garlic), and *Dennstaedtia punctilobula* (eastern hayscented fern). These forests are often young and result from the colonization of old agricultural fields by *Juniperus virginiana* (eastern redcedar) over native and exotic forbs and grasses. These stands may eventually succeed to other forest types as mid- and late-successional canopy species colonize and subsequently overtop the *Juniperus* (juniper).
Environmental Description: This is a broadly defined old-field early-successional community occurring in a variety of environmental settings, typically on former agricultural land and other

disturbed or degraded environmental settings. Soils are mesic to dry-mesic and moderately well-drained to well-drained.

Vegetation Description: *Juniperus virginiana* (eastern redcedar) dominates the canopy layer in stands of this type, which ranges from broadly spaced woodlands to dense and nearly impenetrable thickets. Common associates, typically occurring as scattered individuals, may include *Pinus strobus* (eastern white pine), *Acer rubrum* (red maple), *Liriodendron tulipifera* (tuliptree), *Quercus* (oak) spp., and *Prunus serotina* (black cherry). Shrub cover varies according to canopy closure, with the most forested stands having little or no shrub cover. Exotic shrubs such as *Elaeagnus umbellata* (autumn olive), *Lonicera morrowii* (Morrow's honeysuckle), *Ligustrum vulgare* (European privet), and *Rosa multiflora* (multiflora rose) are most characteristic, along with *Rubus* (blackberry) spp. Herbaceous cover likewise varies. Common species in the more open-canopy stands include old-field denizens such as *Schizachyrium scoparium* (little bluestem), *Andropogon virginicus* (broomsedge bluestem), *Festuca rubra* (red fescue), *Anthoxanthum odoratum* (sweet vernalgrass), *Agrostis gigantea* (redtop), *Elymus repens* (quackgrass), *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago gigantea* (giant goldenrod), *Euthamia graminifolia* (flat-top goldentop), *Monarda fistulosa* (wild bergamot), *Toxicodendron radicans* (eastern poison ivy), *Achillea millefolium* (common yarrow), and *Daucus carota* (Queen Anne's lace). In dense forest stands, herbs may be absent or limited to scattered shade-tolerant species such as *Alliaria petiolata* (garlic mustard), *Allium vineale* (wild garlic), and *Dennstaedtia punctilobula* (eastern hayscented fern).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus virginiana* (eastern redcedar)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Lonicera morrowii* (Morrow's honeysuckle)
Tall shrub/sapling	Needle-leaved tree	*Juniperus virginiana* (eastern redcedar)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Elaeagnus umbellata* (autumn olive)
Short shrub/sapling	Broad-leaved deciduous shrub	*Rosa multiflora* (multiflora rose)
		Toxicodendron radicans (eastern poison ivy)
Herb (field)	Forb	*Solidago rugosa* (wrinkleleaf goldenrod)
Herb (field)	Graminoid	*Schizachyrium scoparium* (little bluestem)

Characteristic Species: *Elaeagnus umbellata* (autumn olive), *Juniperus virginiana* (eastern redcedar), *Lonicera morrowii* (Morrow's honeysuckle), *Rosa multiflora* (multiflora rose), *Schizachyrium scoparium* (little bluestem), *Solidago rugosa* (wrinkleleaf goldenrod), *Toxicodendron radicans* (eastern poison ivy)

Other Noteworthy Species:

Species	GRank	Type	Note
Achillea millefolium (common yarrow)	-	plant	exotic
Agrostis gigantea (redtop)	-	plant	exotic
Alliaria petiolata (garlic mustard)	-	plant	exotic
Allium vineale (wild garlic)	-	plant	exotic
Anthoxanthum odoratum (sweet vernalgrass)	-	plant	exotic
Daucus carota (Queen Anne's lace)	-	plant	exotic
Elaeagnus umbellata (autumn olive)	-	plant	exotic
Elymus repens (quackgrass)	-	plant	exotic
Lonicera morrowii (Morrow's honeysuckle)	-	plant	exotic
Rosa multiflora (multiflora rose)	-	plant	exotic

USFWS Wetland System: Not applicable

DISTRIBUTION

Range: This association is of broad distribution, occurring widely throughout the northeastern U.S. It has been documented from only a limited range but is undoubtedly more widely distributed.

States/Provinces: MA, NJ, NY, PA, VA, WV

Federal Lands: NPS (Appomattox Court House, Bluestone, Boston Harbor Islands, C&O Canal?, Cape Cod, Delaware Water Gap, Fire Island, Fredericksburg-Spotsylvania, George Washington Birthplace, Richmond); USFS (Monongahela)

CONSERVATION STATUS

Rank: GNA (ruderal) (10-Oct-2001)

Reasons: This forest represents early-successional, modified, or silviculturally managed vegetation and is thus not of high conservation concern and does not receive a conservation status rank. This vegetation may be easily restorable by either management, time, or restoration of ecological processes.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 3 - Weak

Comments: This association is currently very generally defined.

Similar Associations: Information not available.

Related Concepts: Information not available.

SOURCES

Description Authors: L.A. Sneddon, mod. R.E. Zaremba, M. Pyne, S.C. Gawler

References: Clark 1986, Eastern Ecology Working Group n.d., Sneddon and Lundgren 2001, Vanderhorst et al. 2008



Figure 6. Old-field Eastern Red-cedar Forest in Cape Cod National Seashore (plot CACO.083). September 2004. NAD 1983 / UTM easting 419764, northing 4630210.



Figure 7. Old-field Eastern Red-cedar Forest in Cape Cod National Seashore (plot CACO.083). September 2004. NAD 1983 / UTM easting 419764, northing 4630210.

COMMON NAME (PARK-SPECIFIC): COASTAL PLAIN ATLANTIC WHITE-CEDAR SWAMP

SYNONYMS
USNVC English Name: **Atlantic White-cedar / Little Gallberry - Swamp Azalea Forest**
USNVC Scientific Name: ***Chamaecyparis thyoides* / *Ilex glabra* - *Rhododendron viscosum* Forest**
USNVC Identifier: **CEGL006188**

LOCAL INFORMATION

Environmental Description: This association occurs in a depression that intersects groundwater. Soils are deep peats overlying outwash sand and gravel. The substrate is nearly always saturated with standing water at least half of the growing season. There is distinct hummock-and-hollow topography with mosses on high points and black leaf litter in low areas reflecting the presence of pools of water throughout most of the year. The forest is protected from salt spray and wind as a result of its setting in deep basins.
Vegetation Description: The canopy is dominated by *Chamaecyparis thyoides* (Atlantic white cedar) with scattered *Acer rubrum* (red maple). Sections of the occurrence are dense thickets of small-diameter *Chamaecyparis* (cedar) suggesting a disturbance event such as cutting or large-scale dieback that resulted in recruitment. The shrub layer has about 50% cover dominated by *Vaccinium corymbosum* (highbush blueberry) with lower cover of *Leucothoe racemosa* (swamp doghobble), *Clethra alnifolia* (coastal sweetpepperbush), and *Kalmia angustifolia* (sheep laurel). The only herb noted in the occurrence is *Woodwardia virginica* (Virginia chainfern).
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Chamaecyparis thyoides* (Atlantic white cedar)
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Clethra alnifolia* (coastal sweetpepperbush)
		Leucothoe racemosa (swamp doghobble)
		Vaccinium corymbosum (highbush blueberry)
Herb (field)	Fern or fern ally	*Woodwardia virginica* (Virginia chainfern)

Characteristic Species: *Chamaecyparis thyoides* (Atlantic white cedar), *Vaccinium corymbosum* (highbush blueberry)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S2*	B	1	Coastal Atlantic White Cedar Swamp	Swain and Kearsley 2001

Local Range: At Cape Cod National Seashore this community type is found only at the Marconi white-cedar swamp.
Classification Comments: Information not available.
Other Comments: The only occurrence of this association in the seashore occurs at the Marconi white-cedar swamp.
Local Description Authors: R.E. Zaremba
Plots: Motzkin (1991)
AA (2004) Points: CACO.151
Cape Cod National Seashore Inventory Notes: Mapped in the Cedar Swamp aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
Formation	Saturated temperate or subpolar needle-leaved evergreen forest (I.A.8.N.g.)
Alliance	*Chamaecyparis thyoides* Saturated Forest Alliance (A.196)
Alliance (English name)	Atlantic White-cedar Saturated Forest Alliance
Association	*Chamaecyparis thyoides / Ilex glabra - Rhododendron viscosum* Forest
Association (English name)	Atlantic White-cedar / Little Gallberry - Swamp Azalea Forest
Ecological System(s):	Atlantic Coastal Plain Northern Bog (CES203.893). Northern Atlantic Coastal Plain Basin Peat Swamp (CES203.522).

GLOBAL DESCRIPTION

Concept Summary: This Atlantic white-cedar swamp occurs on the northern Coastal Plain and in areas of coastal climate (generally within 25 miles of the ocean) from New Hampshire to Delaware. It occurs in poorly-drained depressions or basins generally overlaying sand and gravel deposits. The canopy is dominated by *Chamaecyparis thyoides* (Atlantic white cedar) or codominated with *Acer rubrum* (red maple). Less frequent canopy associated include *Pinus rigida* (pitch pine), *Nyssa sylvatica* (blackgum), and sometimes *Tsuga canadensis* (eastern hemlock) and *Pinus strobus* (eastern white pine). The shrub layer is very dense and diverse with *Clethra alnifolia* (coastal sweetpepperbush), *Ilex glabra* (inkberry), *Morella pensylvanica* (northern bayberry), *Gaylussacia frondosa* (blue huckleberry), *Leucothoe racemosa* (swamp doghobble), *Rhododendron viscosum* (swamp azalea), *Ilex laevigata* (smooth winterberry), *Ilex verticillata* (common winterberry), *Photinia melanocarpa* (black chokeberry), and *Vaccinium corymbosum* (highbush blueberry). The herbaceous layer tends to be sparse or patchy and limited to sunny openings with *Osmunda cinnamomea* (cinnamon fern), *Thelypteris palustris* (eastern marsh fern), *Woodwardia virginica* (Virginia chainfern), *Woodwardia areolata* (netted chainfern), *Thelypteris simulata* (bog fern), *Gaultheria procumbens* (eastern teaberry), *Drosera* (sundew) spp., *Sarracenia purpurea* (purple pitcherplant), *Pogonia ophioglossoides* (snakemouth orchid), *Mitchella repens* (partridgeberry), *Carex striata* (Walter's sedge), *Carex collinsii* (Collins' sedge), *Carex atlantica* (prickly bog sedge), and *Toxicodendron radicans* (eastern poison ivy). The nonvascular layer includes several species of *Sphagnum* (sphagnum), commonly *Sphagnum fallax* (sphagnum), *Sphagnum flavicomans* (sphagnum), *Sphagnum magellanicum* (Magellan's sphagnum), *Sphagnum pulchrum* (sphagnum), *Sphagnum recurvum* (recurved sphagnum), and *Sphagnum palustre* (prairie sphagnum). Key diagnostic characteristics of this association are its coastal setting and the presence of Coastal Plain species such as *Ilex glabra* (inkberry), *Gaylussacia frondosa* (blue huckleberry), *Morella pensylvanica* (northern bayberry), *Leucothoe racemosa* (swamp doghobble), and *Clethra alnifolia* (coastal sweetpepperbush).

Environmental Description: Generally occurs in basins overlying sand and gravel deposits or occasionally over glacial lake sediments. Water-saturated peat overlies mineral sediments. Standing water is usually present for at least half the growing season. Water and soil are nutrient-poor, especially low in nitrogen and phosphorus, and high in iron.

Vegetation Description: Atlantic white-cedar swamp dominated by *Chamaecyparis thyoides* (Atlantic white cedar) or codominated with *Acer rubrum* (red maple). Less frequent canopy associated include *Pinus rigida* (pitch pine), *Nyssa sylvatica* (blackgum), and sometimes *Tsuga*

canadensis (eastern hemlock) and *Pinus strobus* (eastern white pine). The shrub layer is very dense and diverse with *Clethra alnifolia* (coastal sweetpepperbush), *Ilex glabra* (inkberry), *Morella pensylvanica* (northern bayberry), *Gaylussacia frondosa* (blue huckleberry), *Leucothoe racemosa* (swamp doghobble), *Rhododendron viscosum* (swamp azalea), *Ilex laevigata* (smooth winterberry), *Ilex verticillata* (common winterberry), *Photinia melanocarpa* (black chokeberry), and *Vaccinium corymbosum* (highbush blueberry). The herbaceous layer tends to be sparse or patchy and limited to sunny openings with *Osmunda cinnamomea* (cinnamon fern), *Thelypteris palustris* (eastern marsh fern), *Woodwardia virginica* (Virginia chainfern), *Woodwardia areolata* (netted chainfern), *Thelypteris simulata* (bog fern), *Gaultheria procumbens* (eastern teaberry), *Drosera* (sundew) spp., *Sarracenia purpurea* (purple pitcherplant), *Pogonia ophioglossoides* (snakemouth orchid), *Mitchella repens* (partridgeberry), *Carex striata* (Walter's sedge), *Carex collinsii* (Collins' sedge), *Carex atlantica* (prickly bog sedge), and *Toxicodendron radicans* (eastern poison ivy). The nonvascular layer includes several species of *Sphagnum* (sphagnum), commonly *Sphagnum fallax* (sphagnum), *Sphagnum flavicomans* (sphagnum), *Sphagnum magellanicum* (Magellan's sphagnum), *Sphagnum pulchrum* (sphagnum), *Sphagnum recurvum* (recurved sphagnum), and *Sphagnum palustre* (prairie sphagnum).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Chamaecyparis thyoides* (Atlantic white cedar)
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Clethra alnifolia* (coastal sweetpepperbush)
		Leucothoe racemosa (swamp doghobble)
		Vaccinium corymbosum (highbush blueberry)
Herb (field)	Fern or fern ally	*Osmunda cinnamomea* (cinnamon fern)

Characteristic Species: *Chamaecyparis thyoides* (Atlantic white cedar)

Other Noteworthy Species:

Species	GRank	Type	Note
Narthecium americanum (yellow asphodel)	G2	plant	Federal candidate for listing; imperiled

USFWS Wetland System: Palustrine

DISTRIBUTION

Range: This association occurs on the Atlantic Coastal Plain from Massachusetts to New Jersey.
States/Provinces: CT, DE, MA, NJ:S3, NY, RI
Federal Lands: NPS (Cape Cod)

CONSERVATION STATUS

Rank: G3 (10-Dec-1998)
Reasons: There are an estimated 100–200 occurrences of this community covering perhaps 2500 to 7500 acres rangewide. The range is limited to the Atlantic Coastal Plain from Massachusetts to New Jersey and Delaware. Although naturally limited by the range of Atlantic white-cedar, it is likely that this community has declined from historic abundances as a result of logging.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 2 - Moderate
Comments: Information not available.

Similar Associations:

- *Chamaecyparis thyoides - (Tsuga canadensis, Betula alleghaniensis) / Clethra alnifolia* Forest (CEGL006189)--lacks boreal and coastal plain indicators.
- *Chamaecyparis thyoides - Acer rubrum / Lycopus* spp. Forest (CEGL006364)--Atlantic white-cedar swamps in alluvial settings with robust and diverse herbaceous layer.
- *Chamaecyparis thyoides - Picea rubens / Gaylussacia baccata / Gaultheria hispidula* Forest (CEGL006363)--distinguished by presence of boreal species.
- *Chamaecyparis thyoides / Rhododendron maximum* Forest (CEGL006355)--distinguished by dense *Rhododendron maximum* in shrub layer.

Related Concepts:

- *Chamaecyparis thyoides - Vaccinium corymbosum* community (Metzler and Barrett 1992) ?
- *Chamaecyparis thyoides/Rhododendron viscosum* (Type 4) (Sperduto and Crowley 2002b) =
- *Chamaecyparis thyoides/Rhododendron viscosum* Forest (Barrett 1996) ?
- Coastal Atlantic white cedar type (Motzkin 1991) =
- Coastal Plain Atlantic White Cedar Swamp (Breden 1989) B
- Coastal plain Atlantic white cedar swamp (Reschke 1990) ?
- SNE basin swamp, coastal Atlantic white cedar association (Rawinski 1984) B

SOURCES

Description Authors: S.L. Neid

References: Barrett 1996, Bowman 2000, Breden 1989, Breden et al. 2001, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Laderman 1989, McCormick 1979, Metzler and Barrett 1992, Metzler and Barrett 2001, Motzkin 1991, Olsson 1979, Rawinski 1984, Reschke 1990, Sperduto 2000b, Sperduto and Crowley 2002b, Swain and Kearsley 2001



Figure 8. Coastal Plain Atlantic White-cedar Swamp in Cape Cod National Seashore (AA point CACO.151). September 2004. NAD 1983 / UTM easting 418572, northing 4640427.



Figure 9. Coastal Plain Atlantic White-cedar Swamp in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 418719, northing 4640426.

COMMON NAME (PARK-SPECIFIC): NORTHEASTERN ATLANTIC COASTAL OAK - BEECH FOREST

SYNONYMS
USNVC English Name: **American Beech - White Oak - Northern Red Oak Forest**
USNVC Scientific Name: ***Fagus grandifolia* - *Quercus alba* - *Quercus* rubra Forest**
USNVC Identifier: **CEGL006377**

LOCAL INFORMATION

Environmental Description: This association occurs on very old sand dune deposits that have not been tilled or grazed for long periods of time. Soils have developed over several thousand years and are sandy loam with a well-developed podzolic layer. Topography follows old dunes and can be very irregular and steep. The leaf litter is deep.
Vegetation Description: This well-developed coastal forest is dominated by *Fagus grandifolia* (American beech) with *Acer rubrum* (red maple), *Quercus velutina* (black oak), and *Quercus alba* (white oak). Subdominants include *Pinus rigida* (pitch pine), *Nyssa sylvatica* (blackgum), and *Sassafras albidum* (sassafras). *Amelanchier canadensis* (Canadian serviceberry) occurs in the understory. The shrub layer is primarily made up of *Viburnum recognitum* (=*Viburnum dentatum* var. *lucidum*, southern arrowwood) and *Gaylussacia baccata* (black huckleberry). *Gaultheria procumbens* (eastern teaberry) is also common. There are few herbs, but *Aralia nudicaulis* (wild sarsaparilla), *Pteridium aquilinum* (western brackenfern), *Epifagus virginiana* (beechdrops), and *Trientalis borealis* (starflower) are common.
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus rigida* (pitch pine)
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
		Fagus grandifolia (American beech)
		Nyssa sylvatica (blackgum)
		Quercus alba (white oak)
		Quercus velutina (black oak)
Tree subcanopy	Broad-leaved deciduous tree	*Amelanchier canadensis* (Canadian serviceberry)
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
		Viburnum recognitum (=*Viburnum dentatum* var. *lucidum*, southern arrowwood)
Short shrub/sapling	Broad-leaved evergreen shrub	*Gaultheria procumbens* (eastern teaberry)

Characteristic Species: *Fagus grandifolia* (American beech), *Gaultheria procumbens* (eastern teaberry)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S3*	B	1	Coastal Forest/Woodland	Swain and Kearsley 2001

Local Range: This association is known only within Cape Cod National Seashore in the Provincelands.
Classification Comments: Information not available.
Other Comments: This association is the primary forest type at the "Beech Forest" in the Provincelands. It also occurs in very small patches along Route 6 near Snail Road, near Whistlestop Woods and the water tower, and in sections of the forest north of Clapps Pond.
Local Description Authors: R.E. Zaremba

Plots: None
AA (2004) Points: CACO.231.
Cape Cod National Seashore Inventory Notes: Mapped in the Oak Beech Forest aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	*Fagus grandifolia - Quercus rubra - Quercus alba* Forest Alliance (A.229)
Alliance (English name)	American Beech - Northern Red Oak - White Oak Forest Alliance
Association	*Fagus grandifolia - Quercus alba - Quercus rubra* Forest
Association (English name)	American Beech - White Oak - Northern Red Oak Forest
Ecological System(s):	Northern Atlantic Coastal Plain Hardwood Forest (CES203.475).

GLOBAL DESCRIPTION

Concept Summary: This association comprises coastal oak-beech forests of the north Atlantic coast and occurs on dry well-drained, loamy sand of morainal coves. It has a mixed canopy of *Fagus grandifolia* (American beech), *Quercus alba* (white oak), and *Quercus velutina* (black oak) in varying proportions. *Quercus rubra* (northern red oak) is a common associate, although it never occurs in abundance. Occasional canopy associates that occur with low cover can include *Quercus coccinea* (scarlet oak), *Quercus prinus* (chestnut oak), *Acer saccharum* (sugar maple), and *Betula papyrifera* (paper birch) (the latter two species are only occasionally present). There are relatively few shrubs and the herb layer includes tree seedlings, especially of *Quercus* (oak) spp. and *Fagus grandifolia* (American beech), plus *Carex swanii* (Swan's sedge), *Maianthemum canadense* (Canada mayflower), *Eurybia divaricata* (white wood aster), *Epifagus virginiana* (beechdrops), and *Maianthemum racemosum* (feathery false lily of the valley). This community is related to oak-beech Coastal Plain forests of this alliance in southern New Jersey and farther south, but is differentiated from them by the presence of *Quercus rubra* (northern red oak), *Betula papyrifera* (paper birch), and *Acer saccharum* (sugar maple), and by the absence of *Liriodendron tulipifera* (tuliptree).
Environmental Description: These forests occur on dry well-drained, loamy sand of morainal coves.
Vegetation Description: This coastal oak-beech forest has a mixed canopy of *Fagus grandifolia* (American beech), *Quercus alba* (white oak), and *Quercus velutina* (black oak) in varying proportions. *Quercus rubra* (northern red oak) is a common associate, although it never occurs in abundance. Occasional canopy associates that occur with low cover can include *Quercus coccinea* (scarlet oak), *Quercus prinus* (chestnut oak), *Acer saccharum* (sugar maple), and *Betula papyrifera* (paper birch). There are relatively few shrubs and the herb layer includes tree seedlings, especially of *Quercus* (oak) spp. and *Fagus grandifolia* (American beech), plus *Carex swanii* (Swan's sedge), *Maianthemum canadense* (Canada mayflower), *Eurybia divaricata* (white wood aster), *Epifagus virginiana* (beechdrops), and *Maianthemum racemosum* (feathery false lily of the valley).

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Fagus grandifolia* (American beech) *Quercus alba* (white oak)
Tree canopy	Broad-leaved deciduous tree	*Quercus velutina* (black oak)
Tree subcanopy	Broad-leaved deciduous tree	*Quercus velutina* (black oak)
Short shrub/sapling	Broad-leaved deciduous shrub	*Fagus grandifolia* (American beech) *Quercus alba* (white oak)
Herb (field)	Forb	*Eurybia divaricata* (white wood aster)

Characteristic Species: *Fagus grandifolia* (American beech), *Quercus alba* (white oak), *Quercus velutina* (black oak)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable

DISTRIBUTION
Range: These forests occur along the north Atlantic coast in Massachusetts, New York, New Jersey, and possibly Rhode Island.
States/Provinces: MA, NJ:S2, NY, RI?
Federal Lands: NPS (Cape Cod)

CONSERVATION STATUS
Rank: GNR (1-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: This association is the northern analog of *Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / (Ilex opaca var. opaca) / Polystichum acrostichoides* Forest (CEGL006075), although there is some overlap of the geographic range of these types in New Jersey. This association is differentiated by the presence of *Quercus rubra* (northern red oak), *Acer saccharum* (sugar maple), and *Betula papyrifera* (paper birch) on Long Island, New York; on Cape Cod, the presence of *Fagus grandifolia* (American beech) indicates this type. *Quercus rubra - Acer saccharum - Liriodendron tulipifera* Forest (CEGL006125) is an analogous inland type.
Similar Associations:
- *Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / (Ilex opaca var. opaca) / Polystichum acrostichoides* Forest (CEGL006075)
- *Quercus rubra - Acer saccharum - Liriodendron tulipifera* Forest (CEGL006125)

Related Concepts:
- Beech forest (Godfrey et al. 1978) ?
- CNE Mesic hardwood Forest on acidic bedrock / till (Rawinski 1984) ?
- Maritime forest (Rawinski 1984) ?
- Mesic Coastal Plain mixed oak forest, mixed oak-beech subtype (Breden 1989) ?
- Mixed Mesophytic Forest (Greller 1977) ?
- Southern New England oak / pine forest on sandy / gravelly soils (Rawinski 1984) ?

SOURCES
Description Authors: S.L. Neid and L.A. Sneddon
References: Breden 1989, Breden et al. 2001, Eastern Ecology Working Group n.d., Edinger et al. 2002, Godfrey et al. 1978, Greller 1977, Greller et al. 1978, Hunt 1997a, Metzler and Barrett 2001, Rawinski 1984, Swain and Kearsley 2001



Figure 10. Northeastern Atlantic Coastal Oak - Beech Forest in Cape Cod National Seashore (AA point CACO.231). September 2007. NAD 1983 / UTM easting 400774, northing 4658148.

COMMON NAME (PARK-SPECIFIC): NORTHERN TALL MARITIME SHRUBLAND

SYNONYMS

USNVC English Name: **Canada Serviceberry - Viburnum species - Northern Bayberry Scrub Forest**

USNVC Scientific Name: ***Amelanchier canadensis* - *Viburnum* spp. - *Morella pensylvanica* Scrub Forest**

USNVC Identifier: **CEGL006379**

LOCAL INFORMATION

Environmental Description: This association occurs at former agricultural sites on sandy loam soils. It is densely vegetated and difficult to walk through.

Vegetation Description: This tall, dense shrubland is highly variable, but usually dominated by *Prunus serotina* (black cherry) and *Amelanchier canadensis* (Canadian serviceberry). The canopy may also include *Pinus rigida* (pitch pine), *Quercus velutina* (black oak), *Quercus alba* (white oak), and *Robinia pseudoacacia* (black locust). The principal shrub is *Viburnum recognitum* (=*Viburnum dentatum* var. *lucidum*, southern arrowwood). Other common shrubs include *Photinia melanocarpa* (black chokeberry), *Gaylussacia baccata* (black huckleberry), *Morella pensylvanica* (northern bayberry), and *Spiraea alba var. latifolia* (white meadowsweet). Weedy species may be abundant, including *Lonicera morrowii* (Morrow's honeysuckle) and *Rosa multiflora* (multiflora rose). Vines are also present, including *Toxicodendron radicans* (eastern poison ivy), *Parthenocissus quinquefolia* (Virginia creeper), and *Smilax rotundifolia* (roundleaf greenbrier). Herbs are moderately abundant and highly variable, usually reflecting past old-field conditions.

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Amelanchier canadensis* (Canadian serviceberry)
		Prunus serotina (black cherry)
Short shrub/sapling	Broad-leaved deciduous shrub	*Lonicera morrowii* (Morrow's honeysuckle)
		Viburnum recognitum (=*Viburnum dentatum* var. *lucidum*, southern arrowwood)
Short shrub/sapling	Broad-leaved evergreen shrub	*Morella pensylvanica* (northern bayberry)

Characteristic Species: *Amelanchier canadensis* (Canadian serviceberry), *Prunus serotina* (black cherry)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S3*	B	1	Maritime Shrubland	Swain and Kearsley 2001

Local Range: This association occurs throughout Cape Cod National Seashore on outwash deposits on abandoned farmland and along the eroded bluffs in Truro.

Classification Comments: This association occurs in two settings within Cape Cod National Seashore: on agricultural land abandoned in the past 50 years and along stabilized outwash deposit bluffs. Many of the sites that support this association may be former pastures. Most occurrences still support weedy, old-field species including grasses, goldenrods, and asters, as well as a broad range of weedy shrubs including *Lonicera morrowii* (Morrow's honeysuckle), *Lonicera japonica* (Japanese honeysuckle), and *Rosa multiflora* (multiflora rose). This association may persist for many years, but likely develops into an oak-dominated community.

Other Comments: Information not available.

Local Description Authors: R.E. Zaremba
Plots: CACO.002, CACO.057.
AA (2004) Points: CACO.108, CACO.180, CACO.183, CACO.220, CACO.227, CACO.266, CACO.282, CACO.284, CACO.299, CACO.315, CACO.327, CACO.343, CACO.360, CACO.380, CACO.391, CACO.423, CACO.425, CACO.447, CACO.449, CACO.462, CACO.480, CACO.487, CACO.498, CACO.509, CACO.535, CACO.552, CACO.580, CACO.611, CACO.1001, CACO.1002, CACO.1004.
Cape Cod National Seashore Inventory Notes: Mapped in the Scrub Forest aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	*Prunus serotina* - *Acer rubrum* - *Amelanchier canadensis* - *Quercus* spp. Forest Alliance (A.237)
Alliance (English name)	Black Cherry - Red Maple - Canada Serviceberry - Oak species Forest Alliance
Association	*Amelanchier canadensis* - *Viburnum* spp. - *Morella pensylvanica* Scrub Forest
Association (English name)	Canada Serviceberry - Viburnum species - Northern Bayberry Scrub Forest
Ecological System(s):	Northern Atlantic Coastal Plain Maritime Forest (CES203.302). Northern Atlantic Coastal Plain Heathland and Grassland (CES203.895).

GLOBAL DESCRIPTION

Concept Summary: This tall maritime shrubland or scrub forest community characteristically replaces maritime forests that have been cleared. The community is variable in composition and generally includes *Amelanchier canadensis* (Canadian serviceberry), *Prunus serotina* (black cherry), *Sassafras albidum* (sassafras), *Nyssa sylvatica* (blackgum), *Acer rubrum* (red maple), *Juniperus virginiana* (eastern redcedar) in the canopy. The oaks *Quercus velutina* (black oak), *Quercus stellata* (post oak), *Quercus alba* (white oak) may or may not be present. The shrubs *Morella pensylvanica* (northern bayberry), *Photinia* (chokeberry) spp., *Viburnum* (viburnum) spp. may form an understory or contribute substantial cover to the canopy. Vines are often prevalent, including *Smilax* (greenbrier) spp., *Vitis* (grape) spp., *Toxicodendron radicans* (eastern poison ivy), *Parthenocissus quinquefolia* (Virginia creeper). The herbaceous layer is generally sparse. These shrublands are usually very dense, and often maintained in their current state by constant winds and salt spray.
Environmental Description: This tall maritime shrubland or scrub forest community characteristically replaces maritime forests that have been cleared. It occurs at former agricultural sites on sandy loam soils. These shrublands are usually very dense and often maintained in their current state by constant winds and salt spray.
Vegetation Description: This tall shrubland community is variable in composition and generally includes *Amelanchier canadensis* (Canadian serviceberry), *Prunus serotina* (black cherry), *Sassafras albidum* (sassafras), *Nyssa sylvatica* (blackgum), *Acer rubrum* (red maple), and *Juniperus virginiana* (eastern redcedar) in the canopy. The oaks *Quercus velutina* (black oak), *Quercus stellata* (post oak), and *Quercus alba* (white oak) may or may not be present. The shrubs *Morella pensylvanica* (northern bayberry), *Photinia* (chokeberry) spp., *Viburnum*

(viburnum) spp., and *Gaylussacia baccata* (black huckleberry) may form an understory or contribute substantial cover to the canopy. Vines are often prevalent, including *Smilax* (greenbrier) spp., *Vitis* (grape) spp., *Toxicodendron radicans* (eastern poison ivy), and *Parthenocissus quinquefolia* (Virginia creeper). The herbaceous layer is generally sparse.

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Amelanchier canadensis* (Canadian serviceberry)
		Prunus serotina (black cherry)
Short shrub/sapling	Broad-leaved deciduous shrub	*Viburnum recognitum* (southern arrowwood)
Short shrub/sapling	Broad-leaved evergreen shrub	*Morella pensylvanica* (northern bayberry)
Short shrub/sapling	Vine/Liana	*Smilax rotundifolia* (roundleaf greenbrier)
		Toxicodendron radicans (eastern poison ivy)

Characteristic Species: *Amelanchier canadensis* (Canadian serviceberry), *Morella pensylvanica* (northern bayberry), *Prunus serotina* (black cherry)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable

DISTRIBUTION
Range: Information not available.
States/Provinces: CT, MA, ME?, NH, NJ, NY, RI
Federal Lands: NPS (Cape Cod, Gateway); USFWS (Nomans Land Island?)

CONSERVATION STATUS
Rank: GNR (1-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: Information not available.
Similar Associations:
- *Prunus serotina - Sassafras albidum - Amelanchier canadensis - Quercus velutina / Smilax rotundifolia* Forest (CEGL006145)

Related Concepts:
- Coastal dune shrubland (Breden 1989) ?
- Coastal dune woodland (Breden 1989) ?
- SNE coastal rocky headland community (Rawinski 1984) ?

SOURCES
Description Authors: L.A. Sneddon
References: Breden 1989, Breden et al. 2001, Eastern Ecology Working Group n.d., Edinger et al. 2002, Metzler and Barrett 2001, NRCS 2001b, Rawinski 1984, Reschke 1990, Swain and Kearsley 2001



Figure 11. Northern Tall Maritime Shrubland in Cape Cod National Seashore (plot CACO.057). September 2007. NAD 1983 / UTM easting 407596, northing 4656522.

COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL MARITIME FOREST

SYNONYMS

USNVC English Name: **Black Cherry - Sassafras - Canada Serviceberry - Black Oak / Roundleaf Greenbrier Forest**

USNVC Scientific Name: ***Prunus serotina* - *Sassafras albidum* - *Amelanchier canadensis* - *Quercus velutina* / *Smilax rotundifolia* Forest**

USNVC Identifier: **CEGL006145**

LOCAL INFORMATION

Environmental Description: This association occurs on old stabilized dunes that are sheltered from salt spray. The canopy is usually salt-pruned and low on the seaward side and well-developed in protected areas.

Vegetation Description: This tall shrubland canopy varies in height from 3 to 8 m depending on topography. Taller examples are well-developed near the coast, but sheltered from direct salt spray. The canopy is dominated by *Amelanchier canadensis* (Canadian serviceberry) and *Prunus serotina* (black cherry). Some examples include high cover of *Sassafras albidum* (sassafras), *Nyssa sylvatica* (blackgum), or *Quercus velutina* (black oak). The shrub layer is variable, but usually well-developed with *Gaylussacia baccata* (black huckleberry), *Viburnum recognitum* (=*Viburnum dentatum* var. *lucidum*, southern arrowwood), *Morella pensylvanica* (northern bayberry), and, occasionally *Ilex glabra* (inkberry). The herbaceous layer is also variable, but often includes *Deschampsia flexuosa* (wavy hairgrass), *Solidago odora* (anisescented goldenrod), *Solidago sempervirens* (seaside goldenrod), *Trientalis borealis* (starflower), *Aralia nudicaulis* (wild sarsaparilla), *Maianthemum canadense* (Canada mayflower), and *Carex pensylvanica* (Pennsylvania sedge). The examples of this association in Cape Cod National Seashore are not weedy.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Amelanchier canadensis* (Canadian serviceberry)
		Prunus serotina (black cherry)
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
		Viburnum recognitum (=*Viburnum dentatum* var. *lucidum*, southern arrowwood)
Short shrub/sapling	Broad-leaved evergreen shrub	*Morella pensylvanica* (northern bayberry)
Herb (field)	Vine/Liana	*Parthenocissus quinquefolia* (Virginia creeper)
		Toxicodendron radicans (eastern poison ivy)
Herb (field)	Forb	*Aralia nudicaulis* (wild sarsaparilla)
		Solidago odora (anisescented goldenrod)
Herb (field)	Graminoid	*Deschampsia flexuosa* (wavy hairgrass)

Characteristic Species: *Amelanchier canadensis* (Canadian serviceberry)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S3*	B	1	Maritime Shrubland	Swain and Kearsley 2001

Local Range: This association is limited to the Provincelands in Cape Cod National Seashore.

Classification Comments: This association at Cape Cod National Seashore is limited to the older dunes in the Provincelands, particularly in the Herring Cove area. This community varies from a dense shrubland to a well-developed forest with an open understory. There are often

remnants of more open conditions, such as *Deschampsia* (hairgrass) and *Solidago odora* (anisescented goldenrod). Conversely, many of the herbs that are usually found in well-developed forests on outwash deposits are also present, including *Maianthemum* (mayflower), *Trientalis* (starflower), and *Aralia* (spikenard). This association differs from the successional maritime forest, *Amelanchier canadensis - Viburnum* spp. - *Morella pensylvanica* (northern bayberry) Scrub Forest (CEGL006379), in that it is not weedy, often has well-developed structure, and supports a well-developed herbaceous layer.
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: CACO.020, CACO.050, CACO.051, CACO.052, CACO.078.
AA (2004) Points: CACO.127, CACO.361, CACO.556
Cape Cod National Seashore Inventory Notes: Photograph not available. Mapped in the Scrub Forest aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	*Prunus serotina - Acer rubrum - Amelanchier canadensis - Quercus* spp. Forest Alliance (A.237)
Alliance (English name)	Black Cherry - Red Maple - Canada Serviceberry - Oak species Forest Alliance
Association	*Prunus serotina - Sassafras albidum - Amelanchier canadensis - Quercus velutina / Smilax rotundifolia* Forest
Association (English name)	Black Cherry - Sassafras - Canada Serviceberry - Black Oak / Roundleaf Greenbrier Forest
Ecological System(s):	Northern Atlantic Coastal Plain Maritime Forest (CES203.302).

GLOBAL DESCRIPTION

Concept Summary: This maritime forest community of the North Atlantic Coast Ecoregion occurs on sheltered backdunes, bluffs, or more interior coastal areas not directly influenced by overwash but affected by salt spray and wind-pruning. Vegetation in these sheltered areas is sometimes referred to as "sunken forest." This name refers to the topographic position of these examples, which are found in large depressions, lower in elevation (by 1–3 m) than the interdunes. These examples are shielded from strong prevailing winds and salt spray, which permits lush growth of broadleaf shrub and vine species. Soils are coarse, well-drained sand subject to considerable shifting during coastal storms, or till and sand deposits of terminal moraines. Physiognomy is variable and ranges from closed-canopy forest to open woodland to dense tall shrubland, and may be more accurately called scrub. Trees found in this community are usually stunted and flat-topped; the canopy may be only 3–7 m tall. Dominant trees vary locally and include *Prunus serotina* (black cherry), *Sassafras albidum* (sassafras), and *Amelanchier canadensis* (Canadian serviceberry), with admixtures of *Celtis occidentalis* (common hackberry), *Quercus velutina* (black oak), *Pinus rigida* (pitch pine), *Juniperus virginiana* (eastern redcedar), *Acer rubrum* (red maple), *Amelanchier stolonifera* (running serviceberry), and in southern occurrences *Quercus coccinea* (scarlet oak), *Quercus falcata* (southern red oak), *Liquidambar styraciflua* (sweetgum), and *Ilex opaca* (American holly).

Additional shrub species may also contribute substantially to the canopy and include *Vaccinium corymbosum* (highbush blueberry), *Morella pensylvanica* (northern bayberry), *Gaylussacia baccata* (black huckleberry), *Viburnum recognitum* (southern arrowwood), *Viburnum dentatum* (southern arrowwood), and *Rosa virginiana* (Virginia rose). A true shrub layer is generally not present. Lianas are common and can be dense in the canopy or the ground layer; species include *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), *Smilax rotundifolia* (roundleaf greenbrier), and *Smilax glauca* (cat greenbrier). The understory is generally sparse with tree or vine seedlings plus herbaceous species, including *Aralia nudicaulis* (wild sarsaparilla), *Moehringia lateriflora* (bluntleaf sandwort), *Maianthemum stellatum* (starry false lily of the valley), and *Maianthemum canadense* (Canada mayflower). Several invasive species can be prevalent in this association, including *Lonicera morrowii* (Morrow's honeysuckle), *Lonicera japonica* (Japanese honeysuckle), *Ligustrum vulgare* (European privet), *Berberis vulgaris* (common barberry), and *Celastrus orbiculatus* (Oriental bittersweet).

Environmental Description: This association occurs most often on stabilized backdunes, generally leeward of secondary dunes or in protected hollows. It also occurs on bluffs or in more interior coastal areas. It is subject to varying degrees of wind and salt spray. Soils are coarse, well-drained sand subject to considerable shifting during coastal storms, or till and sand deposits of terminal moraines.

Vegetation Description: This association is generally a maritime forest or scrub forest, although physiognomy can vary considerably. Trees found in this community are usually stunted and flat-topped; the canopy may be only 3–7 m tall. Dominant trees vary locally but often include *Prunus serotina* (black cherry), *Sassafras albidum* (sassafras), and *Amelanchier canadensis* (Canadian serviceberry), with admixtures of *Celtis occidentalis* (common hackberry), *Quercus velutina* (black oak), *Pinus rigida* (pitch pine), *Juniperus virginiana* (eastern redcedar), *Acer rubrum* (red maple), *Amelanchier stolonifera* (running serviceberry), and in southern occurrences *Quercus coccinea* (scarlet oak), *Quercus falcata* (southern red oak), *Liquidambar styraciflua* (sweetgum), and/or *Ilex opaca* (American holly). Additional shrub species may also contribute substantially to the canopy and include *Vaccinium corymbosum* (highbush blueberry), *Morella pensylvanica* (northern bayberry), *Gaylussacia baccata* (black huckleberry), *Prunus maritima* (beach plum), *Viburnum recognitum* (southern arrowwood), *Viburnum dentatum* (southern arrowwood), and *Rosa virginiana* (Virginia rose). A true shrub layer is generally not present. Lianas are common and can be dense in the canopy or in the ground layer; species include *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), *Smilax rotundifolia* (roundleaf greenbrier), and *Smilax glauca* (cat greenbrier). The understory is generally sparse with tree or vine seedlings plus herbaceous species, including *Aralia nudicaulis* (wild sarsaparilla), *Moehringia lateriflora* (bluntleaf sandwort), *Maianthemum stellatum* (starry false lily of the valley) and *Maianthemum canadense* (Canada mayflower). Several invasive species can be prevalent in this association, including *Lonicera morrowii* (Morrow's honeysuckle), *Lonicera japonica* (Japanese honeysuckle), *Ligustrum vulgare* (European privet), *Berberis vulgaris* (common barberry), and *Celastrus orbiculatus* (Oriental bittersweet).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Amelanchier canadensis* (Canadian serviceberry)
		Prunus serotina (black cherry)
		Quercus velutina (black oak)
		Sassafras albidum (sassafras)
Shrub/sapling (tall & short)	Vine/Liana	*Parthenocissus quinquefolia* (Virginia creeper)
		Smilax rotundifolia (roundleaf greenbrier)
		Toxicodendron radicans (eastern poison ivy)

Characteristic Species: *Amelanchier canadensis* (Canadian serviceberry), *Ilex opaca* (American holly), *Parthenocissus quinquefolia* (Virginia creeper), *Prunus serotina* (black cherry), *Quercus velutina* (black oak), *Sassafras albidum* (sassafras), *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable

DISTRIBUTION
Range: The range of this community (estimated at 400 square km) is from southern New Hampshire to Delaware but is restricted to the coast.

States/Provinces: CT, DE, MA, ME?, NH, NJ:S1S2, NY, RI
Federal Lands: NPS (Boston Harbor Islands, Cape Cod, Fire Island, Gateway); USFWS (Parker River, Prime Hook)

CONSERVATION STATUS
Rank: G2G3 (31-Jan-2007)
Reasons: This maritime forest community is restricted in range to the coastal areas of seven northeastern states. Average occurrence size is estimated to be 20–100 acres, but many are substantially below this in size. The potential habitat of this community is naturally restricted to areas directly affected by maritime processes, e.g., salt spray and winds. Northeastern coastal areas in general are under significant threat from housing development.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: *Prunus serotina / Morella cerifera / Smilax rotundifolia* Scrub Forest (CEGL006319) is the southern analog of this association and is differentiated by having species of more southern affinity such as *Morella cerifera* (wax myrtle) and *Pinus taeda* (loblolly pine). This association is floristically similar to *Amelanchier canadensis* - *Viburnum* spp. - *Morella pensylvanica* (northern bayberry) Scrub Forest (CEGL006379), which is a successional type.
Similar Associations:
- *Amelanchier canadensis* - *Viburnum* spp. - *Morella pensylvanica* Scrub Forest (CEGL006379)
- *Prunus serotina / Morella cerifera / Smilax rotundifolia* Scrub Forest (CEGL006319)

Related Concepts:
- Dune woodland/dune shrubland (Breden 1989) ?
- High dune thicket (Martin 1959b) F
- High mesic thicket (Martin 1959b) I
- High xeric thicket (Martin 1959b) F
- Maritime Forest, Dune Subtype, Deciduous Forest (Rawinski 1984) ?
- Oak-Mixed Shrub-Herb Forest (Greller 1977) I
- SNE Maritime Forest on Dunes/Maritime Juniper Forest (Rawinski 1984) ?
- SNE Maritime Forest on Uplands/Maritime Oak Forest (Rawinski 1984) ?
- SNE coastal rocky headland community (Rawinski 1984) ?
- Scrub Forest (McDonnell 1979) ?
- Southern New England forest on dunes (Rawinski 1984) ?
- Tall thicket (Dunlop and Crow 1985) ?

SOURCES
Description Authors: S.L. Neid and L.A. Sneddon, mod. E. Largay

References: Art 1987, Bellis 1992, Breden 1989, Breden et al. 2001, Burk 1968, Dowhan and Rozsa 1989, Dunlop and Crow 1985, Eastern Ecology Working Group n.d., Edinger et al. 2002, Greller 1977, Martin 1959b, McDonnell 1979, Metzler and Barrett 2001, NRCS 2001b, Rawinski 1984, Reschke 1990, Sperduto 1997b, Stalter 1979, Svenson 1970, Swain and Kearsley 2001

COMMON NAME (PARK-SPECIFIC): NORTHEASTERN DRY OAK - HICKORY FOREST

SYNONYMS
USNVC English Name: **(White Oak, Northern Red Oak, Black Oak) / Flowering Dogwood / Mapleleaf Viburnum Forest**
USNVC Scientific Name: ***Quercus* (*alba, rubra, velutina*) / *Cornus florida* / *Viburnum acerifolium* Forest**
USNVC Identifier: **CEGL006336**

LOCAL INFORMATION

Environmental Description: This association occurs on well-drained sandy loam on outwash deposits that have not been tilled. Soils are well-developed. The one occurrence included in this study is outside Cape Cod National Seashore, but very nearby on a small island in a salt marsh. Salt spray has pruned off the windward borders of the canopy.
Vegetation Description: The canopy is dominated by *Carya alba* (mockernut hickory), *Sassafras albidum* (sassafras), *Quercus alba* (white oak), and *Quercus velutina* (black oak). Understory trees include *Amelanchier canadensis* (Canadian serviceberry) and *Prunus serotina* (black cherry). The moderately dense shrub layer is dominated by *Viburnum recognitum* (=*Viburnum dentatum* var. *lucidum*, southern arrowwood) and *Lonicera morrowii* (Morrow's honeysuckle). *Gaylussacia baccata* (black huckleberry), *Vaccinium pallidum* (Blue Ridge blueberry) and *Vaccinium angustifolium* (lowbush blueberry) are locally abundant. Vines, *Parthenocissus quinquefolia* (Virginia creeper) and *Vitis labrusca* (fox grape) are common. Herbs are abundant and include *Carex pensylvanica* (Pennsylvania sedge), *Polygonatum biflorum* (smooth Solomon's seal), *Pteridium aquilinum* (western brackenfern), *Aralia nudicaulis* (wild sarsaparilla), and *Symphyotrichum undulatum* (waxyleaf aster).
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Carya alba* (mockernut hickory)
		Quercus alba (white oak)
		Quercus velutina (black oak)
Tree subcanopy	Broad-leaved deciduous tree	*Amelanchier canadensis* (Canadian serviceberry)
		Sassafras albidum (sassafras)
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
		Viburnum recognitum (=*Viburnum dentatum* var. *lucidum*, southern arrowwood)
Herb (field)	Forb	*Aralia nudicaulis* (wild sarsaparilla)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)

Characteristic Species: *Amelanchier canadensis* (Canadian serviceberry), *Carya alba* (mockernut hickory)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S4*	B	1	Oak - Hickory Forest	Swain and Kearsley 2001

Local Range: This association is not known from within Cape Cod National Seashore, but is present on Try Island on the Massachusetts Audubon Sanctuary in Wellfleet.
Classification Comments: Information not available.
Other Comments: Information not available.

Local Description Authors: R.E. Zaremba
Plots: CACO.124 (outside CACO boundary)
AA (2004) Points: None.
Cape Cod National Seashore Inventory Notes: Photograph not available.

GLOBAL INFORMATION

USNVC 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	*Quercus alba - (Quercus rubra, Carya* spp.) Forest Alliance (A.239)
Alliance (English name)	White Oak - (Northern Red Oak, Hickory species) Forest Alliance
Association	*Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest
Association (English name)	(White Oak, Northern Red Oak, Black Oak) / Flowering Dogwood / Mapleleaf Viburnum Forest
Ecological System(s):	Northeastern Interior Dry-Mesic Oak Forest (CES202.592).

GLOBAL DESCRIPTION

Concept Summary: This oak-hickory forest occurs on well-drained loamy sand of midslopes in the northeastern United States. This vegetation is ecologically transitional between dry-rich oak-hickory forests of relatively high diversity and dry, acidic oak species-poor forests. *Quercus rubra* (northern red oak), *Quercus alba* (white oak), and *Quercus velutina* (black oak) are prominent in the canopy. *Quercus prinus* (chestnut oak) and *Quercus coccinea* (scarlet oak) are canopy associates in the southern portion of the range. Typical hickory species include *Carya glabra* (pignut hickory), *Carya ovata* (shagbark hickory), *Carya alba* (mockernut hickory), and *Carya ovalis* (red hickory). Other canopy associates may include *Acer rubrum* (red maple), *Sassafras albidum* (sassafras), and *Amelanchier arborea* (common serviceberry). At the northern range limit of this type, *Pinus strobus* (eastern white pine) and *Betula lenta* (sweet birch) also occur as minor associates. *Cornus florida* (flowering dogwood) is a characteristic understory tree in portions of the range. The shrub layer is characterized by *Viburnum acerifolium* (mapleleaf viburnum), with other frequent associates including *Hamamelis virginiana* (American witchhazel), *Vaccinium corymbosum* (highbush blueberry), *Corylus cornuta* (beaked hazelnut), and *Corylus americana* (American hazelnut). A dwarf-shrub layer may be common, but is generally not abundant, and is characterized by *Vaccinium pallidum* (Blue Ridge blueberry) and *Gaylussacia baccata* (black huckleberry), with *Vaccinium angustifolium* (lowbush blueberry) occurring more frequently to the north. The herbaceous layer is characterized by *Carex pensylvanica* (Pennsylvania sedge), *Carex rosea* (rosy sedge), *Maianthemum racemosum* (feathery false lily of the valley), *Aralia nudicaulis* (wild sarsaparilla), *Hieracium venosum* (rattlesnakeweed), *Solidago bicolor* (white goldenrod), *Desmodium glutinosum* (pointedleaf ticktrefoil), *Desmodium paniculatum* (panicledleaf ticktrefoil), *Melampyrum lineare* (narrowleaf cowwheat), *Chimaphila maculata* (striped prince's pine), *Eurybia divaricata* (white wood aster), *Danthonia spicata* (poverty oatgrass), *Aureolaria* (false foxglove) spp., *Pteridium aquilinum* (western brackenfern), *Dennstaedtia punctilobula* (eastern hayscented fern), and *Helianthemum canadense* (longbranch frostweed).
Environmental Description: This forest type occurs on well-drained loamy sand of midslopes and other dry-mesic sites.

Vegetation Description: This vegetation is ecologically transitional between dry-rich oak-hickory forests of relatively high diversity and dry, acidic oak-species-poor forests. *Quercus rubra* (northern red oak), *Quercus alba* (white oak), and *Quercus velutina* (black oak) are prominent in the canopy. Typical hickory species include *Carya glabra* (pignut hickory), *Carya ovata* (shagbark hickory), *Carya alba* (mockernut hickory), and *Carya ovalis* (red hickory). Other canopy associates may include *Acer rubrum* (red maple), *Quercus prinus* (chestnut oak), *Sassafras albidum* (sassafras), and *Amelanchier arborea* (common serviceberry). *Pinus strobus* (eastern white pine), *Tsuga canadensis* (eastern hemlock), and *Betula lenta* (sweet birch) may also occur as minor associates. *Cornus florida* (flowering dogwood) is a characteristic understory tree in portions of the range. The shrub layer is typically rather sparse and characterized by *Viburnum acerifolium* (mapleleaf viburnum), with other frequent associates including *Hamamelis virginiana* (American witchhazel), *Vaccinium corymbosum* (highbush blueberry), *Kalmia latifolia* (mountain laurel), *Corylus cornuta* (beaked hazelnut), and *Corylus americana* (American hazelnut). A dwarf-shrub layer may be common but generally not abundant, characterized by *Vaccinium pallidum* (Blue Ridge blueberry) and *Gaylussacia baccata* (black huckleberry), with *Vaccinium angustifolium* (lowbush blueberry) occurring more frequently to the north. The herbaceous layer is characterized by *Carex pensylvanica* (Pennsylvania sedge), *Maianthemum racemosum* (feathery false lily of the valley), *Dryopteris marginalis* (marginal woodfern), *Aralia nudicaulis* (wild sarsaparilla), *Hieracium venosum* (rattlesnakeweed), *Solidago bicolor* (white goldenrod), *Desmodium glutinosum* (pointedleaf ticktrefoil), *Desmodium paniculatum* (panicledleaf ticktrefoil), *Melampyrum lineare* (narrowleaf cowwheat), *Chimaphila maculata* (striped prince's pine), *Eurybia divaricata* (white wood aster), *Danthonia spicata* (poverty oatgrass), *Deschampsia flexuosa* (wavy hairgrass), *Dennstaedtia punctilobula* (eastern hayscented fern), *Aureolaria* (false foxglove) spp., *Pteridium aquilinum* (western brackenfern), *Dennstaedtia punctilobula* (eastern hayscented fern), and *Helianthemum canadense* (longbranch frostweed). The invasive species *Microstegium vimineum* (Nepalese browntop) and *Berberis thunbergii* (Japanese barberry) may also be present in this forest type.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus alba* (white oak)
		Quercus prinus (chestnut oak)
		Quercus rubra (northern red oak)
		Quercus velutina (black oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	*Cornus florida* (flowering dogwood)
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)

Characteristic Species: *Aralia nudicaulis* (wild sarsaparilla), *Carex pensylvanica* (Pennsylvania sedge), *Carya alba* (mockernut hickory), *Carya glabra* (pignut hickory), *Carya ovalis* (red hickory), *Cornus florida* (flowering dogwood), *Gaylussacia baccata* (black huckleberry), *Maianthemum racemosum* (feathery false lily of the valley), *Quercus prinus* (chestnut oak), *Vaccinium pallidum* (Blue Ridge blueberry), *Viburnum acerifolium* (mapleleaf viburnum)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable

DISTRIBUTION

Range: This association occurs from Maine to Maryland.

States/Provinces: CT, DE:S3?, MA, MD, ME, NH, NJ:S4S5, NY, PA, RI, VT

Federal Lands: NPS (Boston Harbor Islands, Cape Cod, Delaware Water Gap, Fort Necessity, Gettysburg, Minute Man, Morristown, Sagamore Hill, Saratoga, Upper Delaware, Weir Farm); USFWS (Assabet River, Great Meadows)

CONSERVATION STATUS

Rank: G4G5 (24-Jan-2005)

Reasons: This type is not naturally rare and has a wide geographic distribution. Mature stands, however, are uncommon and most stands are subject to logging disturbances or even complete destruction if located in rapidly developing suburban areas.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: Information not available.

Similar Associations:

- *Acer saccharum - Betula alleghaniensis - Quercus rubra / Viburnum acerifolium* Forest (CEGL006943)
- *Carya (glabra, ovata) - Fraxinus americana - Quercus* spp. Forest (CEGL006236)
- *Pinus strobus - Quercus (rubra, velutina) - Fagus grandifolia* Forest (CEGL006293)--can intergrade with this type in New England but is characterized by *Fagus grandifolia* (more or less absent in CEGL006336), a greater amount of *Pinus strobus* in the canopy (usually >20%), and little or no *Carya*.
- *Quercus alba - Quercus rubra - Carya (alba, ovata) / Cornus florida* Acidic Forest (CEGL002067)--also contains *Actaea racemosa* and can occur on cherty limestone, and *Quercus velutina* is not characteristic.
- *Quercus alba - Quercus rubra - Carya alba / Cornus florida / Vaccinium stamineum / Desmodium nudiflorum* Piedmont Forest (CEGL008475)--southern analogue of CEGL006336; is more diverse and occupies soils with slightly higher base status. *Quercus velutina* is not as characteristic of this type. A number of southern herbs such as *Aristolochia serpentaria* are not found in CEGL006336; northern species such as *Corylus cornuta, Vaccinium angustifolium,* and *Aralia nudicaulis* are not found in CEGL008475.
- *Quercus coccinea - Quercus velutina / Sassafras albidum / Vaccinium pallidum* Forest (CEGL006375)--lacks *Viburnum acerifolium* and *Cornus florida* and in general is less diverse and occurring on relatively more nutrient-poor soils.
- *Quercus prinus - Quercus (rubra, velutina) / Vaccinium angustifolium* Forest (CEGL006282)
- *Quercus velutina - Quercus alba - Carya (glabra, ovata)* Forest (CEGL002076)--also contains *Quercus ellipsoidalis* or *Quercus macrocarpa* and is of shorter stature and more open canopy.
- *Quercus velutina / Carex pensylvanica* Forest (CEGL002078)--is drier and more infertile, and lacks *Viburnum acerifolium, Hamamelis virginiana,* and other shrubs.

Related Concepts:

- *Quercus (alba, rubra, velutina) / Cornus florida - Viburnum acerifolium* Forest (Bartgis 1986) =
- *Quercus alba - Quercus coccinea - Carya glabra / Cornus florida / Viburnum acerifolium* Forest (VDNH 2003) =
- Mesic Coastal Plain mixed oak forest (Breden 1989) ?
- SNE mesic central hardwood forest on acidic till (Rawinski 1984) ?

SOURCES

Description Authors: S.L. Neid and L.A. Sneddon, mod. S.C. Gawler

References: Bartgis 1986, Berdine 1998, Breden 1989, Breden et al. 2001, Clancy 1996, Damman 1977, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fike 1999, Fleming et al. 2001, Fleming pers. comm., Gawler 2002, Harrison 2004, Hunt 1997a, MENHP 1991, McCoy and Fleming 2000, Metzler and Barrett 2001, NRCS 2004, Patterson pers. comm., Rawinski 1984, Soil Conservation Service 1987, Sperduto 1997b, Sperduto and Nichols 2004, Swain and Kearsley 2001, VDNH 2003

COMMON NAME (PARK-SPECIFIC): NORTHEASTERN COASTAL OAK - HEATH FOREST

SYNONYMS
USNVC English Name: **Scarlet Oak - Black Oak / Sassafras / Hillside Blueberry Forest**
USNVC Scientific Name: ***Quercus coccinea* - *Quercus velutina* / *Sassafras albidum* / *Vaccinium pallidum* Forest**
USNVC Identifier: **CEGL006375**

LOCAL INFORMATION

Environmental Description: This association occurs on well-drained, nutrient-poor, sandy soil of both outwash and Holocene deposits. The leaf litter is very deep, not allowing recruitment of species that require mineral soils, unless there is some disturbance. Most of these occurrences in Cape Cod National Seashore are associated with soils that have not been disturbed by plowing or heavy grazing.

Vegetation Description: This association is dominated by *Quercus velutina* (black oak) and *Quercus alba* (white oak). *Pinus rigida* (pitch pine) is nearly always present but in low abundance. *Quercus coccinea* (scarlet oak), *Betula papyrifera* (paper birch), *Populus tremuloides* (quaking aspen), *Sassafras albidum* (sassafras), and *Nyssa sylvatica* (blackgum) may be locally abundant. The understory may include *Amelanchier canadensis* (Canadian serviceberry). The shrub layer is well-developed and includes a range of ericaceous species, including *Gaylussacia baccata* (black huckleberry), *Vaccinium pallidum* (Blue Ridge blueberry), and *Vaccinium angustifolium* (lowbush blueberry). *Viburnum recognitum* (*Viburnum dentatum* var. *lucidum*, southern arrowwood) may be abundant as well. Herbs include *Pteridium aquilinum* (western brackenfern), *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), and *Cypripedium acaule* (moccasin flower). The herbaceous layer is typically sparse, with *Carex pensylvanica* (Pennsylvania sedge), *Aralia nudicaulis* (wild sarsaparilla), and *Pteridium aquilinum* (western brackenfern) being the most common. *Gaultheria procumbens* (eastern teaberry) is more common in stands without significant soil disturbance, while *Deschampsia flexuosa* (wavy hairgrass) is more common on stands with a history of cultivation or other disturbance. *Smilax rotundifolia* (roundleaf greenbrier) is also a frequent associate.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus rigida* (pitch pine)
Tree canopy	Broad-leaved deciduous tree	*Quercus alba* (white oak)
		Quercus coccinea (scarlet oak)
		Quercus velutina (black oak)
		Sassafras albidum (sassafras)
Tree subcanopy	Broad-leaved deciduous tree	*Amelanchier canadensis* (Canadian serviceberry)
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
		Vaccinium pallidum (Blue Ridge blueberry)
Short shrub/sapling	Broad-leaved evergreen shrub	*Chimaphila maculata* (striped prince's pine)
		Gaultheria procumbens (eastern teaberry)
Herb (field)	Forb	*Maianthemum canadense* (Canada mayflower)
		Trientalis borealis (starflower)
Herb (field)	Fern or fern ally	*Pteridium aquilinum* (western brackenfern)

Characteristic Species: *Pteridium aquilinum* (western brackenfern), *Quercus alba* (white oak), *Quercus velutina* (black oak)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S3S4*	I	1	Black Oak - Scarlet Oak Forest / Woodland	Swain and Kearsley 2001
MA	S3*	I	1	Coastal Forest/Woodland	Swain and Kearsley 2001

Local Range: This association occurs throughout Cape Cod National Seashore on lower elevation outwash deposits that have not been highly disturbed by agriculture and on the older, more stable sections of the Provincelands on Holocene deposits.

Classification Comments: Information not available.

Other Comments: This association is found throughout Cape Cod National Seashore. Good, unusual examples occur at the entrance to the Snail Road trail into the Provincelands and on the south side of Clapps Pond.

Local Description Authors: R.E. Zaremba

Plots: Motzkin and Foster (2002) plots: CC6, CC80, CJ101, CJ202, CC52, CJ85, CJ142; CACO **AA (2004) Points:** CACO.135, CACO.200, CACO.214, CACO.229, CACO.230, CACO.267, CACO.317, CACO.323, CACO.324, CACO.338, CACO.349, CACO.372, CACO.398, CACO.402, CACO.415, CACO.502, CACO.523, CACO.528, CACO.540, CACO.543, CACO.589.

Cape Cod National Seashore Inventory Notes: Mapped in the Oak Beech Forest aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	*Quercus velutina - Quercus alba - (Quercus coccinea)* Forest Alliance (A.1911)
Alliance (English name)	Black Oak - White Oak - (Scarlet Oak) Forest Alliance
Association	*Quercus coccinea - Quercus velutina / Sassafras albidum / Vaccinium pallidum* Forest
Association (English name)	Scarlet Oak - Black Oak / Sassafras / Hillside Blueberry Forest
Ecological System(s):	Northern Atlantic Coastal Plain Hardwood Forest (CES203.475).

GLOBAL DESCRIPTION

Concept Summary: This dry coastal oak-heath forest of New England and the northeastern Coastal Plain occurs on rapidly drained, nutrient-poor, sandy or gravelly soils. North of the glacial border, these soils are typically found on till or outwash. The canopy is dominated by *Quercus coccinea* (scarlet oak), *Quercus velutina* (black oak), and *Quercus alba* (white oak), the latter species particularly characteristic of gravel substrates. Other less abundant canopy associates include *Quercus prinus* (chestnut oak), *Betula lenta* (sweet birch), and *Ilex opaca* (American holly) (usually less than 15% cover). *Pinus rigida* (pitch pine) is a common associate but occurs at low cover. *Sassafras albidum* (sassafras) may occur in low cover and may indicate influence by coastal (but not maritime) climate where this type occurs. *Castanea dentata* (American chestnut) saplings can be common. A 'lawn-like' dwarf-shrub heath layer dominated by *Vaccinium pallidum* (Blue Ridge blueberry), *Vaccinium angustifolium* (lowbush blueberry), and *Gaylussacia baccata* (black huckleberry) is characteristic. *Gaylussacia frondosa* (blue huckleberry) also occurs in some stands. The herbaceous layer is typically sparse, with *Carex*

pensylvanica (Pennsylvania sedge), *Pteridium aquilinum* (western brackenfern), and *Gaultheria procumbens* (eastern teaberry) being the most common. Herb diversity is greater in small canopy gaps, where *Helianthemum canadense* (longbranch frostweed), *Tephrosia virginiana* (Virginia tephrosia), *Aureolaria* (false foxglove) spp., *Lespedeza* (lespedeza) spp., *Lechea* (pinweed) spp., and *Arctostaphylos uva-ursi* (kinnikinnick) occur.
Environmental Description: This association occurs on rapidly drained, nutrient-poor, sandy or gravelly soils. North of the glacial border, these soils are typically found on till or outwash.
Vegetation Description: This dry coastal oak-heath forest is dominated by *Quercus coccinea* (scarlet oak), *Quercus velutina* (black oak), and *Quercus alba* (white oak), the latter species particularly characteristic of gravel substrates. Other less abundant canopy associates include *Quercus prinus* (chestnut oak), *Betula lenta* (sweet birch), and *Ilex opaca* (American holly) (usually less than 15% cover). *Pinus rigida* (pitch pine) is a common associate but occurs at low cover. *Sassafras albidum* (sassafras) may occur in low cover and may indicate influence by coastal (but not maritime) climate where this type occurs. *Castanea dentata* (American chestnut) saplings can be common. A 'lawn-like' dwarf-shrub heath layer dominated by *Vaccinium pallidum* (Blue Ridge blueberry), *Vaccinium angustifolium* (lowbush blueberry), and *Gaylussacia baccata* (black huckleberry) is characteristic. *Gaylussacia frondosa* (blue huckleberry) also occurs in some stands. The herbaceous layer is typically sparse, with *Carex pensylvanica* (Pennsylvania sedge), *Pteridium aquilinum* (western brackenfern), and *Gaultheria procumbens* (eastern teaberry) being the most common. Herb diversity is greater in small canopy gaps, where *Helianthemum canadense* (longbranch frostweed), *Tephrosia virginiana* (Virginia tephrosia), *Aureolaria* (false foxglove) spp., *Lespedeza* (lespedeza) spp., *Lechea* (pinweed) spp., and *Arctostaphylos uva-ursi* (kinnikinnick) occur.
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus alba* (white oak)
		Quercus coccinea (scarlet oak)
		Quercus velutina (black oak)
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
		Vaccinium angustifolium (lowbush blueberry)
		Vaccinium pallidum (Blue Ridge blueberry)
Short shrub/sapling	Broad-leaved evergreen shrub	*Gaultheria procumbens* (eastern teaberry)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)
Herb (field)	Fern or fern ally	*Pteridium aquilinum* (western brackenfern)

Characteristic Species: *Pteridium aquilinum* (western brackenfern), *Quercus alba* (white oak), *Quercus coccinea* (scarlet oak), *Quercus velutina* (black oak)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable

DISTRIBUTION
Range: This type occurs in coastal areas from New Hampshire to New Jersey.
States/Provinces: CT, MA, NH, NJ:S1S3, NY, RI
Federal Lands: NPS (Cape Cod, Fire Island); USFWS (Massasoit?)

CONSERVATION STATUS
Rank: GNR (1-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard

Confidence: 2 - Moderate
Comments: Information not available.
Similar Associations:
- *Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest (CEGL006336)
- *Quercus velutina - Quercus alba / Vaccinium (angustifolium, pallidum) / Carex pensylvanica* Forest (CEGL005030)

Related Concepts:
- Black oak savanna (Rawinski 1984) ?
- CNE Mesic hardwood Forest on acidic bedrock / till (Rawinski 1984) ?
- Dry oak - pine forest, scarlet oak - shortleaf pine forest subtype (Breden 1989) ?
- Maritime Oak Forest Community (on Uplands) (Lundgren 2000) ?
- Maritime forest (Rawinski 1984) ?
- Oak - Mixed Heath Forest (Greller 1977) ?
- Southern New England oak / pine forest on sandy / gravelly soils (Rawinski 1984) ?

SOURCES
Description Authors: S.L. Neid and L.A. Sneddon
References: Breden 1989, Breden et al. 2001, Clark 1986, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Greller 1977, Lundgren 2000, Metzler and Barrett 2001, Motzkin and Foster 2002, Rawinski 1984, Reschke 1990, Sperduto 1996, Swain and Kearsley 2001



Figure 12. Northeastern Coastal Oak - Heath Forest in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 413164 northing 4651859.

COMMON NAME (PARK-SPECIFIC): BLACK LOCUST SUCCESSIONAL FOREST

SYNONYMS
USNVC English Name: **Black Locust Forest**
USNVC Scientific Name: ***Robinia pseudoacacia* Forest**
USNVC Identifier: **CEGL007279**

LOCAL INFORMATION

Environmental Description: This community type occurs on glacial outwash deposits where there have been major soil disturbances. Sites include roadsides, old railroad embankments, powerlines, sand pits, and abandoned farms.
Vegetation Description: This community type is dominated by *Robinia pseudoacacia* (black locust) which can be the only tree in the canopy. Other tree species can include *Ailanthus altissima* (tree of heaven), *Juniperus virginiana* (eastern redcedar), *Pinus rigida* (pitch pine), and *Quercus* (oak) spp. Shrubs are usually sparse and include *Rosa multiflora* (multiflora rose) and *Lonicera morrowii* (Morrow's honeysuckle). Common herbaceous associates include *Saponaria officinalis* (bouncingbet), *Galium* (bedstraw) sp., and *Solidago* (goldenrod) spp.
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Ailanthus altissima* (tree of heaven)
		Robinia pseudoacacia (black locust)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Lonicera morrowii* (Morrow's honeysuckle)
		Rosa multiflora (multiflora rose)
		Toxicodendron radicans (eastern poison ivy)

Characteristic Species: *Robinia pseudoacacia* (black locust)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNA	NA	NA	[not crosswalked]	Swain and Kearsley 2001

Local Range: This forest community occurs at scattered locations on glacial outwash deposits throughout the seashore.
Classification Comments: This community can be dominated by *Ailanthus altissima* (tree of heaven). Some occurrences intergrade with *Juniperus virginiana* Forest (CEGL006024). Good examples occur along LeCount Hollow Road, at the Salt Pond Visitors Center, and along the border of Route 6 in Wellfleet.
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: CACO.106, CACO.116.
AA (2004) Points: CACO.131, CACO.249, CACO.319, CACO.322, CACO.414, CACO.439, CACO.453, CACO.476, CACO.499, CACO.510, CACO.521, CACO.566, CACO.572, CACO.595
Cape Cod National Seashore Inventory Notes: Mapped in the Black Locust aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	*Robinia pseudoacacia* Forest Alliance (A.256)
Alliance (English name)	Black Locust Forest Alliance
Association	*Robinia pseudoacacia* Forest
Association (English name)	Black Locust Forest
Ecological System(s):	Southern Interior Low Plateau Dry-Mesic Oak Forest (CES202.898). Northern Atlantic Coastal Plain Pitch Pine Barrens (CES203.269). Central Appalachian Dry Oak - Pine Forest (CES202.591).

GLOBAL DESCRIPTION

Concept Summary: This black locust semi-natural forest is found locally throughout the eastern United States. Stands often establish on old fields abandoned after agricultural cropping or pasturing or around old homesites. In some areas it occurs on post-agricultural floodplain terraces. This vegetation has also become established following the planting of *Robinia pseudoacacia* (black locust) to stabilize and enrich nutrient-poor soils that are subject to erosion. The vegetation is dominated by *Robinia pseudoacacia* (black locust). Associated woody species vary from site to site and include *Prunus serotina* (black cherry), *Juniperus virginiana* (eastern redcedar), *Ulmus americana* (American elm), *Ulmus rubra* (slippery elm), *Carya ovata* (shagbark hickory), *Celtis occidentalis* (common hackberry), *Juglans nigra* (black walnut), *Quercus rubra* (northern red oak), *Ulmus rubra* (slippery elm), and in some areas *Acer platanoides* (Norway maple) or *Ailanthus altissima* (tree of heaven). Understory vegetation is highly variable depending on site history and often includes *Toxicodendron radicans* (eastern poison ivy); *Lindera benzoin* (northern spicebush) is sometimes present. The invasive nonnative *Rosa multiflora* (multiflora rose) may be present as a shrub, along with the nonnative bramble *Rubus phoenicolasius* (wine raspberry). Nonnative species such as *Alliaria petiolata* (garlic mustard), *Chelidonium majus* (celandine), *Glechoma hederacea* (ground ivy), and *Convallaria majalis* (European lily of the valley) can characterize the herb layer, which may also have a native component.

Environmental Description: This type often establishes on old fields abandoned after agricultural cropping or pasturing or around old home sites. This vegetation has also become established following the planting of *Robinia pseudoacacia* (black locust) to stabilize and enrich nutrient-poor soils that are subject to erosion (Rabie 2000). Soils are variable and may be highly acidic, especially where established on old mine sites.

Vegetation Description: The vegetation is dominated by *Robinia pseudoacacia* (black locust) forming a partial to nearly complete canopy. Associated woody species vary from site to site and include *Prunus serotina* (black cherry), *Juniperus virginiana* (eastern redcedar), *Ulmus americana* (American elm), *Ulmus rubra* (slippery elm), *Carya ovata* (shagbark hickory), *Celtis occidentalis* (common hackberry), *Juglans nigra* (black walnut), *Quercus rubra* (northern red oak), *Ulmus rubra* (slippery elm), *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), and in some areas *Acer platanoides* (Norway maple) or *Ailanthus altissima* (tree of heaven). Understory vegetation is highly variable depending on site history and often includes *Toxicodendron radicans* (eastern poison ivy); *Lindera benzoin* (northern spicebush) is sometimes present. The

invasive nonnatives *Rosa multiflora* (multiflora rose) and *Elaeagnus umbellata* (autumn olive) are typically the most common shrubs, along with the nonnative bramble *Rubus phoenicolasius* (wine raspberry). *Cornus florida* (flowering dogwood) may be present in the subcanopy. Nonnative species such as *Alliaria petiolata* (garlic mustard), *Chelidonium majus* (celandine), *Glechoma hederacea* (ground ivy), *Dactylis glomerata* (orchardgrass), *Daucus carota* (Queen Anne's lace), and *Convallaria majalis* (European lily of the valley) can characterize the herb layer, which may have a native component as well, for example with (depending on geography) *Ageratina altissima* (white snakeroot), *Dichanthelium clandestinum* (deertongue), *Elymus hystrix var. hystrix* (eastern bottlebrush grass), *Leersia virginica* (whitegrass), *Parthenocissus quinquefolia* (Virginia creeper), *Pilea pumila* (Canadian clearweed), *Solidago canadensis* (Canada goldenrod), *Solidago rugosa* (wrinkleleaf goldenrod), *Verbesina alternifolia* (wingstem), *Verbesina occidentalis* (yellow crownbeard), and *Viola* (violet) spp.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Robinia pseudoacacia* (black locust)

Characteristic Species: *Acer rubrum* (red maple), *Robinia pseudoacacia* (black locust), *Rosa multiflora* (multiflora rose)

Other Noteworthy Species:

Species	GRank	Type	Note
Acer platanoides (Norway maple)	-	plant	exotic
Ailanthus altissima (tree of heaven)	-	plant	exotic
Alliaria petiolata (garlic mustard)	-	plant	exotic
Chelidonium majus (celandine)	-	plant	exotic
Convallaria majalis (European lily of the valley)	-	plant	exotic
Dactylis glomerata (orchardgrass)	-	plant	exotic
Daucus carota (Queen Anne's lace)	-	plant	exotic
Elaeagnus umbellata (autumn olive)	-	plant	exotic
Glechoma hederacea (ground ivy)	-	plant	exotic
Rosa multiflora (multiflora rose)	-	plant	exotic
Rubus phoenicolasius (wine raspberry)	-	plant	exotic

USFWS Wetland System: Not applicable

DISTRIBUTION

Range: This black locust semi-natural forest is found locally throughout the eastern United States.

States/Provinces: AR, DC?, DE, IA, KY, MA, MD?, MS, NC, NJ, NY, OK, PA, TN, VA, VT, WV

Federal Lands: NPS (Blue Ridge Parkway, Bluestone, Buffalo River?, C&O Canal?, Cape Cod, Catoctin Mountain?, George Washington Birthplace, Marsh-Billings-Rockefeller, Minute Man, Morristown, National Capital-East?, New River Gorge, Saratoga, Vicksburg); USFS (George Washington, Jefferson, Nantahala, Ouachita, Ouachita (Mountains), Ozark, Pisgah)

CONSERVATION STATUS

Rank: GNA (ruderal) (24-Oct-2002

Reasons: Although *Robinia pseudoacacia* (black locust) is a native species found in the Central Appalachians and Ozark Mountains, it does not typically become a dominant species in these natural habitats (Elias 1980). It is now widespread in the eastern U.S. in disturbed habitats. This forest represents early-successional vegetation and is thus not of high conservation concern and does not receive a conservation status rank.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: Information not available.

Similar Associations:

- *Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana - (Robinia pseudoacacia)* Forest (CEGL006599)--can have *Robinia* as an important canopy component but is not dominated by it as is this type.
- *Prunus serotina - Sassafras albidum - (Fraxinus americana) / Juniperus virginiana* Forest (CEGL004133)
- *Robinia pseudoacacia - Celtis occidentalis - (Fraxinus americana, Liriodendron tulipifera)* Forest (CEGL007281)

Related Concepts:

- Juglans nigra - Robinia pseudoacacia / Lonicera japonica / Verbesina alternifolia Association (Rawinski et al. 1996) ?
- Successional black locust disturbed forests (CAP pers. comm. 1998) ?
- Successional communities (Ehrenfeld 1977) B

SOURCES

Description Authors: D. Faber-Langendoen, mod. S.C. Gawler and L.A. Sneddon

References: Baalman 1965, CAP pers. comm. 1998, Ehrenfeld 1977, Elias 1980, Fleming and Coulling 2001, Gaertner 1955, Hoagland 2000, INAI unpubl. data, McDonald 1938, NRCS 2004, Rabie 2000, Rawinski et al. 1996, Southeastern Ecology Working Group n.d., TDNH unpubl. data, Vanderhorst et al. 2007, Vanderhorst et al. 2008



Figure 13. Black Locust Successional Forest in Cape Cod National Seashore (plot CACO.106). September 2004. NAD 1983 / UTM easting 419371, northing 4632296.



Figure 14. Black Locust Successional Forest in Cape Cod National Seashore (plot CACO.116). September 2004. NAD 1983 / UTM easting 418395, northing 4641047.

COMMON NAME (PARK-SPECIFIC): LOWER NEW ENGLAND RED MAPLE - BLACKGUM SWAMP

SYNONYMS
USNVC English Name: **Red Maple / Swamp Azalea - Coastal Sweet-pepperbush Forest**
USNVC Scientific Name: ***Acer rubrum* / *Rhododendron viscosum* - *Clethra alnifolia* Forest**
USNVC Identifier: **CEGL006156**

LOCAL INFORMATION

Environmental Description: This association occurs in poorly drained basins with acidic peat soils of varying depths from only 10 cm to over 130 cm. The community can be very narrow and intergrade with upland forest dominated by *Quercus* (oak) spp., *Fagus grandifolia* (American beech), or *Pinus rigida* (pitch pine). There is usually a dense layer of leaves on the soil surface which is under water in the spring and exposed and unvegetated in late summer.
Vegetation Description: The canopy is dominated by *Acer rubrum* (red maple) and *Nyssa sylvatica* (blackgum). Other common associates include *Sassafras albidum* (sassafras), *Pinus rigida* (pitch pine), and a range of other upland tree species from adjacent communities, including *Quercus velutina* (black oak) and *Fagus grandifolia* (American beech). The shrub layer is dominated by *Vaccinium corymbosum* (highbush blueberry) and *Rhododendron viscosum* (swamp azalea). *Clethra alnifolia* (coastal sweetpepperbush), *Gaylussacia baccata* (black huckleberry), and *Ilex glabra* (inkberry) are common associates. The herb layer is variable, as is the abundance of mosses.
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus rigida* (pitch pine)
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
		Nyssa sylvatica (blackgum)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Clethra alnifolia* (coastal sweetpepperbush)
		Rhododendron viscosum (swamp azalea)
		Vaccinium corymbosum (highbush blueberry)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Ilex glabra* (inkberry)

Characteristic Species: *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), *Vaccinium corymbosum* (highbush blueberry)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S5*	B	1	Red Maple Swamp	Swain and Kearsley 2001

Local Range: This association occurs along the borders of Coastal Plain ponds in Eastham, Wellfleet, and Truro and around the ponds in the Provincelands.
Classification Comments: Information not available.
Other Comments: This community is frequently very narrow and intergrades with upland forest communities.
Local Description Authors: R.E. Zaremba
Plots: CACO.038, CACO.039, CACO.043, CACO.060; Motzkin and Foster (2002) plot CC44.
AA (2004) Points: CACO.226, CACO.232, CACO.332, CACO.357, CACO.422, CACO.436, CACO.474, CACO.484, CACO.532, CACO.574

Cape Cod National Seashore Inventory Notes: Mapped in the Red Maple Swamp aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	Saturated cold-deciduous forest (I.B.2.N.g.)
Alliance	*Acer rubrum - Nyssa sylvatica* Saturated Forest Alliance (A.348)
Alliance (English name)	Red Maple - Blackgum Saturated Forest Alliance
Association	*Acer rubrum / Rhododendron viscosum - Clethra alnifolia* Forest
Association (English name)	Red Maple / Swamp Azalea - Coastal Sweet-pepperbush Forest
Ecological System(s):	North-Central Appalachian Acidic Swamp (CES202.604). Northern Atlantic Coastal Plain Maritime Forest (CES203.302).

GLOBAL DESCRIPTION

Concept Summary: This red maple swamp occurs in poorly drained depressions containing acidic, tannic water without substantial nutrient input from overland flow. The core of distribution is the North Atlantic Coast and adjacent Lower New England / Northern Piedmont ecoregions. Soils are organic and hummock-hollow microtopography is evident. *Acer rubrum* (red maple) dominates the canopy often with abundant *Nyssa sylvatica* (blackgum). The subcanopy varies from sparse to fairly well-developed and may feature *Ulmus americana* (American elm) or occasionally *Quercus bicolor* (swamp white oak), along with additional *Acer rubrum* (red maple). The shrub layer is characterized by *Vaccinium corymbosum* (highbush blueberry), *Clethra alnifolia* (coastal sweetpepperbush), *Ilex verticillata* (common winterberry), *Rhododendron viscosum* (swamp azalea), *Leucothoe racemosa* (swamp doghobble), and on the Atlantic Coastal Plain *Ilex glabra* (inkberry) may also be present. The herbaceous layer is not particularly diverse, characterized by *Osmunda cinnamomea* (cinnamon fern), *Symplocarpus foetidus* (skunk cabbage), *Carex intumescens* (greater bladder sedge), *Osmunda regalis* (royal fern), *Arisaema triphyllum* (Jack in the pulpit), and *Onoclea sensibilis* (sensitive fern). *Sphagnum* (sphagnum) mosses make up the bryophyte layer. This community is differentiated from *Acer rubrum - Nyssa sylvatica - Betula alleghaniensis / Sphagnum* spp. Forest (CEGL006014) by the absence or infrequent occurrence of *Tsuga canadensis* (eastern hemlock), *Betula alleghaniensis* (yellow birch), *Nemopanthus mucronatus* (catberry), *Carex trisperma* (threeseeded sedge), *Clintonia borealis* (bluebead), and by the presence of species with more southern affinities such as *Clethra alnifolia* (coastal sweetpepperbush), *Ilex glabra* (inkberry), and *Rhododendron viscosum* (swamp azalea).

Environmental Description: These are poorly drained basins with acidic, nutrient-poor, peat soils. There is little overland flow or groundwater contribution to the water budget.

Vegetation Description: This type includes red maple basin swamp of Lower New England and adjacent areas. These swamps occur in poorly drained depressions characterized by acidic, tannic water that does not receive substantial nutrient input from overland flow or groundwater seepage. *Acer rubrum* (red maple) dominates the canopy. Other common species that generally occur in low abundance include *Betula alleghaniensis* (yellow birch), *Fraxinus* (ash) spp., *Ulmus americana* (American elm), *Nyssa sylvatica* (blackgum), *Tsuga canadensis* (eastern hemlock), or *Pinus strobus* (eastern white pine). The shrub layer is well-developed and often dense.

Vaccinium corymbosum (highbush blueberry) and *Ilex verticillata* (common winterberry) are common and abundant. *Clethra alnifolia* (coastal sweetpepperbush), *Alnus incana* (gray alder), *Lindera benzoin* (northern spicebush), *Viburnum dentatum* (southern arrowwood), *Viburnum nudum var. cassinoides* (withe-rod), *Spiraea alba var. latifolia* (white meadowsweet), *Rosa palustris* (swamp rose), *Nemopanthus mucronatus* (catberry), and *Rhododendron viscosum* (swamp azalea) are frequent but less abundant, and on the Atlantic Coastal Plain *Ilex glabra* (inkberry), *Rhododendron maximum* (great laurel), and *Leucothoe racemosa* (swamp doghobble) may also be present. The herbaceous layer has scattered herbs and commonly includes *Osmunda cinnamomea* (cinnamon fern), *Symplocarpus foetidus* (skunk cabbage), *Veratrum viride* (green false hellebore), *Thelypteris palustris* (eastern marsh fern), *Dryopteris cristata* (crested woodfern), *Lycopus uniflorus* (northern bugleweed), *Impatiens capensis* (jewelweed), *Calla palustris* (water arum), *Carex folliculata* (northern long sedge), *Carex stricta* (upright sedge), *Carex intumescens* (greater bladder sedge), *Osmunda regalis* (royal fern), and *Onoclea sensibilis* (sensitive fern). Hummock-and-hollow microtopography is evident, and tree seedlings and upland species occur on the hummocks, such as *Coptis trifolia* (threeleaf goldthread), *Aralia nudicaulis* (wild sarsaparilla), *Trientalis borealis* (starflower), and *Gaultheria procumbens* (eastern teaberry). *Sphagnum* (sphagnum) mosses are dominant or abundant in hollows and at the bases of hummocks. This community is differentiated from *Acer rubrum - Nyssa sylvatica - Betula alleghaniensis / Sphagnum* spp. Forest (CEGL006014) by the absence or low abundance of *Nyssa sylvatica* (blackgum) and *Picea rubens* (red spruce).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
Tree subcanopy	Broad-leaved deciduous tree	*Betula alleghaniensis* (yellow birch)
		Quercus bicolor (swamp white oak)
		Ulmus americana (American elm)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Ilex verticillata* (common winterberry)
		Vaccinium corymbosum (highbush blueberry)
Herb (field)	Forb	*Symplocarpus foetidus* (skunk cabbage)
Herb (field)	Fern or fern ally	*Osmunda cinnamomea* (cinnamon fern)

Characteristic Species: *Acer rubrum* (red maple), *Ilex verticillata* (common winterberry), *Vaccinium corymbosum* (highbush blueberry)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine

DISTRIBUTION
Range: Information not available.
States/Provinces: CT, MA, NH, NJ:S4S5, NY:S2, RI
Federal Lands: NPS (Boston Harbor Islands, Cape Cod, Fire Island, Minute Man, Weir Farm); USFWS (Assabet River, Great Meadows, Great Swamp, Oxbow, Parker River)

CONSERVATION STATUS
Rank: GNR (1-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: Information not available.

Similar Associations:

- *Acer rubrum - Betula alleghaniensis / Lindera benzoin* Forest (CEGL006936)
- *Acer rubrum - Fraxinus (pennsylvanica, americana) / Lindera benzoin / Symplocarpus foetidus* Forest (CEGL006406)
- *Acer rubrum - Nyssa sylvatica - Betula alleghaniensis / Sphagnum* spp. Forest (CEGL006014)
- *Acer rubrum / Alnus incana - Ilex verticillata / Osmunda regalis* Woodland (CEGL006395)
- *Acer rubrum / Carex stricta - Onoclea sensibilis* Woodland (CEGL006119)
- *Acer rubrum / Nemopanthus mucronatus - Vaccinium corymbosum* Forest (CEGL006220)

Related Concepts:

- *Acer rubrum - Nyssa sylvatica / Clethra alnifolia* Community (Metzler and Barrett 1996) =
- Inland Red Maple Swamp (Breden 1989) B
- Southern New England acidic seepage swamp, Black gum swamp (Rawinski 1984) ?

SOURCES

Description Authors: S.L. Neid and L.A. Sneddon

References: Breden 1989, Breden et al. 2001, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Golet et al. 1993, Hopping 2000, Metzler and Barrett 1996, Metzler and Barrett 2001, Rawinski 1984, Reschke 1990, Sperduto 2000a, Swain and Kearsley 2001, Thompson and Jenkins 1992

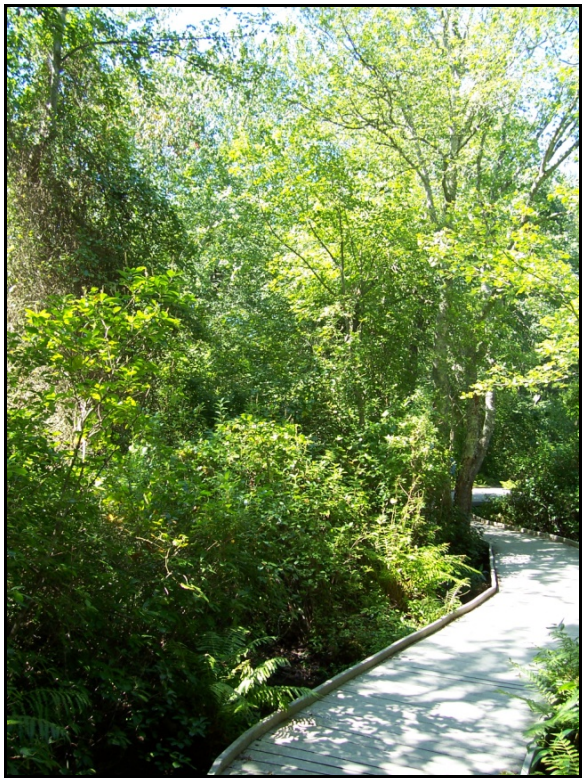


Figure 15. Lower New England Red Maple - Blackgum Swamp in Cape Cod National Seashore (no specific plot). September 2004. UTM coordinates not available.



Figure 16. Lower New England Red Maple - Blackgum Swamp in Cape Cod National Seashore (no specific plot). September 2004. UTM coordinates not available.

COMMON NAME (PARK-SPECIFIC): SEASONALLY FLOODED ATLANTIC WHITE-CEDAR SWAMP

SYNONYMS
USNVC English Name: **Atlantic White-cedar - Red Maple / Water-Horehound species Forest**
USNVC Scientific Name: ***Chamaecyparis thyoides* - *Acer rubrum* / *Lycopus* spp. Forest**
USNVC Identifier: **CEGL006364**

LOCAL INFORMATION

Environmental Description: This community occurs along the borders of ponds. Soils consist of shallow peat deposits over sand. Water levels can vary dramatically betweens year and are usually low in late summer. Trees and shrubs occur in tussocks with intervening stands of *Sphagnum* (sphagnum).
Vegetation Description: This community has a canopy dominated by *Acer rubrum* (red maple), *Chamaecyparis thyoides* (Atlantic white cedar), and *Nyssa sylvatica* (blackgum). The shrub layer consists of *Vaccinium corymbosum* (highbush blueberry), *Clethra alnifolia* (coastal sweetpepperbush), and *Ilex verticillata* (common winterberry) with *Cephalanthus occidentalis* (common buttonbush) and *Decodon verticillatus* (swamp loosestrife) along the open-water edge of the pond. The herbaceous layer is diverse with *Osmunda regalis* (royal fern), *Triadenum virginicum* (Virginia marsh St. Johnswort), and *Thelypteris palustris* (eastern marsh fern). *Sphagnum* (sphagnum) occurs around the bases of tussocks of trees and shrubs.
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Chamaecyparis thyoides* (Atlantic white cedar)
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
		Nyssa sylvatica (blackgum)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Rhododendron viscosum* (swamp azalea)
		Vaccinium corymbosum (highbush blueberry)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Kalmia angustifolia* (sheep laurel)
Herb (field)	Fern or fern ally	*Osmunda regalis* (royal fern)

Characteristic Species: *Acer rubrum* (red maple), *Cephalanthus occidentalis* (common buttonbush), *Chamaecyparis thyoides* (Atlantic white cedar), *Triadenum virginicum* (Virginia marsh St. Johnswort)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S2	=	1	Alluvial Atlantic White Cedar Swamp	Swain and Kearsley 2001

Local Range: This association is found around Coastal Plain ponds in Wellfleet.
Classification Comments: Information not available.
Other Comments: Within Cape Cod National Seashore, *Chamaecyparis thyoides* (Atlantic white cedar) is rare, which probably reflects selective logging over many years. Some pond borders have a few scattered trees.
Local Description Authors: R.E. Zaremba
Plots: CACO.113.
AA (2004) Points: None.

Cape Cod National Seashore Inventory Notes: The one occurrence included in this study is outside Cape Cod National Seashore, but very nearby around Coastal Plain ponds off Paines Hollow Road in Wellfleet.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Mixed evergreen-deciduous forest (I.C.)
Physiognomic Group	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.)
Physiognomic Subgroup	Natural/Semi-natural mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.)
Formation	Seasonally flooded mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.c.)
Alliance	*Chamaecyparis thyoides - Acer rubrum* Seasonally Flooded Forest Alliance (A.3008)
Alliance (English name)	Atlantic White-cedar - Red Maple Seasonally Flooded Forest Alliance
Association	*Chamaecyparis thyoides - Acer rubrum / Lycopus* spp. Forest
Association (English name)	Atlantic White-cedar - Red Maple / Water-Horehound species Forest
Ecological System(s):	Northern Atlantic Coastal Plain Basin Peat Swamp (CES203.522).

GLOBAL DESCRIPTION

Concept Summary: This seasonally flooded Atlantic white-cedar swamp occurs along streamsides, pond borders, and wettest portions of swamp basins in New England and possibly elsewhere. Seasonal overbank flow makes these swamps more nutrient-rich than other Atlantic white cedar swamps. The canopy is generally codominated by *Chamaecyparis thyoides* (Atlantic white cedar) and *Acer rubrum* (red maple). The shrub layer is variable and often includes *Vaccinium corymbosum* (highbush blueberry), *Clethra alnifolia* (coastal sweetpepperbush), *Ilex verticillata* (common winterberry), *Lyonia ligustrina* (maleberry), and occasionally *Frangula alnus* (glossy buckthorn), *Alnus incana ssp. rugosa* (speckled alder), and *Rhododendron viscosum* (swamp azalea). The herbaceous layer is diverse and robust including *Lycopus uniflorus* (northern bugleweed), *Lycopus virginicus* (Virginia water horehound), *Lycopus americanus* (American water horehound), *Osmunda regalis* (royal fern), *Bidens* (beggarticks) spp., *Thelypteris palustris* (eastern marsh fern), *Carex stricta* (upright sedge), and *Triadenum virginicum* (Virginia marsh St. Johnswort). Additional species occurring less frequently include *Peltandra virginica* (green arrow arum), *Sagittaria latifolia* (broadleaf arrowhead), *Sparganium* (bur-reed) spp., *Leersia oryzoides* (rice cutgrass), *Boehmeria cylindrica* (smallspike false nettle), *Lysimachia terrestris* (earth loosestrife), *Carex folliculata* (northern long sedge), *Impatiens capensis* (jewelweed), and *Typha latifolia* (broadleaf cattail). The key diagnostic characteristic of this association is the robust and diverse herb layer of these Atlantic white-cedar swamps.
Environmental Description: Alluvial Atlantic white-cedar swamp along streamsides, pond borders, and wettest portions of swamp basins. Peat is approximately 1 m thick over mineral sediments. Standing water generally occurs for at least half of the growing season.
Vegetation Description: The canopy is generally codominated by *Chamaecyparis thyoides* (Atlantic white cedar) and *Acer rubrum* (red maple). The shrub layer is variable and often includes *Vaccinium corymbosum* (highbush blueberry), *Clethra alnifolia* (coastal sweetpepperbush), *Ilex verticillata* (common winterberry), *Lyonia ligustrina* (maleberry), and occasionally *Frangula alnus* (glossy buckthorn), *Alnus incana ssp. rugosa* (speckled alder), and *Rhododendron viscosum* (swamp azalea). The herbaceous layer is diverse and robust including

Lycopus uniflorus (northern bugleweed), *Lycopus virginicus* (Virginia water horehound), *Lycopus americanus* (American water horehound), *Osmunda regalis* (royal fern), *Bidens* (beggarticks) spp., *Thelypteris palustris* (eastern marsh fern), *Carex stricta* (upright sedge), and *Triadenum virginicum* (Virginia marsh St. Johnswort). Additional species occurring less frequently include *Peltandra virginica* (green arrow arum), *Sagittaria latifolia* (broadleaf arrowhead), *Sparganium* (bur-reed) spp., *Leersia oryzoides* (rice cutgrass), *Boehmeria cylindrica* (smallspike false nettle), *Lysimachia terrestris* (earth loosestrife), *Carex folliculata* (northern long sedge), *Impatiens capensis* (jewelweed), and *Typha latifolia* (broadleaf cattail).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Chamaecyparis thyoides* (Atlantic white cedar)
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Vaccinium corymbosum* (highbush blueberry)
Herb (field)	Forb	*Lycopus uniflorus* (northern bugleweed)
Herb (field)	Fern or fern ally	*Osmunda regalis* (royal fern)

Characteristic Species: *Acer rubrum* (red maple), *Chamaecyparis thyoides* (Atlantic white cedar), *Lycopus uniflorus* (northern bugleweed)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine

DISTRIBUTION

Range: This association is known from New Hampshire and Massachusetts.

States/Provinces: CT, MA:S2, NH, RI

Federal Lands: NPS (Cape Cod)

CONSERVATION STATUS

Rank: GNR (1-Dec-1997)

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: Information not available.

Similar Associations:

- *Chamaecyparis thyoides - (Tsuga canadensis, Betula alleghaniensis) / Clethra alnifolia* Forest (CEGL006189)--lacks boreal and coastal plain indicators.
- *Chamaecyparis thyoides - Picea rubens / Gaylussacia baccata / Gaultheria hispidula* Forest (CEGL006363)
- *Chamaecyparis thyoides / Ilex glabra - Rhododendron viscosum* Forest (CEGL006188)--distinguished by coastal plain indicators.
- *Chamaecyparis thyoides / Rhododendron maximum* Forest (CEGL006355)

Related Concepts:

- *Chamaecyparis/Lycopus* (Type 6) (Sperduto and Crowley 2002b) ?
- SNE Streambottom forest, Atlantic white cedar association (Rawinski 1984) ?
- Seasonally flooded [Atlantic white cedar] type (Motzkin 1991) ?

SOURCES

Description Authors: S.L. Neid

References: Eastern Ecology Working Group n.d., Metzler and Barrett 2001, Motzkin 1991, Rawinski 1984, Sperduto 2000a, Sperduto 2000b, Sperduto and Crowley 2002b, Sperduto and Ritter 1994, Swain and Kearsley 2001



Figure 17. Seasonally Flooded Atlantic White-cedar Swamp (plot CACO.113). Summer 2003. NAD 1983 / UTM easting 416710, northing 4640947.

COMMON NAME (PARK-SPECIFIC): PITCH PINE - OAK FOREST

SYNONYMS

USNVC English Name: **Pitch Pine - Scarlet Oak / Hillside Blueberry - (Northern Bayberry) Woodland**

USNVC Scientific Name: ***Pinus rigida* - *Quercus coccinea* / *Vaccinium pallidum* - (*Morella pensylvanica*) Woodland**

USNVC Identifier: **CEGL006381**

LOCAL INFORMATION

Environmental Description: This association occurs on sandy well-drained soils of both glacial outwash deposits and the older barrier beach deposits of the Provincelands. Soils are well-developed with a deep litter layer that precludes most herbaceous plants and limits recruitment. The community is fire-adapted and recovers quickly from all but severe fires. Pine density is usually related to disturbances, such as fires or other events that bare mineral soil.

Vegetation Description: This association is the matrix forest of Cape Cod and is found throughout the seashore. It is dominated by *Pinus rigida* (pitch pine) and *Quercus velutina* (black oak) with lower cover of *Quercus alba* (white oak). Scattered throughout the occurrences are *Quercus coccinea* (scarlet oak) and *Amelanchier canadensis* (Canadian serviceberry). Unusual examples in the Provincelands include *Populus grandidentata* (bigtooth aspen) and *Betula populifolia* (gray birch). The low-shrub layer is dominated by *Vaccinium pallidum* (Blue Ridge blueberry) or *Gaylussacia baccata* (black huckleberry) and may have a local abundance of *Vaccinium angustifolium* (lowbush blueberry). *Gaultheria procumbens* (eastern teaberry) is nearly always present, and there are usually scattered individuals of *Morella pensylvanica* (northern bayberry). *Epigaea repens* (trailing arbutus) and *Arctostaphylos uva-ursi* (kinnikinnick) occur at many sites. The herbaceous layer is very sparse and may include *Carex pensylvanica* (Pennsylvania sedge), *Aralia nudicaulis* (wild sarsaparilla), *Trientalis borealis* (starflower), and *Pteridium aquilinum* (western brackenfern). There are often many other herbaceous species, but these are nearly always associated with roadsides and small disturbances that open the canopy and expose mineral soil. Species in these areas often include *Solidago odora* (anisescented goldenrod), *Comptonia peregrina* (sweet fern), and *Deschampsia flexuosa* (wavy hairgrass).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus rigida* (pitch pine)
Tree canopy	Broad-leaved deciduous tree	*Quercus alba* (white oak)
		Quercus velutina (black oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Quercus ilicifolia* (bear oak)
		Vaccinium angustifolium (lowbush blueberry)
		Vaccinium pallidum (Blue Ridge blueberry)
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Gaultheria procumbens* (eastern teaberry)
		Morella pensylvanica (northern bayberry)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)
Herb (field)	Fern or fern ally	*Pteridium aquilinum* (western brackenfern)

Characteristic Species: *Pinus rigida* (pitch pine), *Quercus alba* (white oak), *Quercus velutina* (black oak), *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium pallidum* (Blue Ridge blueberry)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S3*	B	1	Coastal Forest/Woodland	Swain and Kearsley 2001

Local Range: This association occurs throughout the seashore.
Classification Comments: This community is the matrix forest type of the seashore. The dominance of *Pinus rigida* (pitch pine) varies by location from nearly 100% cover to only a few percent. *Quercus velutina* (black oak) is nearly always present and can be dominant. Disturbed examples will often have a high concentration of *Deschampsia flexuosa* (wavy hairgrass), *Trientalis borealis* (starflower), and *Arctostaphylos uva-ursi* (kinnikinnick) and a low cover of other ericaceous shrubs. There are numerous plots sampled by the Harvard Forest for this association.
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: CACO.126, Motzkin and Foster (2002) plots: CJ276, CJ37, CJ218, CJ125, CJ148, CJ174, CJ183, CJ222, CJ223, CJ225, CJ229, CJ293, CJ298, CJ319, CJ445, CJ334, CC17, CC40, CJ112, CJ299, CC25, CJ65, CJ105, CJ124, CJ143, CC53, CC47, CC175, CJ178, CJ198, CC26, CJ251, CJ175, CC20, CJ245, CJ140, CJ226, CJ318, CC47, CJ236, CC35, CC36, CJ488.
AA (2004) Points: CACO.116, CACO.120, CACO.133, CACO.152, CACO.164, CACO.187, CACO.189, CACO.191, CACO.212, CACO.215, CACO.228, CACO.240, CACO.281, CACO.283, CACO.302, CACO.331, CACO.336, CACO.401, CACO.417, CACO.426, CACO.464, CACO.465, CACO.470, CACO.500, CACO.511, CACO.522, CACO.533, CACO.542, CACO.555, CACO.560, CACO.573, CACO.581, CACO.582, CACO.585, CACO.591, CACO.594, CACO.598, CACO.616.
Cape Cod National Seashore Inventory Notes: Mapped in the Mixed Forest aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Woodland (II)
Physiognomic Subclass	Evergreen woodland (II.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
Formation	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
Alliance	*Pinus rigida* Woodland Alliance (A.524)
Alliance (English name)	Pitch Pine Woodland Alliance
Association	*Pinus rigida - Quercus coccinea / Vaccinium pallidum - (Morella pensylvanica)* Woodland
Association (English name)	Pitch Pine - Scarlet Oak / Hillside Blueberry - (Northern Bayberry) Woodland
Ecological System(s):	Northern Atlantic Coastal Plain Pitch Pine Barrens (CES203.269).

GLOBAL DESCRIPTION

Concept Summary: This vegetation is a matrix woodland type of the central Pine Barrens from Long Island, New York, north to Cape Cod, Massachusetts. It occurs on very well-drained sandy outwash or moraine deposits. The canopy is dominated by *Pinus rigida* (pitch pine) plus the following oaks in variable proportions: *Quercus coccinea* (scarlet oak), *Quercus velutina* (black oak), *Quercus alba* (white oak), and *Quercus rubra* (northern red oak) and occasionally *Quercus stellata* (post oak). Tall shrubs such as *Quercus ilicifolia* (bear oak) can be sporadic to locally

well-developed. Heaths tend to form a dense dwarf-shrub layer, especially *Gaylussacia baccata* (black huckleberry), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium pallidum* (Blue Ridge blueberry). *Morella pensylvanica* (northern bayberry) can also commonly occur. The herb layer is often sparse and characterized by *Pteridium aquilinum* (western brackenfern), *Gaultheria procumbens* (eastern teaberry), and *Carex pensylvanica* (Pennsylvania sedge). This mixed conifer-deciduous woodland is a fire-dependent community with a proportion of canopy species dependent on the fire regime.

Environmental Description: Matrix woodland type occurring on very well-drained sandy outwash or moraine deposits.

Vegetation Description: The canopy is dominated by *Pinus rigida* (pitch pine) plus the following oaks in variable proportions: *Quercus coccinea* (scarlet oak), *Quercus velutina* (black oak), *Quercus alba* (white oak), and *Quercus rubra* (northern red oak) and occasionally *Quercus stellata* (post oak). Tall shrubs such as *Quercus ilicifolia* (bear oak) can be sporadic to locally well-developed. Heaths tend to form a dense dwarf-shrub layer, especially *Gaylussacia baccata* (black huckleberry), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium pallidum* (Blue Ridge blueberry). *Morella pensylvanica* (northern bayberry) can also commonly occur. The herb layer is often sparse and characterized by *Pteridium aquilinum* (western brackenfern), *Gaultheria procumbens* (eastern teaberry), and *Carex pensylvanica* (Pennsylvania sedge).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus rigida* (pitch pine)
Tree canopy	Broad-leaved deciduous tree	*Quercus alba* (white oak)
		Quercus coccinea (scarlet oak)
		Quercus velutina (black oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Quercus ilicifolia* (bear oak)
		Vaccinium angustifolium (lowbush blueberry)
		Vaccinium pallidum (Blue Ridge blueberry)
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Gaultheria procumbens* (eastern teaberry)
		Morella pensylvanica (northern bayberry)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)
Herb (field)	Fern or fern ally	*Pteridium aquilinum* (western brackenfern)

Characteristic Species: *Pinus rigida* (pitch pine), *Pteridium aquilinum* (western brackenfern), *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium pallidum* (Blue Ridge blueberry)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable

DISTRIBUTION

Range: This matrix forest type is found in coastal and adjacent inland areas from Massachusetts to New Jersey.

States/Provinces: CT, MA, NJ, NY, RI

Federal Lands: NPS (Cape Cod); USFWS (Massasoit, Parker River)

CONSERVATION STATUS

Rank: GNR (1-Dec-1997)

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: Information not available.

Similar Associations:

- *Pinus rigida - Quercus (velutina, prinus)* Forest (CEGL006290)
- *Pinus rigida / Quercus ilicifolia / Lespedeza capitata* Woodland (CEGL006025)

Related Concepts:

- CNE Mesic hardwood Forest on acidic bedrock / till (Rawinski 1984) ?
- Dry Pine-Oak Forest (Breden 1989) B
- Maritime forest (Rawinski 1984) ?
- Southern New England oak / pine forest on sandy / gravelly soils (Rawinski 1984) ?

SOURCES

Description Authors: S.L. Neid and L.A. Sneddon

References: Breden 1989, Breden et al. 2001, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Jordan et al. 2003, Metzler and Barrett 2001, Motzkin and Foster 2002, Rawinski 1984, Reschke 1990, Swain and Kearsley 2001, Windisch 1995b



Figure 18. Pitch Pine - Oak Forest in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 418808, northing 4640452.

COMMON NAME (PARK-SPECIFIC): PITCH PINE DUNE WOODLAND

SYNONYMS
USNVC English Name: **Pitch Pine / Woolly Beach-heather Woodland**
USNVC Scientific Name: ***Pinus rigida* / *Hudsonia tomentosa* Woodland**
USNVC Identifier: **CEGL006117**

LOCAL INFORMATION

Environmental Description: This association occurs on stabilized dunes. Soils are very well-drained and acidic. Wind and sand movement define the location and persistence of the community over time. Most occurrences are to the lee of dunes or in depressions. Some older examples can develop organic layers in the soil that allow greater species diversity.
Vegetation Description: This woodland community is dominated by *Pinus rigida* (pitch pine) with *Quercus velutina* (black oak). The canopy may be closed, but often has only 40–60% cover with areas of open sand. On some older dunes, *Acer rubrum* (red maple) is present. Blowing sand can bury the windward edges of this community. In some examples, *Acer rubrum* (red maple) can survive almost complete burial and put out new leaves at the terminus of exposed branches. The understory is often very open with *Morella pensylvanica* (northern bayberry) and *Prunus maritima* (beach plum). *Hudsonia tomentosa* (woolly beachheather) and *Arctostaphylos uva-ursi* (kinnikinnick) are found in open areas and at the edges of canopy openings. Characteristic herbaceous species include *Trientalis borealis* (starflower), *Melampyrum lineare* (narrowleaf cowwheat), *Maianthemum canadense* (Canada mayflower), *Cypripedium acaule* (moccasin flower), *Lysimachia quadrifolia* (whorled yellow loosestrife), *Aralia nudicaulis* (wild sarsaparilla), *Pteridium aquilinum* (western brackenfern), and *Deschampsia flexuosa* (wavy hairgrass). Some examples have an abundance of vines, including *Parthenocissus quinquefolia* (Virginia creeper), *Smilax rotundifolia* (roundleaf greenbrier), and *Toxicodendron radicans* (eastern poison ivy).
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus rigida* (pitch pine)
Tree canopy	Broad-leaved deciduous tree	*Quercus velutina* (black oak)
Short shrub/sapling	Broad-leaved deciduous shrub	*Prunus maritima* (beach plum)
Short shrub/sapling	Broad-leaved evergreen shrub	*Hudsonia tomentosa* (woolly beachheather)
		Morella pensylvanica (northern bayberry)
Herb (field)	Vine/Liana	*Parthenocissus quinquefolia* (Virginia creeper)
		Smilax rotundifolia (roundleaf greenbrier)
		Toxicodendron radicans (eastern poison ivy)
Herb (field)	Forb	*Maianthemum canadense* (Canada mayflower)
		Trientalis borealis (starflower)

Characteristic Species: *Pinus rigida* (pitch pine)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S1*	B	1	Maritime Pitch Pine on Dunes	Swain and Kearsley 2001

Local Range: This association occurs only in the Provincelands in the seashore.
Classification Comments: Within the Provincelands, there is a range of expressions of this community. Large sections of the Provincelands were planted in pines in the early part of the 20th century. Some of these pines persist as scattered trees with little other vegetation. In

sections of the Provincelands that have been stable the longest, this community has succeeded into a hardwood forest with only a few remnant individuals of *Pinus rigida* (pitch pine). Typically, this community exists as a patch of less than a hectare bordered by barren, moving sand, *Hudsonia* (goldenheather) heathland, or more stable hardwood forest types.
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: Gwilliam (1998) plots: H9911220, H9912110, H9912120, H9912210.
AA (2004) points: CACO.118, CACO.123, CACO.124, CACO.159, CACO.179, CACO.205, CACO.223, CACO.244, CACO.298, CACO.347, CACO.384, CACO.388, CACO.411, CACO.420, CACO.512, CACO.539, CACO.541, CACO.603, CACO.605.
Cape Cod National Seashore Inventory Notes: Mapped in the Dune PineForest aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Woodland (II)
Physiognomic Subclass	Evergreen woodland (II.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
Formation	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
Alliance	*Pinus rigida* Woodland Alliance (A.524)
Alliance (English name)	Pitch Pine Woodland Alliance
Association	*Pinus rigida / Hudsonia tomentosa* Woodland
Association (English name)	Pitch Pine / Woolly Beach-heather Woodland
Ecological System(s):	Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264). Northern Atlantic Coastal Plain Maritime Forest (CES203.302).

GLOBAL DESCRIPTION

Concept Summary: This maritime pitch pine woodland occurs on coastal sand dunes from southern Maine to Cape Henlopen, Delaware. The community occurs on stabilized backdunes influenced by wind and salt spray. Substrate is dry, acidic, nutrient-poor sand. Active sand movement occurs with storm activity, causing the boundaries of the community to migrate over time. There is generally significant cover of bare sand, but where more stabilized, species diversity tends to increase. *Pinus rigida* (pitch pine) dominates the canopy. Canopy associates are few but include *Juniperus virginiana* (eastern redcedar), and occasionally *Sassafras albidum* (sassafras), with scattered individuals of *Quercus velutina* (black oak) in the northern part of the range, and *Quercus falcata* (southern red oak) and *Pinus virginiana* (Virginia pine) to the south. The shrub layer, if present, may include *Hudsonia tomentosa* (woolly beachheather), *Morella pensylvanica* (northern bayberry), *Gaylussacia baccata* (black huckleberry), *Gaylussacia frondosa* (blue huckleberry), *Vaccinium pallidum* (Blue Ridge blueberry), and occasionally *Hudsonia ericoides* (pinebarren goldenheather), or *Viburnum nudum var. cassinoides* (withe-rod). Vines may be present but scarce and include *Smilax rotundifolia* (roundleaf greenbrier), *Smilax glauca* (cat greenbrier), *Parthenocissus quinquefolia* (Virginia creeper), and *Toxicodendron radicans* (eastern poison ivy). The herbaceous layer is sparse but can include *Aralia nudicaulis* (wild sarsaparilla), *Dichanthelium ovale var. addisonii* (Addison's rosette grass), *Solidago odora* (anisescented goldenrod), *Chimaphila maculata* (striped prince's pine),

Lechea maritima (beach pinweed), *Pteridium aquilinum* (western brackenfern), and *Trientalis borealis* (starflower), *Maianthemum canadense* (Canada mayflower), *Deschampsia flexuosa* (wavy hairgrass), *Carex lucorum* (Blue Ridge sedge), and *Arctostaphylos uva-ursi* (kinnikinnick) in the north. Lichens are common, especially *Cladonia* (cup lichen) spp., *Cladina* (reindeer lichen) sp., and *Lepraria* (dust lichen) sp.

Environmental Description: The community occurs on backdunes that are more stabilized than foredunes. Active sand movement occurs with storm activity, causing the boundaries of the community to migrate over time. This community occurs on stabilized, parabolic dunes. The substrate is wind- and wave-deposited sand which is characteristically excessively well-drained and nutrient-poor. Maritime occurrences are subjected to a number of environmental stresses such as high winds, "sand-blasting " by salt spray, shifting substrate and both water and nutrient stress. All of these factors appear to be important in structuring the form and composition of the community.

Vegetation Description: There is generally significant cover of bare sand, but where more stabilized, species diversity tends to increase. *Pinus rigida* (pitch pine) dominates the canopy and averages 10–15 m in height, but is quite variable, ranging from 1 m in an unusual shrub form in Delaware to over 20 m. Canopy associates are few but include *Juniperus virginiana* (eastern redcedar), and occasionally *Sassafras albidum* (sassafras), with scattered individuals of *Quercus velutina* (black oak) in the northern part of the range, and *Quercus falcata* (southern red oak) and *Pinus virginiana* (Virginia pine) to the south. At Cape Henlopen, the subcanopy is sparse but may also include *Quercus marilandica* (blackjack oak), *Quercus stellata* (post oak), *Nyssa sylvatica* (blackgum), and *Prunus serotina* (black cherry). The shrub layer, if present, may include *Hudsonia tomentosa* (woolly beachheather), *Morella pensylvanica* (northern bayberry), *Gaylussacia baccata* (black huckleberry), *Gaylussacia frondosa* (blue huckleberry), *Vaccinium pallidum* (Blue Ridge blueberry), and occasionally *Hudsonia ericoides* (pinebarren goldenheather), or *Viburnum nudum var. cassinoides* (withe-rod). Vines may be present but scarce and include *Smilax rotundifolia* (roundleaf greenbrier), *Smilax glauca* (cat greenbrier), *Parthenocissus quinquefolia* (Virginia creeper), and *Toxicodendron radicans* (eastern poison ivy). The herbaceous layer is sparse but can include *Aralia nudicaulis* (wild sarsaparilla), *Dichanthelium ovale var. addisonii* (Addison's rosette grass), *Solidago odora* (anisescented goldenrod), *Chimaphila maculata* (striped prince's pine), *Lechea maritima* (beach pinweed), *Pteridium aquilinum* (western brackenfern), and *Trientalis borealis* (starflower), *Maianthemum canadense* (Canada mayflower), *Deschampsia flexuosa* (wavy hairgrass), *Carex lucorum* (Blue Ridge sedge), and *Arctostaphylos uva-ursi* (kinnikinnick) in the north. Lichens are common; at Cape Henlopen State Park, Delaware, species included *Cladonia strepsilis* (cup lichen), *Cladina terrae-novae* (reindeer lichen), *Lepraria incana* (dust lichen), and *Cladonia squamosa* (cup lichen).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus rigida* (pitch pine)
Short shrub/sapling	Broad-leaved evergreen shrub	*Hudsonia tomentosa* (woolly beachheather)

Characteristic Species: *Hudsonia tomentosa* (woolly beachheather), *Pinus rigida* (pitch pine)

Other Noteworthy Species:

Species	GRank	Type	Note
Carex silicea (beach sedge)	-	plant	

USFWS Wetland System: Not applicable

DISTRIBUTION

Range: This association occurs along the North Atlantic Coast from southern Maine to Cape Henlopen, Delaware.
States/Provinces: DE:S1, MA, ME, NJ:S1?, NY, RI?
Federal Lands: NPS (Cape Cod, Fire Island)

CONSERVATION STATUS

Rank: G2G3 (31-Jan-2007)
Reasons: This maritime woodland community is restricted to major coastal sand dune systems. It ranges from southern Maine to Cape Henlopen, Delaware; it does not occur in Connecticut or Rhode Island. Occurrences are generally small, ranging from 5 or 10 acres to a few hundred acres at maximum. Rangewide, 25–30 occurrences covering 1000–1200 acres are estimated. This community is threatened by a host of threats common to coastal dune systems in general: dune stabilization, residential and commercial development, and road expansion.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 2 - Moderate
Comments: Floristically this community is similar in composition to maritime shrub forests which lack a tree canopy. Occurrences are patchy within its distributional range and are part of a coastal zone mosaic of communities.
Similar Associations: Information not available.
Related Concepts:

- Coastal dune woodland (Breden 1989) ?
- Maritime forest, dune subtype (Rawinski 1984) ?
- Pine forest (McDonnell 1979) ?
- Pine forest (Johnson 1985b) ?
- Pitch pine dune semiforest community (MENHP 1991) ?

SOURCES

Description Authors: M. Anderson, mod. S.L. Neid
References: Art 1976, Bennett et al. 1998, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1996, DNHP 1998, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Gawler 2001, Gawler 2002, Godfrey et al. 1978, Johnson 1985b, MENHP 1991, Martin 1959b, McDonnell 1979, Motzkin and Foster 2002, Nelson and Fink 1980, RINHP n.d., Rawinski 1984, Reschke 1990, Swain and Kearsley 2001, Trudeau et al. 1977



Figure 19. Pitch Pine Dune Woodland (AA point CACO.244). September 2004. NAD 1983 / UTM easting 401346, northing 4658522.



Figure 20. Pitch Pine Dune Woodland in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 399927, northing 4658408.

COMMON NAME (PARK-SPECIFIC): COASTAL PITCH PINE / SCRUB OAK BARREN

SYNONYMS
USNVC English Name: **Pitch Pine / Bear Oak / Northern Bayberry Woodland**
USNVC Scientific Name: ***Pinus rigida* / *Quercus ilicifolia* / *Morella pensylvanica* Woodland**
USNVC Identifier: **CEGL006315**

LOCAL INFORMATION

Environmental Description: This association occurs on sandy or gravelly outwash plain deposits in exposed areas subject to high winds and salt spray. Soils are acidic and well-drained. Most locations for this association were subject to grazing and were treeless 100 years ago. This community invades maritime heathlands and may have been subject to frequent fires in the past.
Vegetation Description: This association is characterized by a dense thicket dominated by *Quercus ilicifolia* (bear oak) with scattered emergent *Pinus rigida* (pitch pine) and occasional small opening with remnants of the maritime heathland community. Other frequent shrubs in the thicket include *Morella pensylvanica* (northern bayberry), *Gaylussacia baccata* (black huckleberry), and *Vaccinium pallidum* (Blue Ridge blueberry). There are occasional individuals of *Prunus serotina* (black cherry) growing with *Pinus rigida* (pitch pine). The small heathland openings are often dominated by *Arctostaphylos uva-ursi* (kinnikinnick), *Vaccinium angustifolium* (lowbush blueberry), *Hudsonia ericoides* (pinebarren goldenheather), and occasionally *Corema conradii* (broom crowberry). *Gaultheria procumbens* (eastern teaberry) is more prevalent on sites with relatively undisturbed soils. *Deschampsia flexuosa* (wavy hairgrass), *Schizachyrium scoparium* (little bluestem), and lichens are frequently abundant, with *Deschampsia flexuosa* (wavy hairgrass) more prevalent on sites with a history of cultivation or other soil disturbance (Motzkin and Foster 2002).
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus rigida* (pitch pine)
Tree canopy	Broad-leaved deciduous tree	*Prunus serotina* (black cherry)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
		Quercus ilicifolia (bear oak)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Arctostaphylos uva-ursi* (kinnikinnick)
		Morella pensylvanica (northern bayberry)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)
		Schizachyrium scoparium (little bluestem)

Characteristic Species: *Pinus rigida* (pitch pine), *Quercus ilicifolia* (bear oak), *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium pallidum* (Blue Ridge blueberry)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S2*	B	1	Pitch Pine - Scrub Oak	Swain and Kearsley 2001

Local Range: This association occurs along the Atlantic coast bluffs in Eastham, Wellfleet, and Truro and on exposed hilltops along Cape Cod Bay in Wellfleet and Truro.
Classification Comments: Information not available.

Other Comments: This association generally grades into maritime heathlands toward the ocean and the summits of hills and into pitch pine-oak woodlands toward more protected areas. Many of the species found in heathlands persist in this association until the canopy completely closes.
Local Description Authors: R.E. Zaremba
Plots: Foster and Motzkin (2002) plots: CJ92, CC22, CJ120, CJ200, CJ308, CJ108, CJ12, CJ4, CJ203, CC5, CJ115, CJ151, CJ152, CJ111, CJ154, CJ500, CJ727, CJ208, CJ216, CJ265; CACO **AA (2004) points:** CACO.150, CACO.184, CACO.280, CACO.321, CACO.334, CACO.348, CACO.413, CACO.416, CACO.438, CACO.548, CACO.559, CACO.565, CACO.586, CACO.604, CACO.608.
Cape Cod National Seashore Inventory Notes: Mapped in the Pitch Pine Barrens aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Woodland (II)
Physiognomic Subclass	Evergreen woodland (II.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
Formation	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
Alliance	*Pinus rigida* Woodland Alliance (A.524)
Alliance (English name)	Pitch Pine Woodland Alliance
Association	*Pinus rigida / Quercus ilicifolia / Morella pensylvanica* Woodland
Association (English name)	Pitch Pine / Bear Oak / Northern Bayberry Woodland
Ecological System(s):	Northern Atlantic Coastal Plain Pitch Pine Barrens (CES203.269). Northern Atlantic Coastal Plain Maritime Forest (CES203.302). Northern Atlantic Coastal Plain Heathland and Grassland (CES203.895).

GLOBAL DESCRIPTION

Concept Summary: These woodlands of pine barrens in the North Atlantic Coast ecoregion are characterized by droughty, fire-prone vegetation, sandy soils and maritime influence. *Pinus rigida* (pitch pine) is strongly dominant in the canopy. *Quercus ilicifolia* (bear oak) forms a dense, 1- to 2-m tall shrub layer with occasional *Quercus prinoides* (dwarf chinkapin oak). Dwarf-shrubs such as *Gaylussacia baccata* (black huckleberry), *Morella pensylvanica* (northern bayberry), *Vaccinium pallidum* (Blue Ridge blueberry), and *Vaccinium angustifolium* (lowbush blueberry) intermingle with the tall shrubs. Herbs tend to be sparse, although more open areas may support patches of *Schizachyrium scoparium* (little bluestem) and *Deschampsia flexuosa* (wavy hairgrass), or *Carex pensylvanica* (Pennsylvania sedge) and *Carex swanii* (Swan's sedge). Additional scattered herbs include *Comptonia peregrina* (sweet fern), *Pteridium aquilinum* (western brackenfern), *Gaultheria procumbens* (eastern teaberry), and *Arctostaphylos uva-ursi* (kinnikinnick). Diagnostic characteristics include the presence of *Morella pensylvanica* (northern bayberry) to indicate coastal setting.
Environmental Description: These woodlands of pine barrens in the North Atlantic Coast ecoregion are characterized by droughty, fire-prone vegetation, sandy soils and maritime influence. Soils are acidic and well-drained.
Vegetation Description: *Pinus rigida* (pitch pine) is strongly dominant in the canopy. *Quercus ilicifolia* (bear oak) forms a dense, 1- to 2-m tall shrub layer with occasional *Quercus prinoides* (dwarf chinkapin oak). Dwarf-shrubs such as *Gaylussacia baccata* (black huckleberry), *Morella*

pensylvanica (northern bayberry), *Vaccinium pallidum* (Blue Ridge blueberry), and *Vaccinium angustifolium* (lowbush blueberry) intermingle with the tall shrubs. Herbs tend to be sparse, although more open areas may support patches of *Schizachyrium scoparium* (little bluestem) and *Deschampsia flexuosa* (wavy hairgrass), or *Carex pensylvanica* (Pennsylvania sedge) and *Carex swanii* (Swan's sedge). Additional scattered herbs include *Comptonia peregrina* (sweet fern), *Pteridium aquilinum* (western brackenfern), *Gaultheria procumbens* (eastern teaberry), and *Arctostaphylos uva-ursi* (kinnikinnick). Diagnostic characteristics include the presence of *Morella pensylvanica* (northern bayberry) to indicate coastal setting.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus rigida* (pitch pine)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
		Quercus ilicifolia (bear oak)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Morella pensylvanica* (northern bayberry)
Short shrub/sapling	Broad-leaved evergreen shrub	*Arctostaphylos uva-ursi* (kinnikinnick)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)
		Schizachyrium scoparium (little bluestem)

Characteristic Species: *Morella pensylvanica* (northern bayberry), *Pinus rigida* (pitch pine), *Quercus ilicifolia* (bear oak)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable

DISTRIBUTION

Range: Occurs in coastal areas of Massachusetts, Rhode Island, New York, and New Jersey.
States/Provinces: CT, MA, NJ, NY, RI
Federal Lands: NPS (Cape Cod); USFWS (Massasoit?, Parker River)

CONSERVATION STATUS

Rank: G3 (1-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 1 - Strong
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts:

- CNE Mesic hardwood Forest on acidic bedrock / till (Rawinski 1984) B
- Maritime forest (Rawinski 1984) B
- Maritime forest, dune subtype (Rawinski 1984) ?
- New England pitch pine/scrub oak barrens (Rawinski 1984) ?
- SNE dry oak/pine forest on sandy/gravelly soils (Rawinski 1984) B
- SNE dry oak/pine forests on acidic bedrock or till (Rawinski 1984) B
- Southern New England oak / pine forest on sandy / gravelly soils (Rawinski 1984) B

SOURCES

Description Authors: S.L. Neid, mod. E. Largay
References: Breden et al. 2001, Eastern Ecology Working Group n.d., Lundgren et al. 2000, Motzkin and Foster 2002, Rawinski 1984, Swain and Kearsley 2001



Figure 21. Coastal Pitch Pine / Scrub Oak Barren in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 419129, northing 4640474.



Figure 22. Coastal Pitch Pine / Scrub Oak Barren in Cape Cod National Seashore (near AA point CACO.150). September 2004. NAD 1983 / UTM easting 419514, northing 4638240.

COMMON NAME (PARK-SPECIFIC): PITCH PINE - HEATH BARRENS

SYNONYMS
USNVC English Name: **Pitch Pine / Blueberry species - Black Huckleberry Woodland**
USNVC Scientific Name: ***Pinus rigida* / *Vaccinium* spp. - *Gaylussacia baccata* Woodland**
USNVC Identifier: **CEGL005046**

LOCAL INFORMATION

Environmental Description: This association occurs on sandy glacial outwash deposits in areas that have been used as pastures or have been tilled. Periodic fires may have occurred at these sites.

Vegetation Description: These low-diversity pine barrens are dominated by *Pinus rigida* (pitch pine) and are distinctive in that they support few oak species. The canopy may include *Prunus serotina* (black cherry) and an occasional individual of *Quercus velutina* (black oak). The understory is generally open with a low layer of ericaceous shrubs dominated by *Gaylussacia baccata* (black huckleberry), *Vaccinium pallidum* (Blue Ridge blueberry), or *Vaccinium angustifolium* (lowbush blueberry). Some occurrences have concentrations of *Arctostaphylos uva-ursi* (kinnikinnick) or *Corema conradii* (broom crowberry). Occurrences that have been disturbed by past land use may lack ericaceous shrubs and have a ground cover dominated by *Deschampsia flexuosa* (wavy hairgrass). *Carex pensylvanica* (Pennsylvania sedge), *Trientalis borealis* (starflower), *Melampyrum lineare* (narrowleaf cowwheat), *Pteridium aquilinum* (western brackenfern), and *Aralia nudicaulis* (wild sarsaparilla) are often present with a range of lichen species.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus rigida* (pitch pine)
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
		Vaccinium angustifolium (lowbush blueberry)
		Vaccinium pallidum (Blue Ridge blueberry)
Short shrub/sapling	Broad-leaved evergreen shrub	*Gaultheria procumbens* (eastern teaberry)
Herb (field)	Forb	*Maianthemum canadense* (Canada mayflower)
		Melampyrum lineare (narrowleaf cowwheat)
		Trientalis borealis (starflower)
Herb (field)	Graminoid	*Deschampsia flexuosa* (wavy hairgrass)

Characteristic Species: *Deschampsia flexuosa* (wavy hairgrass), *Pinus rigida* (pitch pine)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S2*	B	1	Pitch Pine - Scrub Oak	Swain and Kearsley 2001

Local Range: This association is known from Wellfleet and Truro east of Route 6 and from Great Island in Wellfleet. It may be more common at other locations in Eastham, Wellfleet, and Truro.
Classification Comments: Information not available.
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: Motzkin and Foster (2002) plots: CC54, CC14, CC15, CJ117, CC42, CJ95, CJ176, CJ853, CC50.
AA (2004) Points: CACO.156, CACO.176, CACO.245, CACO.248, CACO.258, CACO.259, CACO.275, CACO.293, CACO.295, CACO.328, CACO.345, CACO.355, CACO.363, CACO.366, CACO.382, CACO.390, CACO.406, CACO.406, CACO.419, CACO.424,

CACO.432, CACO.443, CACO.459, CACO.460, CACO.463, CACO.466, CACO.471, CACO.482, CACO.493, CACO.494, CACO.518, CACO.529, CACO.538, CACO.550, CACO.554, CACO.561, CACO.563, CACO.571, CACO.579, CACO.601.

Cape Cod National Seashore Inventory Notes: Mapped in the Pitch Pine Barrens aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Woodland (II)
Physiognomic Subclass	Evergreen woodland (II.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
Formation	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
Alliance	*Pinus rigida* Woodland Alliance (A.524)
Alliance (English name)	Pitch Pine Woodland Alliance
Association	*Pinus rigida / Vaccinium* spp. - *Gaylussacia baccata* Woodland
Association (English name)	Pitch Pine / Blueberry species - Black Huckleberry Woodland
Ecological System(s):	Northeastern Interior Pine Barrens (CES202.590).

GLOBAL DESCRIPTION

Concept Summary: These pitch pine - heath barrens occur on sandy glacial deposits at low elevations in New England and adjacent Canada. The soils are derived from glacial outwash or, less frequently, till, and are coarse, well-drained to excessively drained, nutrient-poor, and acidic. Sites generally have a history of periodic fire. The tree canopy ranges from sparse to partly open, and the understory features a well-developed low heath layer. Taller shrubs are sparse or absent. The herb and bryoid layers are of variable cover, and the ground cover is sparse needle litter and base sand. The open canopy is dominated by *Pinus rigida* (pitch pine) with a variable mixture of associates, including *Pinus strobus* (eastern white pine), *Pinus resinosa* (red pine), *Quercus rubra* (northern red oak), or *Populus grandidentata* (bigtooth aspen). In the northern part of the range, *Pinus banksiana* (jack pine) or *Picea rubens* (red spruce) may also be present. A few scrub oaks (*Quercus ilicifolia* (bear oak), *Quercus prinoides* (dwarf chinkapin oak)) may be present as tall shrubs. The dwarf-shrub layer is comprised largely of heaths, including *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Vaccinium myrtilloides* (velvetleaf huckleberry), *Gaylussacia baccata* (black huckleberry), and *Kalmia angustifolia* (sheep laurel). The herbaceous layer often includes *Pteridium aquilinum* (western brackenfern), *Carex pensylvanica* (Pennsylvania sedge), *Carex lucorum* (Blue Ridge sedge), *Piptatherum pungens* (mountain ricegrass), *Gaultheria procumbens* (eastern teaberry), *Aralia nudicaulis* (wild sarsaparilla), *Maianthemum canadense* (Canada mayflower), *Melampyrum lineare* (narrowleaf cowwheat), *Fragaria virginiana* (Virginia strawberry), *Lysimachia quadrifolia* (whorled yellow loosestrife), and *Cypripedium acaule* (moccasin flower). The bryophyte layer is of variable cover and is characterized by *Cladina arbuscula* (reindeer lichen), *Cladonia pyxidata* (cup lichen), *Dicranum polysetum* (dicranum moss), *Pleurozium schreberi* (Schreber's big red stem moss), and *Leucobryum glaucum* (leucobryum moss). These barrens differ from the related *Pinus rigida / Quercus ilicifolia / Piptatherum pungens* Woodland (CEGL006203) in their lack of a well-defined scrub oak shrub layer; they are also more likely to have *Pinus strobus* (eastern white pine) and/or *Pinus resinosa* (red pine) as a canopy associate.

Environmental Description: These pitch pine - heath barrens occur on sandy glacial deposits at low elevations in New England and adjacent Canada. The soils are derived from glacial outwash

or, less frequently, till, and are coarse, well-drained to excessively drained, nutrient-poor, and acidic. Sites generally have a history of periodic fire.

Vegetation Description: The tree canopy ranges from sparse to partly open, and the understory features a well-developed low heath layer. Taller shrubs are sparse or absent. The herb and bryoid layers are of variable cover, and the ground cover is sparse needle litter and base sand. The open canopy is dominated by *Pinus rigida* (pitch pine) with a variable mixture of associates, including *Pinus strobus* (eastern white pine), *Pinus resinosa* (red pine), *Quercus rubra* (northern red oak), or *Populus grandidentata* (bigtooth aspen). In the northern part of the range, *Pinus banksiana* (jack pine) or *Picea rubens* (red spruce) may also be present. A few scrub oaks (*Quercus ilicifolia* (bear oak), *Quercus prinoides* (dwarf chinkapin oak)) may be present as tall shrubs. The dwarf-shrub layer is comprised largely of heaths, including *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Vaccinium myrtilloides* (velvetleaf huckleberry), *Gaylussacia baccata* (black huckleberry), and *Kalmia angustifolia* (sheep laurel). The herbaceous layer often includes *Pteridium aquilinum* (western brackenfern), *Carex pensylvanica* (Pennsylvania sedge) and/or *Carex lucorum* (Blue Ridge sedge), *Piptatherum pungens* (mountain ricegrass), *Gaultheria procumbens* (eastern teaberry), *Aralia nudicaulis* (wild sarsaparilla), *Maianthemum canadense* (Canada mayflower), *Melampyrum lineare* (narrowleaf cowwheat), *Fragaria virginiana* (Virginia strawberry), *Lysimachia quadrifolia* (whorled yellow loosestrife), and *Cypripedium acaule* (moccasin flower). The bryophyte layer is of variable cover and is characterized by *Cladina arbuscula* (reindeer lichen), *Cladonia pyxidata* (cup lichen), *Dicranum polysetum* (dicranum moss), *Pleurozium schreberi* (Schreber's big red stem moss), and *Leucobryum glaucum* (leucobryum moss).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus rigida* (pitch pine)
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
		Vaccinium angustifolium (lowbush blueberry)
		Vaccinium pallidum (Blue Ridge blueberry)
Short shrub/sapling	Broad-leaved evergreen shrub	*Gaultheria procumbens* (eastern teaberry)
Herb (field)	Forb	*Maianthemum canadense* (Canada mayflower)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)

Characteristic Species: *Gaylussacia baccata* (black huckleberry), *Pinus rigida* (pitch pine), *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium pallidum* (Blue Ridge blueberry)

Other Noteworthy Species:

Species	GRank	Type	Note
Catharus fuscescens (veery)	-	animal	
Dendroica pensylvanica (chestnut-sided warbler)	-	animal	
Geothlypis trichas (common yellowthroat)	-	animal	
Hylocichla mustelina (wood thrush)	-	animal	
Seiurus aurocapilla (ovenbird)	-	animal	

USFWS Wetland System: Not applicable

DISTRIBUTION

Range: This association occurs at low elevations in New England and adjacent Canada.
States/Provinces: CT, MA, ME:S1, NH, NY:S1S2, ON:S1, RI, VT
Federal Lands: NPS (Acadia, Cape Cod)

CONSERVATION STATUS

Rank: G3G5 (15-Dec-1994)
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: Information not available.

Similar Associations:

- *Pinus rigida / Quercus ilicifolia / Piptatherum pungens* Woodland (CEGL006203)

Related Concepts:

- New England pitch pine/scrub oak barrens (Rawinski 1984) ?
- Pitch pine-heath barrens (NAP pers. comm. 1998) ?

SOURCES

Description Authors: S.C. Gawler

References: Eastern Ecology Working Group n.d., Edinger et al. 2002, Gawler 2002, Lundgren 1999a, Metzler and Barrett 2001, Moore and Taylor 1927, Motzkin and Foster 2002, NAP pers. comm. 1998, Rawinski 1984, Sperduto 2000a, Swain and Kearsley 2001



Figure 23. Pitch Pine - Heath Barrens in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 400413, northing 4658611.



Figure 24. Pitch Pine - Heath Barrens in Truro, Cape Cod National Seashore (no specific plot). September 2004. UTM coordinates not available.

COMMON NAME (PARK-SPECIFIC): ATLANTIC WHITE-CEDAR BOG

SYNONYMS
USNVC English Name: **Atlantic White-cedar / Leatherleaf Woodland**
USNVC Scientific Name: ***Chamaecyparis thyoides* / *Chamaedaphne calyculata* Woodland**
USNVC Identifier: **CEGL006321**

LOCAL INFORMATION

Environmental Description: This Atlantic white-cedar shrubland occurs in interdunal swales in the Provincelands on deep layers of peat which appear to be floating. Trees and shrubs are gnarled, occur on tussocks, and appear to be very old. Between the tussocks are narrow deer-maintained passages which support *Sphagnum* (sphagnum) and *Woodwardia virginica* (Virginia chainfern).
Vegetation Description: In the interdunal swale occurrence, a low canopy (2.25 m) is dominated by *Chamaecyparis thyoides* (Atlantic white cedar), *Acer rubrum* (red maple), and *Pinus rigida* (pitch pine). The dense shrub layer is dominated by *Gaylussacia baccata* (black huckleberry) with *Vaccinium corymbosum* (highbush blueberry) and *Rhododendron viscosum* (swamp azalea). The only herbaceous plant in this setting of the community is *Woodwardia virginica* (Virginia chainfern).
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Chamaecyparis thyoides* (Atlantic white cedar)
		Pinus rigida (pitch pine)
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
		Rhododendron viscosum (swamp azalea)
		Vaccinium corymbosum (highbush blueberry)
Herb (field)	Fern or fern ally	*Woodwardia virginica* (Virginia chainfern)

Characteristic Species: *Acer rubrum* (red maple), *Chamaecyparis thyoides* (Atlantic white cedar), *Gaylussacia baccata* (black huckleberry), *Pinus rigida* (pitch pine)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S2*	I	1	Atlantic White Cedar Bog	Swain and Kearsley 2001

Local Range: This association occurs in interdunal swales in the Provincelands.
Classification Comments: This is an unusual setting for *Chamaecyparis thyoides* (Atlantic white cedar). The interdunal swale supporting this community is in the oldest part of the Provinceland Spit. A railroad embankment occurs along the western border of the swale. A dense stand of *Chamaecyparis thyoides* (Atlantic white cedar) occurs along the embankment.
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: CACO.112 (outside CACO boundary)
AA (2004) Points: None.
Cape Cod National Seashore Inventory Notes: Photograph not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Woodland (II)
Physiognomic Subclass	Evergreen woodland (II.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
Formation	Saturated temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.f.)
Alliance	*Chamaecyparis thyoides* Saturated Woodland Alliance (A.575)
Alliance (English name)	Atlantic White-cedar Saturated Woodland Alliance
Association	*Chamaecyparis thyoides / Chamaedaphne calyculata* Woodland
Association (English name)	Atlantic White-cedar / Leatherleaf Woodland
Ecological System(s):	North-Central Interior and Appalachian Acidic Peatland (CES202.606).

GLOBAL DESCRIPTION

Concept Summary: This Atlantic white-cedar bog of the northeastern coastal region is an oligotrophic basin peatland dominated by heath shrubs with an open canopy of stunted white-cedar. *Chamaecyparis thyoides* (Atlantic white cedar) is the most abundant tree but generally grows in association with other trees such as *Acer rubrum* (red maple), *Pinus rigida* (pitch pine), *Nyssa sylvatica* (blackgum), and *Magnolia virginiana* (sweetbay). Tall shrubs may be present and scattered, including *Vaccinium corymbosum* (highbush blueberry), *Clethra alnifolia* (coastal sweetpepperbush), or *Rhododendron viscosum* (swamp azalea). Heath shrubs form a dense low-shrub layer dominated by *Chamaedaphne calyculata* (leatherleaf) and *Kalmia angustifolia* (sheep laurel). Other dwarf-shrub associates may include *Gaylussacia baccata* (black huckleberry), *Rhododendron canadense* (rhodora), and *Gaylussacia dumosa* (dwarf huckleberry). Herbaceous species growing within the dwarf-shrub mat often include *Eriophorum* (cottongrass) spp., *Woodwardia virginica* (Virginia chainfern), *Vaccinium macrocarpon* (cranberry), *Drosera* (sundew) spp., and *Sarracenia purpurea* (purple pitcherplant). *Sphagnum* (sphagnum) mosses form a continuous layer. Key diagnostic characteristic is the sparse *Chamaecyparis thyoides* (Atlantic white cedar) canopy over dense heath shrubs.
Environmental Description: This Atlantic white-cedar bog of the northeastern coastal region is an oligotrophic basin peatland dominated by heath shrubs with an open canopy of stunted cedar.
Vegetation Description: *Chamaecyparis thyoides* (Atlantic white cedar) is the most abundant tree but generally grows in association with other trees such as *Acer rubrum* (red maple), *Pinus rigida* (pitch pine), *Nyssa sylvatica* (blackgum), and *Magnolia virginiana* (sweetbay). Tall shrubs may be present and scattered, including *Vaccinium corymbosum* (highbush blueberry), *Clethra alnifolia* (coastal sweetpepperbush), or *Rhododendron viscosum* (swamp azalea). Heath shrubs form a dense low-shrub layer dominated by *Chamaedaphne calyculata* (leatherleaf) and *Kalmia angustifolia* (sheep laurel). Other dwarf-shrub associates may include *Gaylussacia baccata* (black huckleberry), *Rhododendron canadense* (rhodora), and *Gaylussacia dumosa* (dwarf huckleberry). Herbaceous species growing within the dwarf-shrub mat often include *Eriophorum* (cottongrass) spp., *Woodwardia virginica* (Virginia chainfern), *Vaccinium macrocarpon* (cranberry), *Drosera* (sundew) spp., and *Sarracenia purpurea* (purple pitcherplant). *Sphagnum* (sphagnum) mosses form a continuous layer. Key diagnostic characteristic is the sparse *Chamaecyparis thyoides* (Atlantic white cedar) canopy over dense heath shrubs.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Chamaecyparis thyoides* (Atlantic white cedar)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Clethra alnifolia* (coastal sweetpepperbush)
		Rhododendron viscosum (swamp azalea)
		Vaccinium corymbosum (highbush blueberry)
Short shrub/sapling	Broad-leaved evergreen shrub	*Chamaedaphne calyculata* (leatherleaf)
		Kalmia angustifolia (sheep laurel)
Herb (field)	Fern or fern ally	*Woodwardia virginica* (Virginia chainfern)

Characteristic Species: *Chamaecyparis thyoides* (Atlantic white cedar), *Chamaedaphne calyculata* (leatherleaf), *Gaylussacia baccata* (black huckleberry), *Vaccinium corymbosum* (highbush blueberry)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine

DISTRIBUTION
Range: Occurs from Maine to Connecticut.
States/Provinces: CT, MA, ME:S1, NH, NJ, NY, RI
Federal Lands: NPS (Cape Cod)

CONSERVATION STATUS
Rank: G3G4 (1-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: Information not available.
Similar Associations:
- *Chamaecyparis thyoides - (Tsuga canadensis, Betula alleghaniensis) / Clethra* alnifolia Forest (CEGL006189)--lacks boreal and coastal plain indicators.
- *Chamaecyparis thyoides - Picea rubens / Gaylussacia baccata / Gaultheria hispidula* Forest (CEGL006363)--distinguished by presence of boreal species.
- *Chamaecyparis thyoides / Rhododendron maximum* Forest (CEGL006355)--distinguished by dense *Rhododendron maximum* in shrub layer.

Related Concepts:
- *Chamaecyparis thyoides/Chamaedaphne* (Barrett 1996) ?
- *Chamaecyparis/Chamaedaphne* (Type 5) (Sperduto and Crowley 2002b) ?
- Cedar bog type (Motzkin 1991) ?

SOURCES
Description Authors: S.L. Neid
References: Barrett 1996, Breden et al. 2001, Eastern Ecology Working Group n.d., Enser 1999, Gawler 2002, Metzler 1997, Metzler and Barrett 2001, Metzler and Barrett 2004, Motzkin 1991, Sperduto and Crowley 2002b, Sperduto and Nichols 2004, Swain and Kearsley 2001

COMMON NAME (PARK-SPECIFIC): PITCH PINE / CRANBERRY INTERDUNAL SWALE

SYNONYMS
USNVC English Name: **Pitch Pine / Large Cranberry Woodland**
USNVC Scientific Name: ***Pinus rigida* / *Vaccinium macrocarpon* Woodland**
USNVC Identifier: **CEGL006127**

LOCAL INFORMATION

Environmental Description: This association occurs in freshwater interdunal swales that dry out during periods of extended drought and can be full of water up to 20 cm deep during very wet periods. Wetland species are generally precluded from persisting in these sites because of extended dry periods. *Vaccinium macrocarpon* (cranberry) often covers the surface to a depth of 5 to 15 cm reducing the potential for other species to colonize. There is a thin layer of organic material from shed leaves of *Vaccinium macrocarpon* (cranberry). *Pinus rigida* (pitch pine) and wetland border shrubs, such as *Vaccinium corymbosum* (highbush blueberry), *Morella pensylvanica* (northern bayberry), and *Ilex glabra* (inkberry), occur at slightly higher elevation points in the swales, often looking like small islands or ridges, reflecting past disturbances and eolian deflation of the swale surface.

Vegetation Description: This association is dominated by *Vaccinium macrocarpon* (cranberry) which can form 100% cover in many instances. Often the vegetation is "springy" from dense stands of *Vaccinium macrocarpon* (cranberry) that can be 20 cm deep. Common associates include *Scirpus cyperinus* (woolgrass), *Juncus canadensis* (Canadian rush), *Drosera intermedia* (spoonleaf sundew), and *Polytrichum* (polytrichum moss) sp., Within these swales there are occasional small islands or ridges that support scattered *Pinus rigida* (pitch pine) and wetland border species, including *Vaccinium corymbosum* (highbush blueberry), *Morella pensylvanica* (northern bayberry), *Ilex glabra* (inkberry), and *Photinia melanocarpa* (black chokeberry). Some of these may also have *Smilax rotundifolia* (roundleaf greenbrier). The association is characteristically low diversity and appears to be stable for long periods of time, maintained by fluctuating water levels and low nutrient, acid conditions.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus rigida* (pitch pine)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Vaccinium corymbosum* (highbush blueberry)
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Morella pensylvanica* (northern bayberry)
		Vaccinium macrocarpon (cranberry)
Herb (field)	Graminoid	*Juncus canadensis* (Canadian rush)
		Scirpus cyperinus (woolgrass)

Characteristic Species: *Vaccinium macrocarpon* (cranberry)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNR	NA	NA	[not crosswalked]	Swain and Kearsley 2001

Local Range: Limited to the Provincelands.
Classification Comments: This is the most common association found in the many interdunal swales in the Provincelands. Most examples are very low diversity and can be a monoculture of *Vaccinium macrocarpon* (cranberry).

Other Comments: There is no clear crosswalk in the MA classification to this USNVC association.
Local Description Authors: R.E. Zaremba
Plots: CACO.006.
AA (2004) Points: CACO.225, CACO.272, CACO.313, CACO.341, CACO.367, CACO.409, CACO.452, CACO.483, CACO.613.
Cape Cod National Seashore Inventory Notes: Mapped in the Dune Pine Forest aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Woodland (II)
Physiognomic Subclass	Evergreen woodland (II.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
Formation	Saturated temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.f.)
Alliance	*Pinus rigida* Saturated Woodland Alliance (A.580)
Alliance (English name)	Pitch Pine Saturated Woodland Alliance
Association	*Pinus rigida / Vaccinium macrocarpon* Woodland
Association (English name)	Pitch Pine / Large Cranberry Woodland
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This northeastern interdunal swale occurs on Cape Cod, Massachusetts, and Long Island, New York. It is characterized by a saturated to seasonally flooded mat of *Vaccinium macrocarpon* (cranberry) with a canopy of *Pinus rigida* (pitch pine). The substrate is a thin organic layer over the deep sands of coastal dunes. Although generally saturated, the water level may drop below the surface during dry periods. The canopy is characterized by *Pinus rigida* (pitch pine) nearly exclusively, and ranges from very open to nearly closed. The shrub layer, if present, is comprised of *Vaccinium corymbosum* (highbush blueberry), *Morella pensylvanica* (northern bayberry), *Ilex glabra* (inkberry), or *Kalmia angustifolia* (sheep laurel). The dwarf-shrub or field layer is heavily dominated by *Vaccinium macrocarpon* (cranberry). Other associates may include *Scirpus cyperinus* (woolgrass), *Juncus canadensis* (Canadian rush), and *Drosera rotundifolia* (roundleaf sundew).
Environmental Description: This association is characterized by saturated to seasonally flooded hydrology, occurring on interdunal swales of coastal sand dunes.
Vegetation Description: The canopy is characterized by *Pinus rigida* (pitch pine) nearly exclusively and ranges from very open to nearly closed. The shrub layer, if present, is comprised of *Vaccinium corymbosum* (highbush blueberry), *Morella pensylvanica* (northern bayberry), *Ilex glabra* (inkberry), or *Kalmia angustifolia* (sheep laurel). The dwarf-shrub or field layer is heavily dominated by *Vaccinium macrocarpon* (cranberry). Other associates may include *Scirpus cyperinus* (woolgrass), *Juncus canadensis* (Canadian rush), and *Drosera rotundifolia* (roundleaf sundew).
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus rigida* (pitch pine)
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Vaccinium macrocarpon* (cranberry)

Characteristic Species: *Vaccinium macrocarpon* (cranberry)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable

DISTRIBUTION
Range: This association occurs on Long Island and coastal Massachusetts on dunes.
States/Provinces: MA, NY
Federal Lands: NPS (Cape Cod)

CONSERVATION STATUS
Rank: GNR (21-Apr-2004)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence:
Comments: Information not available.
Similar Associations:
- *Cladium mariscoides / Vaccinium macrocarpon - Morella pensylvanica* Dwarf-shrubland (CEGL006141)

Related Concepts: Information not available.

SOURCES
Description Authors: L.A. Sneddon and R.E. Zaremba
References: Eastern Ecology Working Group n.d., Johnson 1981b



Figure 25. Pitch Pine / Cranberry Interdunal Swale in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 399807, northing 4658302.

COMMON NAME (PARK-SPECIFIC): RED MAPLE / TUSSOCK SEDGE WOODED MARSH

SYNONYMS
USNVC English Name: **Red Maple / Tussock Sedge - Sensitive Fern Woodland**
USNVC Scientific Name: ***Acer rubrum* / *Carex stricta* - *Onoclea sensibilis* Woodland**
USNVC Identifier: **CEGL006119**

LOCAL INFORMATION

Environmental Description: This community is found on deep peat deposits along a slow-moving Coastal Plain stream. The substrate is loose and appears to be floating. One expression of this community is narrow and linear and occurs immediately along the stream; another is set in a broad, flat embayment along the stream.
Vegetation Description: This woodland has a canopy ranging from 25 to 50% cover of multi-stemmed *Acer rubrum* (red maple) with a variable understory. Along the stream border, *Carex stricta* (upright sedge) dominates. Away from the stream, *Carex lacustris* (hairy sedge) is the dominant graminoid with locally high concentrations of *Scirpus cyperinus* (woolgrass) and *Typha angustifolia* (narrowleaf cattail). A low cover shrub layer includes stunted *Pinus rigida* (pitch pine) and scattered *Toxicodendron vernix* (poison sumac), *Rhododendron viscosum* (swamp azalea), and *Vaccinium corymbosum* (highbush blueberry). Herbs include *Eriophorum viridicarinatum* (thinleaf cottonsedge), *Osmunda cinnamomea* (cinnamon fern), and *Bartonia virginica* (yellow screwstem).
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Spiraea tomentosa* (steeplebush)
		Toxicodendron radicans (eastern poison ivy)
		Toxicodendron vernix (poison sumac)
		Vaccinium corymbosum (highbush blueberry)
Herb (field)	Graminoid	*Carex lacustris* (hairy sedge)
		Carex stricta (upright sedge)

Characteristic Species: *Carex lacustris* (hairy sedge), *Carex stricta* (upright sedge)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S5*	B	1	Red Maple Swamp	Swain and Kearsley 2001

Local Range: This wetland is known only from the borders of the Herring River east of Route 6.
Classification Comments: This community is highly variable and may actually consist of more than one association. The only occurrences of this association were noted along the upper section of the Herring River. There may be additional occurrences elsewhere within the Herring River/Bound Brook region.
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: CACO.042.
AA (2004) Points: CACO.166
Cape Cod National Seashore Inventory Notes: Mapped in the Wooded Marsh aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Woodland (II)
Physiognomic Subclass	Deciduous woodland (II.B.)
Physiognomic Group	Cold-deciduous woodland (II.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous woodland (II.B.2.N.)
Formation	Seasonally flooded cold-deciduous woodland (II.B.2.N.c.)
Alliance	*Acer rubrum* Seasonally Flooded Woodland Alliance (A.653)
Alliance (English name)	Red Maple Seasonally Flooded Woodland Alliance
Association	*Acer rubrum / Carex stricta - Onoclea sensibilis* Woodland
Association (English name)	Red Maple / Tussock Sedge - Sensitive Fern Woodland
Ecological System(s):	Northern Appalachian-Acadian Conifer - Hardwood Acidic Swamp (CES201.574). North-Central Appalachian Acidic Swamp (CES202.604). Northeastern Interior Dry-Mesic Oak Forest (CES202.592).

GLOBAL DESCRIPTION

Concept Summary: This association is a partly wooded, deciduous-canopy wetland of the northeastern United States. It occurs on muck soils or mineral soils with a surface organic layer in poorly drained depressions influenced by groundwater. It is also common in those streamside and lakeside settings where the hydrology is that of a basin setting rather than a floodplain. The community is typically flooded in spring, with pools and small streams persisting throughout much of the growing season; soils may remain saturated or may become dry on the surface over the course of the growing season. Hummock-and-hollow topography may be pronounced. The canopy consists of scattered trees, with as little as 25% overall cover. The shrub layer is patchy and may be extensive in places. The herb layer is typically well-developed, with ferns and graminoids dominant. The bryophyte cover is variable. *Acer rubrum* (red maple) is dominant in the canopy, often with many standing dead trees, and may be the only canopy species present. Associated trees may include *Fraxinus nigra* (black ash), *Ulmus americana* (American elm), and occasional *Pinus strobus* (eastern white pine), *Tsuga canadensis* (eastern hemlock), or *Picea rubens* (red spruce). The shrub layer is characterized by *Vaccinium corymbosum* (highbush blueberry), *Spiraea alba var. latifolia* (white meadowsweet), and *Ilex verticillata* (common winterberry). The herbaceous layer is typically dominated by the graminoids or the ferns. *Sphagnum* (sphagnum) spp. are the characteristic bryophytes, with non-sphagnous mosses as associates. These woodlands are ecologically similar to both *Acer rubrum / Nemopanthus mucronatus - Vaccinium corymbosum* Forest (CEGL006220) and *Picea rubens - Acer rubrum / Nemopanthus mucronatus* Forest (CEGL006198), but those are closed-canopy wetlands. This association does not include red maple wooded wetlands on deeper peat soils [see *Acer rubrum / Alnus incana - Ilex verticillata / Osmunda regalis* Woodland (CEGL006395) and *Acer rubrum - Larix laricina / Rhamnus alnifolia* Woodland (CEGL006118)].

Environmental Description: This association is a partly wooded, deciduous-canopy wetland of central and northern New England. It occurs on muck soils or mineral soils with a surface organic layer, in poorly drained depressions influenced by groundwater. It is also common in those streamside and lakeside settings where the hydrology is that of a basin setting rather than a floodplain. The community is typically flooded in spring, with pools and small streams persisting throughout much of the growing season; soils may remain saturated, or may become dry on the surface over the course of the growing season. Hummock-and-hollow topography may be pronounced.

Vegetation Description: The canopy consists of scattered trees, with as little as 25% overall cover. The shrub layer is patchy and may be extensive in places. The herb layer is typically well-developed, with ferns and graminoids dominant. The bryophyte cover is variable. *Acer rubrum* (red maple) is dominant in the canopy, often with many standing dead trees. Associated trees may include *Fraxinus nigra* (black ash), *Ulmus americana* (American elm), and occasional *Pinus strobus* (eastern white pine), *Tsuga canadensis* (eastern hemlock), or *Picea rubens* (red spruce). The shrub layer is characterized by *Vaccinium corymbosum* (highbush blueberry), *Spiraea alba var. latifolia* (white meadowsweet), and *Ilex verticillata* (common winterberry). Other shrubs may be locally common, including *Nemopanthus mucronatus* (catberry), *Viburnum nudum var. cassinoides* (withe-rod), *Viburnum dentatum* (southern arrowwood), *Lyonia ligustrina* (maleberry), *Alnus incana* (gray alder), *Ilex laevigata* (smooth winterberry), and the creeping *Rubus hispidus* (bristly dewberry). The herbaceous layer is typically dominated by the graminoids *Carex stricta* (upright sedge), *Carex lacustris* (hairy sedge), or *Calamagrostis canadensis* (bluejoint) or the ferns *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), or *Osmunda claytoniana* (interrupted fern). Less abundant herbs include *Carex intumescens* (greater bladder sedge), *Carex folliculata* (northern long sedge), *Carex canescens* (silvery sedge), *Carex trisperma* (threeseeded sedge), *Glyceria striata* (fowl mannagrass), *Osmunda regalis* (royal fern), *Dryopteris cristata* (crested woodfern), *Thelypteris palustris* (eastern marsh fern), *Lycopus uniflorus* (northern bugleweed), *Symplocarpus foetidus* (skunk cabbage), *Galium palustre* (common marsh bedstraw), *Cicuta bulbifera* (bulblet-bearing water hemlock), *Caltha palustris* (yellow marsh marigold), and *Impatiens capensis* (jewelweed). *Sphagnum* (sphagnum) spp. are the characteristic bryophytes, with non-sphagnous mosses as associates.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Ilex verticillata* (common winterberry)
		Vaccinium corymbosum (highbush blueberry)
Short shrub/sapling	Broad-leaved deciduous shrub	*Spiraea alba* var. *latifolia* (white meadowsweet)
Herb (field)	Graminoid	*Calamagrostis canadensis* (bluejoint)
		Carex lacustris (hairy sedge)
		Carex stricta (upright sedge)
Herb (field)	Fern or fern ally	*Onoclea sensibilis* (sensitive fern)
		Osmunda cinnamomea (cinnamon fern)
		Osmunda claytoniana (interrupted fern)

Characteristic Species: *Acer rubrum* (red maple), *Ilex verticillata* (common winterberry), *Onoclea sensibilis* (sensitive fern), *Spiraea alba* var. *latifolia* (white meadowsweet), *Vaccinium corymbosum* (highbush blueberry)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine

DISTRIBUTION

Range: This wetland is found in central and northern New England, south to Pennsylvania and New Jersey.

States/Provinces: CT, MA, ME, NH, NJ, PA, RI, VT

Federal Lands: NPS (Cape Cod, Minute Man); USFWS (Erie, Great Meadows, Great Swamp, Moosehorn, Oxbow)

CONSERVATION STATUS
Rank: G3G5 (1-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: Information not available.
Similar Associations:
- *Acer rubrum / Carex lacustris* Woodland (CEGL006105)
- *Acer rubrum / Nemopanthus mucronatus - Vaccinium corymbosum* Forest (CEGL006220)
- *Acer rubrum / Rhododendron viscosum - Clethra alnifolia* Forest (CEGL006156)

Related Concepts:
- *Acer rubrum / Vaccinium corymbosum / Carex intumescens* Alluvial Forest (Barrett and Enser 1997) ?
- Palustrine Broad-leaved Deciduous Forested Wetlands (PFO1) (Cowardin et al. 1979) ?
- Red Maple: 108 (Eyre 1980) B
- Red maple wooded sedge/fern marsh (CAP pers. comm. 1998) ?
- Southern New England stream bottom forest (Rawinski 1984) ?

SOURCES
Description Authors: S.C. Gawler
References: Barrett and Enser 1997, CAP pers. comm. 1998, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Eyre 1980, Fike 1999, Gawler 2002, Golet et al. 1993, Hunt 1999, Metzler and Barrett 2001, Moore and Taylor 1927, Rawinski 1984, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2001, Thompson and Sorenson 2000



Figure 26. Red Maple / Tussock Sedge Wooded Marsh along the Herring River in Cape Cod National Seashore (plot CACO.042). September 2007. NAD 83 / UTM easting 414855, northing 4645979.

COMMON NAME (PARK-SPECIFIC): NORTHERN BAYBERRY DUNE SHRUBLAND

SYNONYMS
USNVC English Name: **Northern Bayberry - Beach Plum Shrubland**
USNVC Scientific Name: ***Morella pensylvanica* - *Prunus maritima* Shrubland**
USNVC Identifier: **CEGL006295**

LOCAL INFORMATION

Environmental Description: This association occurs on stabilized dunes and along the exposed bluffs. There are also occurrences on dune sand deposited on high outwash bluffs. Soils are sandy or gravelly and extremely well-drained.
Vegetation Description: This association is dominated by *Morella pensylvanica* (northern bayberry) and *Prunus maritima* (beach plum). *Rosa rugosa* (rugosa rose) is a dominant in some areas and can co-occur with *Morella pensylvanica* (northern bayberry). Other shrubs (and trees) include *Prunus serotina* (black cherry), *Amelanchier canadensis* (Canadian serviceberry), and *Baccharis halimifolia* (eastern baccharis). *Toxicodendron radicans* (eastern poison ivy) is usually present. Herbs may be sparse and include *Deschampsia flexuosa* (wavy hairgrass), *Ammophila breviligulata* (American beachgrass), and *Solidago sempervirens* (seaside goldenrod).
Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Prunus maritima* (beach plum)
		Rosa rugosa (rugosa rose)
		Toxicodendron radicans (eastern poison ivy)
Short shrub/sapling	Broad-leaved evergreen shrub	*Morella pensylvanica* (northern bayberry)
Herb (field)	Graminoid	*Ammophila breviligulata* (American beachgrass)
		Deschampsia flexuosa (wavy hairgrass)

Characteristic Species: *Morella pensylvanica* (northern bayberry), *Prunus maritima* (beach plum)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S2*	I	1	Maritime Dune	Swain and Kearsley 2001
MA	S3*	I	1	Maritime Shrubland	Swain and Kearsley 2001

Local Range: This association occurs along the more stable sections of the Nauset Spit, in the Provincelands, along the Atlantic bluffs in Eastham, Wellfleet and Truro, and along Cape Cod Bay in Wellfleet and Truro.
Classification Comments: Many occurrences include species from nearby stabilized dunes dominated by *Ammophila breviligulata* (American beachgrass), *Deschampsia* (hairgrass), and *Solidago sempervirens* (seaside goldenrod). Other occurrences suggest the future development of a maritime forest with *Amelanchier canadensis* (Canadian serviceberry) and *Prunus serotina* (black cherry).
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: CACO.014, CACO.028, CACO.035, CACO.048, CACO.067, CACO.121, CACO.122.
AA (2004) Points: CACO.106, CACO.139, CACO.146, CACO.168, CACO.172, CACO.262, CACO.291, CACO.304, CACO.335, CACO.337, CACO.377, CACO.392, CACO.434, CACO.440, CACO.501, CACO.551.

Cape Cod National Seashore Inventory Notes: Mapped in the Dune Shrub aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Temperate cold-deciduous shrubland (III.B.2.N.a.)
Alliance	*Morella pensylvanica - (Prunus maritima)* Shrubland Alliance (A.902)
Alliance (English name)	Northern Bayberry - (Beach Plum) Shrubland Alliance
Association	*Morella pensylvanica - Prunus maritima* Shrubland
Association (English name)	Northern Bayberry - Beach Plum Shrubland
Ecological System(s):	Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264). Northern Atlantic Coastal Plain Maritime Forest (CES203.302). Acadian-North Atlantic Rocky Coast (CES201.573).

GLOBAL DESCRIPTION

Concept Summary: This association comprises maritime dune shrublands of protected slopes and hollows of dry, stabilized maritime backdunes along the northern Atlantic Coast. It is dominated by *Morella pensylvanica* (northern bayberry) and *Prunus maritima* (beach plum). Additional shrubs that are commonly present but with low cover can include *Rosa carolina* (Carolina rose), *Rosa rugosa* (rugosa rose), *Baccharis halimifolia* (eastern baccharis), *Rhus typhina* (staghorn sumac), or *Juniperus virginiana* (eastern redcedar). Although *Rosa rugosa* (rugosa rose) is not a native species, it is naturalized and is nearly restricted to this vegetation, where it grows in similar habit and physiognomy as the other two shrubs characteristic of this vegetation. The herbaceous layer tends to be sparse and low, particularly where shrub growth is dense, and can include dune grassland or adjacent upland species such as *Ammophila breviligulata* (American beachgrass), *Solidago sempervirens* (seaside goldenrod), *Hudsonia tomentosa* (woolly beachheather), *Lechea maritima* (beach pinweed), *Juncus greenei* (Greene's rush), *Carex silicea* (beach sedge), *Polygonella articulata* (coastal jointweed), *Symphyotrichum subulatum* (eastern annual saltmarsh aster), *Solidago rugosa* (wrinkleleaf goldenrod), *Achillea millefolium* (common yarrow), *Oenothera parviflora* (northern evening-primrose), *Euthamia* (goldentop) spp., *Cyperus grayi* (Gray's flatsedge), *Cyperus polystachyos* (manyspike flatsedge), *Schizachyrium scoparium* (little bluestem), and others. Typical vine associates are *Toxicodendron radicans* (eastern poison ivy), *Parthenocissus quinquefolia* (Virginia creeper), and *Smilax* (greenbrier) spp. Large patches of open unvegetated or sparsely vegetated sand are present in some examples. Depending on exposure, these shrublands range from over 2 m tall in sheltered areas to less than 1 m tall in areas with greater exposure to winds and storms.
Environmental Description: This association occurs on protected slopes and hollows of dry, stabilized maritime backdunes where the water table is greater than 1 m from the surface.
Vegetation Description: This shrubland vegetation is dominated by *Morella pensylvanica* (northern bayberry) and *Prunus maritima* (beach plum). Additional shrubs that are commonly present but with low cover can include *Rosa carolina* (Carolina rose), *Rosa rugosa* (rugosa rose), *Baccharis halimifolia* (eastern baccharis), *Rhus copallinum* (flameleaf sumac), *Rhus typhina* (staghorn sumac), or *Juniperus virginiana* (eastern redcedar). The herbaceous layer tends to be sparse and can include dune grassland or adjacent upland species such as *Ammophila*

breviligulata (American beachgrass), *Solidago sempervirens* (seaside goldenrod), *Hudsonia tomentosa* (woolly beachheather), *Lechea maritima* (beach pinweed), *Juncus greenei* (Greene's rush), *Carex silicea* (beach sedge), *Polygonella articulata* (coastal jointweed), *Symphyotrichum subulatum* (eastern annual saltmarsh aster), *Solidago rugosa* (wrinkleleaf goldenrod), *Achillea millefolium* (common yarrow), *Oenothera parviflora* (northern evening-primrose), *Euthamia* (goldentop) spp., *Cyperus grayi* (Gray's flatsedge), *Cyperus polystachyos* (manyspike flatsedge), *Schizachyrium scoparium* (little bluestem), and others. Typical vine associates are *Toxicodendron radicans* (eastern poison ivy), *Parthenocissus quinquefolia* (Virginia creeper), and *Smilax* (greenbrier) spp. Large patches of open unvegetated or sparsely vegetated sand are present in some examples. Depending on exposure, these shrublands range from over 2 m tall in sheltered areas to less than 1 m tall in areas with greater exposure to winds and storms.

Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Morella pensylvanica* (northern bayberry)
		Prunus maritima (beach plum)

Characteristic Species: *Morella pensylvanica* (northern bayberry), *Prunus maritima* (beach plum)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable

DISTRIBUTION

Range: This association occurs from Maine to New Jersey.

States/Provinces: CT, DE?, MA, ME, NH:S1, NJ:S1S2, NY, RI

Federal Lands: NPS (Boston Harbor Islands, Cape Cod, Fire Island, Gateway, Muskeget Island); USFWS (Monomoy, Nomans Land Island, Parker River)

CONSERVATION STATUS

Rank: G4 (1-Dec-1997)

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: This vegetation is compositionally similar to maritime rocky headland, *Prunus serotina - Rhus typhina* Scrub Forest (CEGL006399). *Morella pensylvanica / Diodia teres* Shrubland (CEGL003881) is the southern analog of this association.

Similar Associations:

- *Morella pensylvanica / Diodia teres* Shrubland (CEGL003881)
- *Prunus serotina - Rhus typhina* Scrub Forest (CEGL006399)

Related Concepts:

- *Myrica* thicket (Chrysler 1930) ?
- Coastal dune community (Rawinski 1984) ?
- Dune shrubland (Breden 1989) ?
- Low dune thicket (Martin 1959b) ?
- Maritime Shrubland on Dunes (Lundgren 2000) ?
- SNE coastal rocky headland community (Rawinski 1984) ?
- Short shrub thicket (Dunlop and Crow 1985) ?

SOURCES

Description Authors: S.L. Neid and L.A. Sneddon, mod. E. Largay

References: Art 1976, Breden 1989, Breden et al. 2001, Chrysler 1930, Conard 1935, Dunlop and Crow 1985, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Gawler 2001, Gawler 2002, Lundgren 2000, Martin 1959b, McDonnell 1979, Metzler and Barrett 2001, Metzler and Barrett 2004, Moul 1969, NRCS 2001b, Nelson and Fink 1980, Nichols 1920, Rawinski 1984, Reschke 1990, Sneddon and Lundgren 2001, Sperduto 1997b, Sperduto 2000a, Swain and Kearsley 2001



Figure 27. Northern Bayberry Dune Shrubland in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 398877, northing 4659053.

COMMON NAME (PARK-SPECIFIC): OUTWASH SCRUB OAK BARRENS

SYNONYMS
USNVC English Name: **Bear Oak - Dwarf Chinquapin Oak Shrubland**
USNVC Scientific Name: ***Quercus ilicifolia* - *Quercus prinoides* Shrubland**
USNVC Identifier: **CEGL006111**

LOCAL INFORMATION

Environmental Description: This association occurs on well-drained sands and gravels of outwash deposits or on outwash deposits covered with windblown sand. Salt spray and high winds slow the growth of some woody plants and prune the seaward edges of the plant community. Fires may have played a role in the past in maintaining this community.
Vegetation Description: This dense shrubland is dominated by *Quercus ilicifolia* (bear oak) and, in some areas, can be nearly a monoculture of *Quercus ilicifolia* (bear oak). *Prunus serotina* (black cherry) and *Morella pensylvanica* (northern bayberry) are frequent associates. Locally *Quercus prinoides* (dwarf chinkapin oak) can be abundant. There may be scattered individuals of *Pinus rigida* (pitch pine) and *Quercus velutina* (black oak) which emerge from the dense shrub thicket. *Parthenocissus quinquefolia* (Virginia creeper) and *Rubus flagellaris* (northern dewberry) are often present. There may be other ericads, including *Gaylussacia baccata* (black huckleberry) and *Vaccinium pallidum* (Blue Ridge blueberry). *Arctostaphylos uva-ursi* (kinnikinnick), *Gaultheria procumbens* (eastern teaberry), and *Epigaea repens* (trailing arbutus) may also persist under the *Quercus ilicifolia* (bear oak), indicating that the shrubland has invaded a former heathland. *Comptonia peregrina* (sweet fern), *Rhus copallinum* (flameleaf sumac), and *Prunus maritima* (beach plum) are also common. There are only a few herbaceous plants associated with this community, including *Solidago odora* (anisescented goldenrod), *Solidago sempervirens* (seaside goldenrod), *Lechea maritima* (beach pinweed), and *Trientalis borealis* (starflower). *Carex pensylvanica* (Pennsylvania sedge) and *Deschampsia flexuosa* (wavy hairgrass) may also be common. *Cladonia* (cup lichen) and *Cladina* (reindeer lichen) lichens are frequent in small open areas within the community.
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus rigida* (pitch pine)
Tree canopy	Broad-leaved deciduous tree	*Prunus serotina* (black cherry)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Quercus ilicifolia* (bear oak)
		Quercus prinoides (dwarf chinkapin oak)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Morella pensylvanica* (northern bayberry)
Herb (field)	Graminoid	*Deschampsia flexuosa* (wavy hairgrass)

Characteristic Species: *Quercus ilicifolia* (bear oak), *Quercus prinoides* (dwarf chinkapin oak)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S1*	B	1	Scrub Oak Shrubland	Swain and Kearsley 2001

Local Range: This association occurs in a narrow band from Coast Guard Beach North to Truro along the upper edge of the outwash cliffs.
Classification Comments: Within Cape Cod National Seashore this association is a shrubland that has invaded a heathland along the tops of the outwash bluffs. There are remnants of the open heathland growing under dense shrubs. *Pinus rigida* (pitch pine), *Prunus serotina* (black cherry), and *Quercus velutina* (black oak) and/or *Quercus alba* (white oak) are often scattered throughout

older examples suggesting that the shrubland is succeeding into woodland and will eventually develop into a forest. In areas with high winds and severe salt spray, this community may be stable for many years.
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: Motzkin and Foster (2002) plots: CC39 and CC28.
AA (2004) points: CACO.175, CACO.201, CACO.213, CACO.242, CACO.274, CACO.286, CACO.312, CACO.354,CACO.381, CACO.403, CACO.431, CACO.442, CACO.444, CACO.458,CACO.569, CACO.599, CACO.600.
Cape Cod National Seashore Inventory Notes: Mapped in the Scrub Oak aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Temperate cold-deciduous shrubland (III.B.2.N.a.)
Alliance	*Quercus ilicifolia* Shrubland Alliance (A.906)
Alliance (English name)	Bear Oak Shrubland Alliance
Association	*Quercus ilicifolia* - *Quercus prinoides* Shrubland
Association (English name)	Bear Oak - Dwarf Chinquapin Oak Shrubland
Ecological System(s):	Northern Atlantic Coastal Plain Pitch Pine Barrens (CES203.269).

GLOBAL DESCRIPTION

Concept Summary: This association comprises scrub oak barrens that form within a mosaic of pitch pine-scrub oak barrens along the north Atlantic coast. It occurs on sandy, drought-prone soils of glacial outwash plains in low "frost pocket" depressions on the landscape or where there are frequent fire-return intervals (<5 years). The shrubland is strongly dominated by *Quercus ilicifolia* (bear oak), although it can be codominated by *Quercus prinoides* (dwarf chinkapin oak). *Pinus rigida* (pitch pine) can form a scattered tree layer, but with low cover (<10% cover). Additional shrub associates that occur in low abundance include *Rosa carolina* (Carolina rose), *Rosa virginiana* (Virginia rose), *Morella pensylvanica* (northern bayberry), and *Viburnum dentatum* (southern arrowwood). Shrub cover can vary from 30–100%. Vines are common, especially *Smilax rotundifolia* (roundleaf greenbrier) and *Smilax glauca* (cat greenbrier), and can form locally dense thickets. Low shrub and herbaceous cover is inversely proportional to shrub cover, with greater herb cover occurring where shrub cover is less. Dwarf-shrubs include *Gaylussacia baccata* (black huckleberry), *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium pallidum* (Blue Ridge blueberry), and *Kalmia angustifolia* (sheep laurel). Herbaceous species commonly include *Schizachyrium scoparium* (little bluestem), *Deschampsia flexuosa* (wavy hairgrass), *Piptochaetium avenaceum* (blackseed speargrass), *Carex pensylvanica* (Pennsylvania sedge), and *Carex swanii* (Swan's sedge). Lichens can be locally common, especially *Cladonia* (cup lichen) and *Cladina* (reindeer lichen) species.
Environmental Description: This association occurs on drought-prone soils of sandy outwash plains with frequent fire-return intervals or in small depressional "frost pockets" on the landscape that trap cold air.

Vegetation Description: This shrubland is dominated by *Quercus ilicifolia* (bear oak). *Quercus prinoides* (dwarf chinkapin oak) is a common associate that can codominate in some stands. Scattered *Pinus rigida* (pitch pine) can occur, but generally at less than 10% cover. Additional shrub associates that occur in low abundance include *Rosa carolina* (Carolina rose), *Rosa virginiana* (Virginia rose), *Morella pensylvanica* (northern bayberry), and *Viburnum dentatum* (southern arrowwood). Shrub cover can vary from 30–100%. Vines are common, especially *Smilax rotundifolia* (roundleaf greenbrier) and *Smilax glauca* (cat greenbrier), and can form locally dense thickets. Low-shrub and herbaceous cover is inversely proportional to shrub cover, with greater herb cover occurring where shrub cover is less. Dwarf-shrubs include *Gaylussacia baccata* (black huckleberry), *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium pallidum* (Blue Ridge blueberry), and *Kalmia angustifolia* (sheep laurel). Herbaceous species commonly include *Schizachyrium scoparium* (little bluestem), *Deschampsia flexuosa* (wavy hairgrass), *Piptochaetium avenaceum* (blackseed speargrass), *Carex pensylvanica* (Pennsylvania sedge), and *Carex swanii* (Swan's sedge). Lichens can be locally common, especially *Cladonia* (cup lichen) and *Cladina* (reindeer lichen) species.

Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Vine/Liana	*Smilax glauca* (cat greenbrier)
		Smilax rotundifolia (roundleaf greenbrier)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Quercus ilicifolia* (bear oak)
		Quercus prinoides (dwarf chinkapin oak)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)
		Deschampsia flexuosa (wavy hairgrass)
		Schizachyrium scoparium (little bluestem)

Characteristic Species: *Quercus ilicifolia* (bear oak), *Quercus prinoides* (dwarf chinkapin oak)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable

DISTRIBUTION
Range: Information not available.
States/Provinces: MA, NH, NJ, NY, RI
Federal Lands: NPS (Cape Cod)

CONSERVATION STATUS
Rank: GNR (10-May-2002)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: Information not available.
Similar Associations:
- *Quercus ilicifolia - Prunus pumila* Shrubland (CEGL006121)

Related Concepts:
- Scrub Oak Shrubland Community (Lundgren 2000) ?
- Scrub oak shrubland (Jordan 1999) ?

SOURCES

Description Authors: S.L. Neid

References: Breden et al. 2001, Eastern Ecology Working Group n.d., Edinger et al. 2002, Jordan 1999, Lundgren 2000, Motzkin and Foster 2002, Motzkin et al. 2002, Reschke 1990, Swain and Kearsley 2000



Figure 28. Outwash Scrub Oak Barrens in the Marconi Area of Cape Cod National Seashore (no specific plot). September 2004. UTM coordinates not available.



Figure 29. Outwash Scrub Oak Barrens in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 419268, northing 4640535.

COMMON NAME (PARK-SPECIFIC): NORTH ATLANTIC COASTAL PLAIN VINE DUNE

SYNONYMS
USNVC English Name: **Whiteleaf Greenbrier - Eastern Poison-ivy Vine-Shrubland**
USNVC Scientific Name: ***Smilax glauca* - *Toxicodendron radicans* Vine-Shrubland**
USNVC Identifier: **CEGL003886**

LOCAL INFORMATION

Environmental Description: This community occurs on stabilized dunes subject to high winds and severe salt spray. The sandy surface can be coarse-grained because fine-grained sand is blown away.
Vegetation Description: This community is characterized by a dominance of *Toxicodendron radicans* (eastern poison ivy) which can cover up to 90% of an area. More typically, *Toxicodendron radicans* (eastern poison ivy) covers 30–50%. Frequent associates include the vines *Parthenocissus quinquefolia* (Virginia creeper) and *Rubus flagellaris* (northern dewberry). Remnants of the stabilized dune community may also be present, including *Ammophila breviligulata* (American beachgrass), *Solidago sempervirens* (seaside goldenrod), *Deschampsia flexuosa* (wavy hairgrass), and *Polygonella articulata* (coastal jointweed).
Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Rubus flagellaris* (northern dewberry)
		Toxicodendron radicans (eastern poison ivy)
Short shrub/sapling	Broad-leaved evergreen shrub	*Morella pensylvanica* (northern bayberry)
Short shrub/sapling	Vine/Liana	*Parthenocissus quinquefolia* (Virginia creeper)
Herb (field)	Forb	*Solidago sempervirens* (seaside goldenrod)
Herb (field)	Graminoid	*Ammophila breviligulata* (American beachgrass)

Characteristic Species: Information not available.
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S2*	I	1	Maritime Dune	Swain and Kearsley 2001
MA	S3*	I	1	Maritime Shrubland	Swain and Kearsley 2001

Local Range: This type occurs in the Provincelands, on Long Point, and along the Nauset Spit system.
Classification Comments: Neither *Smilax* (greenbrier) species has been noted within this community at Cape Cod National Seashore. *Toxicodendron* (poison oak) can be extremely dense and form almost a monoculture. At Long Point, this community is heavily used by gulls for nesting.
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: CACO.027, CACO.036, CACO.047, CACO.068.
AA (2004) Points: CACO.221, CACO.300, CACO.309, CACO.596, CACO.607.
Cape Cod National Seashore Inventory Notes: Mapped in the Dune Shrub aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Temperate cold-deciduous shrubland (III.B.2.N.a.)
Alliance	*Smilax* spp. - *Toxicodendron radicans* Vine-Shrubland Alliance (A.909)
Alliance (English name)	Greenbrier species - Eastern Poison-ivy Vine-Shrubland Alliance
Association	*Smilax glauca* - *Toxicodendron radicans* Vine-Shrubland
Association (English name)	Whiteleaf Greenbrier - Eastern Poison-ivy Vine-Shrubland
Ecological System(s):	Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264).

GLOBAL DESCRIPTION

Concept Summary: This community is best described as vine-covered maritime sand dunes. Generally confined to barrier beach systems of the North Atlantic, this vegetation is comprised of dense vines that cover the crests of dunes exposed to wind, salt spray and periodic overwash by storm tides. Very little soil development occurs, and the water table is well below 1 m in depth. The dominant species of any single dune may be one of several vine species such as *Smilax glauca* (cat greenbrier), *Smilax rotundifolia* (roundleaf greenbrier), *Vitis rotundifolia* (muscadine), *Parthenocissus quinquefolia* (Virginia creeper), or *Toxicodendron radicans* (eastern poison ivy). In some cases, the vines are shallowly rooted in sand or growing over older vine stems or other living or dead shrubs such as *Morella pensylvanica* (northern bayberry). Scattered dune grassland species may be present such as *Ammophila breviligulata* (American beachgrass), *Lechea maritima* (beach pinweed), *Solidago sempervirens* (seaside goldenrod), and *Hudsonia tomentosa* (woolly beachheather). Diagnostic species are *Smilax glauca* (cat greenbrier), *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy), and *Parthenocissus quinquefolia* (Virginia creeper). The vegetation is generally low to the ground (less than half a meter tall) and generally covers 70–80% of the surface of the ground, the remainder being exposed sand. This vegetation is not widely described in the literature, but is likely to occur in New England south to Maryland and perhaps Virginia.

Environmental Description: This community occurs on maritime sand dunes, generally of barrier beach systems, where vegetation is exposed to wind, salt spray and periodic overwash by storm tides. Vegetation is shallowly rooted in sand or draped over living or dead shrubs. Very little soil development occurs, and the water table is well below 1 m in depth (Martin 1959b).

Vegetation Description: The dominant species of any single dune may be one of several vine species such as *Smilax glauca* (cat greenbrier), *Smilax rotundifolia* (roundleaf greenbrier), *Vitis rotundifolia* (muscadine), *Parthenocissus quinquefolia* (Virginia creeper), or *Toxicodendron radicans* (eastern poison ivy). In some cases, the vines are shallowly rooted in the sand or grow over older vine stems or other living or dead shrubs such as *Morella pensylvanica* (northern bayberry) and *Prunus serotina* (black cherry). Scattered dune grassland species may be present such as *Ammophila breviligulata* (American beachgrass), *Lechea maritima* (beach pinweed), *Solidago sempervirens* (seaside goldenrod), and *Hudsonia tomentosa* (woolly beachheather). The vegetation is generally low to the ground (less than half a meter tall) and generally covers 70–80% of the surface of the ground, the remainder being exposed sand. Invasive species, including *Lonicera japonica* (Japanese honeysuckle) and *Celastrus orbiculatus* (Oriental bittersweet), may also be present.

Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Vine/Liana	*Smilax glauca* (cat greenbrier)
		Smilax rotundifolia (roundleaf greenbrier)
		Toxicodendron radicans (eastern poison ivy)

Characteristic Species: *Parthenocissus quinquefolia* (Virginia creeper), *Smilax glauca* (cat greenbrier), *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable

DISTRIBUTION
Range: This type is likely to occur in New England south to Maryland and perhaps Virginia.
States/Provinces: DE, MA, MD, NJ, NY, VA?
Federal Lands: NPS (Assateague Island, Cape Cod, Fire Island, Gateway); USFWS (Parker River?)

CONSERVATION STATUS
Rank: G1G2 (18-Jan-2006)
Reasons: This small-patch community is restricted to coastal sand dunes of only four states. Total number of occurrences is 21–100, and total acreage is well less than 2000 acres.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: Information not available.
Similar Associations:
- *Smilax auriculata - Toxicodendron radicans* Vine-Shrubland (CEGL003885)--is the southern analog of this association.

Related Concepts:
- Coastal dune community (Rawinski 1984) ?
- Greenbrier thicket (Martin 1959b) ?
- SNE coastal rocky headland community (Rawinski 1984) ?

SOURCES
Description Authors: S.L. Neid and L.A. Sneddon, mod. E. Largay
References: Berdine 1998, Bowman 2000, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Harrison 2004, Harrison and Stango 2003, Martin 1959b, NRCS 2001b, Rawinski 1984, Reschke 1990, Sneddon and Lundgren 2001, Swain and Kearsley 2001



Figure 30. North Atlantic Coastal Plain Vine Dune in Wellfleet, Cape Cod National Seashore (no specific plot). September 2004. UTM coordinates not available.



Figure 31. North Atlantic Coastal Plain Vine Dune in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 399004, northing 4659127.

COMMON NAME (PARK-SPECIFIC): SWAMP-LOOSESTRIFE COASTAL PLAIN POND

SYNONYMS
USNVC English Name: **Swamp-loosestrife / Virginia Marsh St. John's-wort Shrubland**
USNVC Scientific Name: ***Decodon verticillatus* / *Triadenum virginicum* Shrubland**
USNVC Identifier: **CEGL006087**

LOCAL INFORMATION

Environmental Description: This wetland vegetation characterized by *Decodon verticillatus* (swamp loosestrife) often completely vegetates small seasonally flooded basins or occurs in a patchy zone on the periphery of larger permanent water bodies. Although the flooding regime is typified by a longer hydroperiod than many other Coastal Plain pondshore vegetation types as evidenced by moderately deep to deep muck, water levels in dry years drop below the surface, exposing substrate supporting occasional Coastal Plain species such as *Drosera intermedia* (spoonleaf sundew), *Hypericum mutilum* (dwarf St. Johnswort), and *Viola lanceolata* (bog white violet).
Vegetation Description: Typical associates include *Triadenum virginicum* (Virginia marsh St. Johnswort), *Leersia oryzoides* (rice cutgrass), *Lycopus uniflorus* (northern bugleweed), *Lycopus virginicus* (Virginia water horehound), *Bidens connata* (purplestem beggarticks), *Lysimachia terrestris* (earth loosestrife), *Juncus canadensis* (Canadian rush), *Galium palustre* (common marsh bedstraw), and *Woodwardia virginica* (Virginia chainfern).
Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Decodon verticillatus* (swamp loosestrife)
Herb (field)	Forb	*Triadenum virginicum* (Virginia marsh St. Johnswort)

Characteristic Species: *Decodon verticillatus* (swamp loosestrife), *Viola lanceolata* (bog white violet)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNR	NA	NA	[not crosswalked]	Swain and Kearsley 2001

Local Range: This association is known from Higgins Pond and Herring Pond, but likely occurs along the borders of many of the Coastal Plain ponds.
Classification Comments: This community occurs in at the border of Coastal Plain ponds and in a few cases covers the entire surface of small wetlands with fluctuating water levels. A closely related association, *Decodon verticillatus* Semipermanently Flooded Shrubland (CEGL005089), occurs at the outer edges of water bodies with permanent water. *Decodon* (decodon) grows out into standing water and is usually associated with emergent and floating species.
Other Comments: There is no clear crosswalk in the MA classification to this USNVC association.
Local Description Authors: R.E. Zaremba
Plots: Sneddon et al. (1999).
AA (2004) Points: CACO.288.
Cape Cod National Seashore Inventory Notes: Mapped in the Freshwater Marsh aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	Seasonally flooded cold-deciduous shrubland (III.B.2.N.e.)
Alliance	*Decodon verticillatus* Seasonally Flooded Shrubland Alliance (A.990)
Alliance (English name)	Swamp-loosestrife Seasonally Flooded Shrubland Alliance
Association	*Decodon verticillatus / Triadenum virginicum* Shrubland
Association (English name)	Swamp-loosestrife / Virginia Marsh St. John's-wort Shrubland
Ecological System(s):	Northern Atlantic Coastal Plain Pondshore (CES203.518).

GLOBAL DESCRIPTION

Concept Summary: This wetland vegetation of mucky substrates occurs in southern New England. It often completely covers small seasonally flooded basins, or occurs in a patchy zone on the periphery of larger permanent water bodies. The vegetation is dominated by *Decodon verticillatus* (swamp loosestrife). Although the flooding regime is typified by a longer hydroperiod than many other Coastal Plain pondshore vegetation types as evidenced by moderately deep to deep muck, water levels in dry years drop below the surface, exposing substrate supporting Coastal Plain species such as *Drosera intermedia* (spoonleaf sundew), *Hypericum mutilum* (dwarf St. Johnswort), and *Viola lanceolata* (bog white violet). Typical associates include *Triadenum virginicum* (Virginia marsh St. Johnswort), *Leersia oryzoides* (rice cutgrass), *Lycopus uniflorus* (northern bugleweed), *Lycopus virginicus* (Virginia water horehound), *Bidens connata* (purplestem beggarticks), *Lysimachia terrestris* (earth loosestrife), *Juncus canadensis* (Canadian rush), *Galium palustre* (common marsh bedstraw), and *Woodwardia virginica* (Virginia chainfern).

Environmental Description: This wetland vegetation of mucky substrates occurs in southern New England. It often completely covers small seasonally flooded basins, or occurs in a patchy zone on the periphery of larger permanent water bodies. It occupies moderately deep to deep muck, and water levels in dry years drop below the surface, exposing substrate that supports occasional Coastal Plain pondshore species.

Vegetation Description: The vegetation is dominated by *Decodon verticillatus* (swamp loosestrife). Although the flooding regime is typified by a longer hydroperiod than many other Coastal Plain pondshore vegetation types, as evidenced by moderately deep to deep muck, water levels in dry years drop below the surface, exposing substrate supporting Coastal Plain species such as *Drosera intermedia* (spoonleaf sundew), *Hypericum mutilum* (dwarf St. Johnswort), and *Viola lanceolata* (bog white violet). Typical associates include *Triadenum virginicum* (Virginia marsh St. Johnswort), *Leersia oryzoides* (rice cutgrass), *Lycopus uniflorus* (northern bugleweed), *Lycopus virginicus* (Virginia water horehound), *Bidens connata* (purplestem beggarticks), *Lysimachia terrestris* (earth loosestrife), *Juncus canadensis* (Canadian rush), *Galium palustre* (common marsh bedstraw), and *Woodwardia virginica* (Virginia chainfern).

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Decodon verticillatus* (swamp loosestrife)

Characteristic Species: *Decodon verticillatus* (swamp loosestrife), *Triadenum virginicum* (Virginia marsh St. Johnswort)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine

DISTRIBUTION
Range: This association occurs in southern New England.
States/Provinces: CT, DE, MA, NJ, NY, RI
Federal Lands: NPS (Cape Cod); USFWS (Monomoy?, Nomans Land Island?)

CONSERVATION STATUS
Rank: GNR (21-Apr-2004)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: L.A. Sneddon
References: Eastern Ecology Working Group n.d., Sneddon et al. 1999



Figure 32. Swamp-loosestrife Coastal Plain Pond in Cape Cod National Seashore (Herring Pond, no specific plot). September 2007. NAD 1983 / UTM easting 416165, northing 4646071.



Figure 33. Swamp-loosestrife Coastal Plain Pond in Cape Cod National Seashore (Williams Pond, no specific plot). September 2007. NAD 1983 / UTM easting 415060, northing 4646131.

COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL WET MEADOW

SYNONYMS

USNVC English Name: **Steeplebush - Blackberry species / Reed Canarygrass Shrubland**

USNVC Scientific Name: ***Spiraea tomentosa* - *Rubus* spp. / *Phalaris arundinacea* Shrubland**

USNVC Identifier: **CEGL006571**

LOCAL INFORMATION

Environmental Description: This community occurs in various environmental settings within Cape Cod National Seashore, including a flat area, an interdunal flat, and adjacent to a stream channel. In all three examples, the substrate consists of mineral soil with a layer of muck at the surface. This community floods early in the growing season and may be saturated for part of the growing season, but may also be dry for much of the year.

Vegetation Description: The physiognomy of this community is variable and can range from a tall-shrub thicket with scattered patches of herbaceous wet meadow to a graminoid-dominated meadow with scattered shrubs. Dominant shrub species include *Spiraea tomentosa* (steeplebush), *Viburnum recognitum* (=*Viburnum dentatum* var. *lucidum*, southern arrowwood), *Clethra alnifolia* (coastal sweetpepperbush), and in one example *Morella pensylvanica* (northern bayberry). Vines include *Rubus flagellaris* (northern dewberry), *Toxicodendron radicans* (eastern poison ivy), and *Rubus hispidus* (bristly dewberry). *Calamagrostis canadensis* (bluejoint), *Dennstaedtia punctilobula* (eastern hayscented fern), and/or *Symphyotrichum puniceum var. puniceum* (purplestem aster) are dominant herbaceous species. *Solidago rugosa* (wrinkleleaf goldenrod) and *Euthamia graminifolia* (flat-top goldentop) are also common herbs.

Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Vine/Liana	*Rubus flagellaris* (northern dewberry)
		Toxicodendron radicans (eastern poison ivy)
Short shrub/sapling	Broad-leaved deciduous shrub	*Spiraea tomentosa* (steeplebush)
Herb (field)	Forb	*Symphyotrichum puniceum* var. *puniceum* (purplestem aster)
Herb (field)	Graminoid	*Calamagrostis canadensis* (bluejoint)
Herb (field)	Fern or fern ally	*Dennstaedtia punctilobula* (eastern hayscented fern)

Characteristic Species: *Solidago rugosa* (wrinkleleaf goldenrod), *Spiraea tomentosa* (steeplebush)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNR	NA	NA	[not crosswalked]	Swain and Kearsley 2001

Local Range: Small examples occur throughout Cape Cod National Seashore.

Classification Comments: There is no clear crosswalk in the MA classification to this USNVC association.**Other Comments:** None.

Local Description Authors: E. Largay

Plots: None.

AA (2004) points: CACO.606, CACO.196, CACO.526.

Cape Cod National Seashore Inventory Notes: Mapped in the Shrub Swamp aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	Seasonally flooded cold-deciduous shrubland (III.B.2.N.e.)
Alliance	*Spiraea (alba, tomentosa)* - *Rubus* spp. Seasonally Flooded Shrubland Alliance (A.3022)
Alliance (English name)	(White Meadowsweet, Steeplebush) - Blackberry species Seasonally Flooded Shrubland Alliance
Association	*Spiraea tomentosa* - *Rubus* spp. / *Phalaris arundinacea* Shrubland
Association (English name)	Steeplebush - Blackberry species / Reed Canarygrass Shrubland
Ecological System(s):	High Allegheny Wetland (CES202.069).

GLOBAL DESCRIPTION

Concept Summary: This wet meadow vegetation of the northeastern states occurs in a variety of settings, most frequently in low-lying areas of old fields or pastures, headwater basins, or beaver-impacted wetlands. The physiognomy is complex and variable, ranging from shrub thicket to herbaceous meadow with scattered shrubs. Shrub species usually include *Spiraea tomentosa* (steeplebush), *Spiraea alba var. alba* (white meadowsweet), *Cornus amomum* (silky dogwood), *Rubus allegheniensis* (Allegheny blackberry), *Rubus hispidus* (bristly dewberry), *Salix* (willow) spp., and others. *Hypericum densiflorum* (bushy St. Johnswort) often occurs in the Central Appalachians. The invasive exotic shrubs *Lonicera morrowii* (Morrow's honeysuckle) and *Rosa multiflora* (multiflora rose) may be locally abundant. Associated herbaceous species are also variable in composition, depending on land-use history. Commonly seen are *Phalaris arundinacea* (reed canarygrass), *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago gigantea* (giant goldenrod), *Solidago canadensis* (Canada goldenrod), *Juncus effusus* (common rush), *Scirpus cyperinus* (woolgrass), *Scirpus expansus* (woodland bulrush), *Leersia oryzoides* (rice cutgrass), *Calamagrostis canadensis* (bluejoint), *Carex scoparia* (broom sedge), *Carex folliculata* (northern long sedge), *Carex lurida* (shallow sedge), *Carex lupulina* (hop sedge), *Carex vulpinoidea* (fox sedge), *Carex trichocarpa* (hairyfruit sedge), *Vernonia noveboracensis* (New York ironweed), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Lycopus uniflorus* (northern bugleweed), *Impatiens capensis* (jewelweed), *Eupatorium maculatum* (spotted joepyeweed), *Polygonum sagittatum* (arrowleaf tearthumb), *Thelypteris palustris* (eastern marsh fern), *Onoclea sensibilis* (sensitive fern), *Eleocharis* (spikerush) spp., and others. The invasive species *Microstegium vimineum* (Nepalese browntop), *Lythrum salicaria* (purple loosestrife), and *Phragmites australis* (common reed) can be abundant or form monocultures in these wetlands.

Environmental Description: This wet meadow vegetation of the northeastern states occurs in a variety of settings, most frequently in low-lying areas of old fields or pastures, headwater basins, or beaver-impacted wetlands. These wetlands typically flood early in the growing season and may be saturated to near the surface for some of the growing season, but they are generally dry for much of the year. The substrate is typically mineral soil with a layer of muck at the surface.

Vegetation Description: The physiognomy is complex and variable, ranging from shrub thicket to herbaceous meadow with scattered shrubs. Within each wetland, species may be locally abundant and often have patchy distribution. Shrub species usually include *Spiraea tomentosa* (steeplebush), *Spiraea alba var. alba* (white meadowsweet), *Cornus amomum* (silky dogwood),

Rubus allegheniensis (Allegheny blackberry), *Rubus hispidus* (bristly dewberry), *Salix* (willow) spp., and others. *Hypericum densiflorum* (bushy St. Johnswort) often occurs in the Central Appalachians. The invasive exotic shrubs *Lonicera morrowii* (Morrow's honeysuckle) and *Rosa multiflora* (multiflora rose) may be locally abundant. Associated herbaceous species are also variable in composition, depending on land-use history. Commonly seen are *Phalaris arundinacea* (reed canarygrass), *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago gigantea* (giant goldenrod), *Solidago canadensis* (Canada goldenrod), *Juncus effusus* (common rush), *Scirpus cyperinus* (woolgrass), *Scirpus expansus* (woodland bulrush), *Leersia oryzoides* (rice cutgrass), *Calamagrostis canadensis* (bluejoint), *Carex scoparia* (broom sedge), *Carex folliculata* (northern long sedge), *Carex lurida* (shallow sedge), *Carex lupulina* (hop sedge), *Carex vulpinoidea* (fox sedge), *Carex trichocarpa* (hairyfruit sedge), *Vernonia noveboracensis* (New York ironweed), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Lycopus uniflorus* (northern bugleweed), *Impatiens capensis* (jewelweed), *Eupatorium maculatum* (spotted joepyeweed), *Polygonum sagittatum* (arrowleaf tearthumb), *Thelypteris palustris* (eastern marsh fern), *Onoclea sensibilis* (sensitive fern), *Eleocharis* (spikerush) spp., and others. *Sphagnum* (sphagnum) spp. are often abundant along with lesser amounts of other nonvascular species. The invasive species *Microstegium vimineum* (Nepalese browntop), *Lythrum salicaria* (purple loosestrife), and *Phragmites australis* (common reed) can be abundant or form monocultures in these wetlands.

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Rubus allegheniensis* (Allegheny blackberry)
		Spiraea alba var. *alba* (white meadowsweet)
		Spiraea tomentosa (steeplebush)
Herb (field)	Forb	*Solidago canadensis* (Canada goldenrod)
		Solidago rugosa (wrinkleleaf goldenrod)
Herb (field)	Graminoid	*Leersia oryzoides* (rice cutgrass)
		Phalaris arundinacea (reed canarygrass)

Characteristic Species: *Rubus allegheniensis* (Allegheny blackberry), *Spiraea tomentosa* (steeplebush)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine

DISTRIBUTION

Range: Although this vegetation is widespread, its range has not been evaluated. It is known from the Central Appalachian ecoregion, the High Alleghany Plateau, Western Alleghany Plateau, North Atlantic Coast, and the Lower New England / Northern Piedmont ecoregions, and is likely in others.
States/Provinces: CT, MA, ME?, NJ, NY, PA, WV:S2
Federal Lands: NPS (Allegheny Portage Railroad, Boston Harbor Islands, Cape Cod, Delaware Water Gap, Johnstown Flood, Saratoga, Upper Delaware, Weir Farm); USFS (Monongahela); USFWS (Assabet River?, Erie, Great Meadows?, Great Swamp, Parker River?)

CONSERVATION STATUS

Rank: GNR (8-Jul-1999)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: Information not available.
Similar Associations:
- *Cornus (amomum, sericea)* - *Viburnum dentatum* - *Rosa multiflora* Shrubland (CEGL006576)

Related Concepts: Information not available.

SOURCES
Description Authors: L.A. Sneddon, mod. S.C. Gawler
References: Byers et al. 2007, Decker 1955, Eastern Ecology Working Group n.d., Fike 1999, NRCS 2004, NatureServe and Russell 2003



Figure 34. Successional Wet Meadow in Cape Cod National Seashore near Herring River (no specific plot). September 2007. UTM coordinates not available.

COMMON NAME (PARK-SPECIFIC): BLUEBERRY WETLAND THICKET

SYNONYMS

USNVC English Name: **Highbush Blueberry - Swamp Azalea - Coastal Sweet-pepperbush Shrubland**

USNVC Scientific Name: ***Vaccinium corymbosum* - *Rhododendron viscosum* - *Clethra alnifolia* Shrubland**

USNVC Identifier: **CEGL006371**

LOCAL INFORMATION

Environmental Description: This wet shrub thicket occurs in interdunal swales. The substrate is sand with a thin layer or organic material. The water levels vary in relation to long-term trends that affect groundwater. The soils are acidic and can be wet or dry for long periods.

Vegetation Description: This association is dominated by a tall shrub cover of *Vaccinium corymbosum* (highbush blueberry) with a lower, dense layer of shrubs dominated by *Morella pensylvanica* (northern bayberry), *Photinia* (chokeberry) spp., *Spiraea tomentosa* (steeplebush), and *Ilex verticillata* (common winterberry). There may be a high cover of *Vaccinium macrocarpon* (cranberry), reflecting that the interdunal swale was once more open. The herb layer is dominated by *Euthamia caroliniana* (=*Euthamia tenuifolia*, slender goldentop) and *Panicum* (panicgrass) spp.

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Vaccinium corymbosum* (highbush blueberry)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Morella pensylvanica* (northern bayberry)
		Vaccinium macrocarpon (cranberry)
Herb (field)	Forb	*Euthamia caroliniana* (=*Euthamia tenuifolia*, slender goldentop)
Herb (field)	Graminoid	*Juncus canadensis* (Canadian rush)

Characteristic Species: *Vaccinium corymbosum* (highbush blueberry)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S5*	B	1	Shrub Swamp	Swain and Kearsley 2001

Local Range: This association is found in the Provincelands and Truro.

Classification Comments: The *Vaccinium corymbosum* (highbush blueberry)-dominated communities at the seashore are divided into this association, *Vaccinium corymbosum* - *Rhododendron viscosum* - *Clethra alnifolia* Shrubland (CEGL006371), and *Vaccinium corymbosum / Sphagnum* spp. Shrubland (CEGL006190). Both are dominated by *Vaccinium corymbosum* (highbush blueberry) and occur in nutrient-poor, acidic sandy soil. This association is a successional development of a *Vaccinium macrocarpon* (cranberry) swale and may be moderately stable over time. *Vaccinium corymbosum / Sphagnum* spp. Shrubland (CEGL006190) probably develops eventually into a red maple swamp.

Other Comments: Information not available.

Local Description Authors: R.E. Zaremba

Plots: CACO.031, CACO.56, and CACO.123.

AA (2004) Points: CACO.105, CACO.134, CACO.182, CACO.216, CACO.270, CACO.488, CACO.491, CACO.506.

Cape Cod National Seashore Inventory Notes: Mapped in the Shrub Swamp aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	Seasonally flooded cold-deciduous shrubland (III.B.2.N.e.)
Alliance	*Vaccinium formosum* - *Vaccinium fuscatum* - *Vaccinium corymbosum* Seasonally Flooded Shrubland Alliance (A.992)
Alliance (English name)	Southern Highbush Blueberry - Black Highbush Blueberry - Highbush Blueberry Seasonally Flooded Shrubland Alliance
Association	*Vaccinium corymbosum* - *Rhododendron viscosum* - *Clethra alnifolia* Shrubland
Association (English name)	Highbush Blueberry - Swamp Azalea - Coastal Sweet-pepperbush Shrubland
Ecological System(s):	Northern Atlantic Coastal Plain Basin Peat Swamp (CES203.522). Northern Atlantic Coastal Plain Pondshore (CES203.518). Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264).

GLOBAL DESCRIPTION

Concept Summary: This is a tall-shrub swamp of seasonally flooded basins in the eastern United States. It occurs in small open basins, closed sandplain basins, and seasonally flooded zones within larger wetlands. This vegetation can occur on the margins of Coastal Plain ponds. This community is influenced by a strongly fluctuating water table with flooded conditions in spring and early summer followed by a drop in the water table below soil surface usually by late summer. There is usually a shallow organic layer often over sand. Dominant shrubs include *Vaccinium corymbosum* (highbush blueberry), *Ilex verticillata* (common winterberry), and *Rhododendron viscosum* (swamp azalea). Scattered *Acer rubrum* (red maple) are not uncommon. *Lyonia ligustrina* (maleberry) and *Cephalanthus occidentalis* (common buttonbush) are characteristic although not necessarily dominant. Associated shrub species may include *Clethra alnifolia* (coastal sweetpepperbush), *Spiraea tomentosa* (steeplebush), *Chamaedaphne calyculata* (leatherleaf), *Ilex glabra* (inkberry), *Leucothoe racemosa* (swamp doghobble), *Decodon verticillatus* (swamp loosestrife), *Kalmia angustifolia* (sheep laurel), *Alnus serrulata* (hazel alder), *Myrica gale* (sweetgale), and *Photinia* (chokeberry) spp.. Herbaceous composition is variable; some of the more typical species include *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* (royal fern), *Thelypteris palustris* (eastern marsh fern), *Onoclea sensibilis* (sensitive fern), *Calla palustris* (water arum), *Lycopus uniflorus* (northern bugleweed), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Glyceria striata* (fowl mannagrass), *Leersia oryzoides* (rice cutgrass), *Dulichium arundinaceum* (threeway sedge), *Juncus effusus* (common rush), and *Woodwardia virginica* (Virginia chainfern). A layer of peatmoss is common and varies in cover; species include *Sphagnum fimbriatum* (sphagnum), *Sphagnum rubellum* (sphagnum), *Sphagnum magellanicum* (Magellan's sphagnum), *Sphagnum fallax* (sphagnum), and *Sphagnum viridum* (sphagnum).

Environmental Description: This community is influenced by a strongly fluctuating water table with flooded conditions in spring and early summer, often followed by a drop in the water table below soil surface usually by late summer. There is usually a shallow organic layer often over mineral soil.

Vegetation Description: This association is a tall-shrub swamp where the dominant shrubs include *Vaccinium corymbosum* (highbush blueberry), *Ilex verticillata* (common winterberry), and *Rhododendron viscosum* (swamp azalea). Scattered *Acer rubrum* (red maple) are not uncommon. *Lyonia ligustrina* (maleberry) and *Cephalanthus occidentalis* (common buttonbush) are characteristic although not necessarily dominant. Associated shrub species may include *Clethra alnifolia* (coastal sweetpepperbush), *Spiraea tomentosa* (steeplebush), *Chamaedaphne calyculata* (leatherleaf), *Ilex glabra* (inkberry), *Leucothoe racemosa* (swamp doghobble), *Decodon verticillatus* (swamp loosestrife), *Kalmia angustifolia* (sheep laurel), *Alnus serrulata* (hazel alder), *Myrica gale* (sweetgale), and *Photinia* (chokeberry) spp.. Herbaceous composition is variable; some of the more typical species include *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* (royal fern), *Thelypteris palustris* (eastern marsh fern), *Onoclea sensibilis* (sensitive fern), *Calla palustris* (water arum), *Lycopus uniflorus* (northern bugleweed), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Glyceria striata* (fowl mannagrass), *Leersia oryzoides* (rice cutgrass), *Dulichium arundinaceum* (threeway sedge), *Juncus effusus* (common rush), and *Woodwardia virginica* (Virginia chainfern). A layer of peatmoss is common and varies in cover; species include *Sphagnum fimbriatum* (sphagnum), *Sphagnum rubellum* (sphagnum), *Sphagnum magellanicum* (Magellan's sphagnum), *Sphagnum fallax* (sphagnum), and *Sphagnum viridum* (sphagnum).

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Ilex verticillata* (common winterberry)
		Rhododendron viscosum (swamp azalea)
		Vaccinium corymbosum (highbush blueberry)
Herb (field)	Forb	*Lycopus uniflorus* (northern bugleweed)
Herb (field)	Graminoid	*Glyceria striata* (fowl mannagrass)
Herb (field)	Fern or fern ally	*Osmunda cinnamomea* (cinnamon fern)
		Osmunda regalis (royal fern)
		Woodwardia virginica (Virginia chainfern)

Characteristic Species: *Calla palustris* (water arum), *Lyonia ligustrina* (maleberry), *Rhododendron viscosum* (swamp azalea), *Sphagnum fallax* (sphagnum), *Sphagnum fimbriatum* (sphagnum), *Sphagnum magellanicum* (Magellan's sphagnum), *Sphagnum rubellum* (sphagnum), *Sphagnum viridum* (sphagnum), *Thelypteris palustris* (eastern marsh fern), *Vaccinium corymbosum* (highbush blueberry)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine

DISTRIBUTION
Range: This type occurs from New Hampshire south to New Jersey and possibly Delaware over an estimated range of 388,000 square km (total acreage of subsections of occurrence).
States/Provinces: CT, DE, MA, ME, NH:S4, NJ:S1S3, NY, PA, RI
Federal Lands: NPS (Cape Cod, Delaware Water Gap, Fire Island, Weir Farm); USFWS (Assabet River, Great Meadows, Great Swamp, Oxbow, Parker River)

CONSERVATION STATUS
Rank: G4 (31-Jan-2007)
Reasons: This vegetation is a small-patch type that occurs over a wide range. The number of EOs is estimated to be greater than 300 rangewide, but the area of occupancy is relatively small.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: More inland examples of this association may lack some characteristically Coastal Plain species such as *Clethra alnifolia* (coastal sweetpepperbush) and *Ilex glabra* (inkberry).
Similar Associations:
- *Vaccinium corymbosum / Sphagnum* spp. Shrubland (CEGL006190)

Related Concepts: Information not available.

SOURCES
Description Authors: L.A. Sneddon and S.L. Neid, mod. S.C. Gawler
References: Breden et al. 2001, Conard 1935, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fike 1999, Gawler 2002, Golet 1973, Johnson 1981b, Lynn and Karlin 1985, Metzler and Barrett 2001, Niering and Egler 1966, Reschke 1990, Schall and Murley 1984, Sperduto 2000a, Sperduto and Nichols 2004



Figure 35. Blueberry Wetland Thicket in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 408163, northing 4657210.

COMMON NAME (PARK-SPECIFIC): NORTHEASTERN BUTTONBUSH SHRUB SWAMP

SYNONYMS
USNVC English Name: **Common Buttonbush - Swamp-loosestrife Shrubland**
USNVC Scientific Name: ***Cephalanthus occidentalis* - *Decodon verticillatus* Shrubland**
USNVC Identifier: **CEGL006069**

LOCAL INFORMATION

Environmental Description: This community occurs in depressions in outwash deposits. Buttonbush thickets are usually flooded with deep organic soils. They are groundwater-influenced and may be dry only during prolonged droughts. The major structural plants, *Cephalanthus occidentalis* (common buttonbush) and *Decodon verticillatus* (swamp loosestrife), form tall mounds around which soil accumulates over time. Most other species in the community are associated with the bases of these plants.
Vegetation Description: This shrub swamp community is dominated by *Cephalanthus occidentalis* (common buttonbush) with scattered *Decodon verticillatus* (swamp loosestrife). There may be a few individuals of *Acer rubrum* (red maple) within the wetland. Throughout the swamp *Bidens tripartita* (threelobe beggarticks), *Galium aparine* (stickywilly), and *Triadenum virginicum* (Virginia marsh St. Johnswort) occur frequently around the higher, exposed parts of shrub bases. During extreme low water periods, the organic surface between plants may dry somewhat and support *Ludwigia palustris* (marsh seedbox), *Lysimachia terrestris* (earth loosestrife), and *Eleocharis* (spikerush) spp. Mosses also occur around the bases of the shrubs. Some areas between the shrubs are dominated by *Sphagnum* (sphagnum); others are bare.
Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Decodon verticillatus* (swamp loosestrife)
Short shrub/sapling	Broad-leaved deciduous shrub	*Cephalanthus occidentalis* (common buttonbush)
Herb (field)	Forb	*Bidens tripartita* (threelobe beggarticks)

Characteristic Species: *Cephalanthus occidentalis* (common buttonbush), *Decodon verticillatus* (swamp loosestrife)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S5*	B	1	Shrub Swamp	Swain and Kearsley 2001

Local Range: Known only from a series of small depressions in Eastham near the Salt Pond Visitors Center.
Classification Comments: Information not available.
Other Comments: This community is only known from the area north of the Salt Pond Visitors Center in Eastham. One of the occurrences has a boardwalk around a portion of its perimeter and has park interpretive material.
Local Description Authors: R.E. Zaremba
Plots: CACO.097, CACO.098, CACO.099.
AA (2004) Points: CACO.158, CACO.178, CACO.243.
Cape Cod National Seashore Inventory Notes: Mapped in the Buttonbush aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	Semipermanently flooded cold-deciduous shrubland (III.B.2.N.f.)
Alliance	*Cephalanthus occidentalis* Semipermanently Flooded Shrubland Alliance (A.1011)
Alliance (English name)	Common Buttonbush Semipermanently Flooded Shrubland Alliance
Association	*Cephalanthus occidentalis - Decodon verticillatus* Shrubland
Association (English name)	Common Buttonbush - Swamp-loosestrife Shrubland
Ecological System(s):	Laurentian-Acadian Floodplain Forest (CES201.587). Central Appalachian River Floodplain (CES202.608).

GLOBAL DESCRIPTION

Concept Summary: This buttonbush swamp occurs in the northeastern United States. These swamps experience prolonged or semipermanent flooding for much of the growing season, with water tables receding below the soil surface only during drought or very late in the growing season. They occur in a variety of environmental settings, including backwater sloughs or oxbow ponds, wet swales in floodplains, pond and lake borders, and small, isolated depressions where water levels recede very slowly, such as those with perched water tables. The substrate is typically loose muck. *Cephalanthus occidentalis* (common buttonbush) is dominant and often monotypic. Occasional associates depend on the environmental setting and most often occur in drier areas. They include *Vaccinium corymbosum* (highbush blueberry), *Rhododendron viscosum* (swamp azalea), *Acer rubrum* (red maple), *Cornus* (dogwood) spp. closer to upland borders, or *Acer saccharinum* (silver maple), *Fraxinus pennsylvanica* (green ash), and *Viburnum dentatum* (southern arrowwood) where adjacent to floodplains, or *Decodon verticillatus* (swamp loosestrife), *Chamaedaphne calyculata* (leatherleaf), and *Spiraea alba var. latifolia* (white meadowsweet) in more stagnant basins. Herbaceous species tend to be sparse but can include *Glyceria canadensis* (rattlesnake mannagrass), *Dulichium arundinaceum* (threeway sedge), *Carex stricta* (upright sedge), *Scirpus cyperinus* (woolgrass), *Thelypteris palustris* (eastern marsh fern), *Leersia oryzoides* (rice cutgrass), *Acorus calamus* (calamus), *Alisma plantago-aquatica* (American waterplantain), *Polygonum* (knotweed) spp., *Sparganium* (bur-reed) spp., and floating or submerged aquatic species such as *Lemna minor* (common duckweed), *Potamogeton natans* (floating pondweed), and *Nuphar lutea ssp. variegata* (variegated yellow pond-lily). Bryophytes, if present, cling to shrub bases and include *Warnstorfia fluitans* (warnstorfia moss), *Drepanocladus aduncus* (drepanocladus moss), or *Sphagnum fallax* (sphagnum). In disturbed areas, these wetland may be invaded by *Lythrum salicaria* (purple loosestrife).

Environmental Description: This association includes buttonbush swamps that experience prolonged or semipermanent flooding for much of the growing season with water tables receding below the soil surface only during drought or very late in the growing season. They occur in a variety of environmental settings including backwater sloughs or oxbow ponds, wet swales in floodplains, pond and lake borders, and small, isolated depressions where water levels recede very slowly, such as those with perched water tables. Soils are often organic mucks or silt loams.

Vegetation Description: This association includes buttonbush swamps of the eastern and northeastern United States. These swamps experience prolonged or semipermanent flooding for much of the growing season with water tables receding below the soil surface only during

drought or very late in the growing season. They occur in a variety of environmental settings including backwater sloughs or oxbow ponds, wet swales in floodplains, pond and lake borders, and small isolated depressions where water levels recede very slowly, such as those with perched water tables. *Cephalanthus occidentalis* (common buttonbush) is dominant and often monotypic. Scattered *Acer rubrum* (red maple) trees may be present in the wetland. Occasional associates depend on the environmental setting, and some only occur in drier areas. They include *Vaccinium corymbosum* (highbush blueberry), *Rhododendron viscosum* (swamp azalea), *Acer rubrum* (red maple), *Salix* (willow) spp., *Cornus amomum* (silky dogwood) or *Cornus sericea* (redosier dogwood) closer to upland borders, or *Acer saccharinum* (silver maple), *Fraxinus pennsylvanica* (green ash), or *Viburnum dentatum* (southern arrowwood) where adjacent to floodplains, or *Decodon verticillatus* (swamp loosestrife), *Chamaedaphne calyculata* (leatherleaf), and *Spiraea alba var. latifolia* (white meadowsweet) in more stagnant basins. Herbaceous species tend to be sparse but can include *Glyceria canadensis* (rattlesnake mannagrass), *Dulichium arundinaceum* (threeway sedge), *Carex stricta* (upright sedge), *Scirpus cyperinus* (woolgrass), *Osmunda regalis* (royal fern), *Thelypteris palustris* (eastern marsh fern), *Bidens* (beggarticks) spp., *Sium suave* (hemlock waterparsnip), *Scutellaria lateriflora* (blue skullcap), *Alisma plantago-aquatica* (American waterplantain), *Polygonum* (knotweed) spp., *Sparganium* (bur-reed) spp., and floating or submerged aquatic species such as *Lemna minor* (common duckweed), *Potamogeton natans* (floating pondweed), and *Nuphar lutea ssp. variegata* (variegated yellow pond-lily). Bryophytes, if present, cling to shrub bases and include *Warnstorfia fluitans* (warnstorfia moss), *Drepanocladus aduncus* (drepanocladus moss), or *Sphagnum fallax* (sphagnum).

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Cephalanthus occidentalis* (common buttonbush)
Herb (field)	Graminoid	*Dulichium arundinaceum* (threeway sedge)

Characteristic Species: *Cephalanthus occidentalis* (common buttonbush), *Dulichium arundinaceum* (threeway sedge), *Osmunda regalis* (royal fern), *Sparganium americanum* (American bur-reed), *Vaccinium corymbosum* (highbush blueberry)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine

DISTRIBUTION

Range: This association is found throughout the northeastern United States (an estimated 450,000 square km based on subsection attribution).
States/Provinces: CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, WV?
Federal Lands: NPS (Boston Harbor Islands, C&O Canal?, Cape Cod, Delaware Water Gap, Minute Man, National Capital-East?, Saratoga, Weir Farm); USFWS (Assabet River?, Chesapeake Marshlands, Great Meadows, Great Swamp, Oxbow)

CONSERVATION STATUS

Rank: G4G5 (31-Jan-2007)
Reasons: This association is widely distributed in the northeastern U.S. and relatively common in its small-patch setting. It is vulnerable to groundwater disruption, agricultural runoff, and adjacent forest clearing.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: This type may be synonymous with *Cephalanthus occidentalis / Carex* spp. Northern Shrubland (CEGL002190), although it also ranges south of the glaciation boundary in the east. CEGL002190 is distributed from the Western Allegheny Plateau (TNC Ecoregion 49) and Great Lakes (TNC Ecoregion 48) west to the Central Tallgrass Prairie (TNC Ecoregion 36), while this type occurs from the Central Appalachian Forest (TNC Ecoregion 59) and High Allegheny Plateau (TNC Ecoregion 60) east.

Similar Associations:

- *Cephalanthus occidentalis - (Leucothoe racemosa) / Carex joorii* Shrubland (CEGL004075)
- *Cephalanthus occidentalis / Carex* spp. - *Lemna* spp. Southern Shrubland (CEGL002191)
- *Cephalanthus occidentalis / Carex* spp. Northern Shrubland (CEGL002190)

Related Concepts:

- Buttonbush Swamp (Kettle Basin Shrub Swamp) (Thompson 1996) ?
- Buttonbush semipermanently flooded shrub swamp (CAP pers. comm. 1998) ?
- Palustrine Broad-leaved Deciduous Scrub-Shrub Wetland, Seasonally Flooded (PSS1C) (Cowardin et al. 1979) ?

SOURCES

Description Authors: S.L. Neid, mod. E. Southgate, L.A. Sneddon, S.C. Gawler, E. Largay

References: Bowman 2000, Breden et al. 2001, CAP pers. comm. 1998, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Elliman 2003, Enser 1999, Fike 1999, Fleming et al. 2001, Gawler 2002, Harrison 2004, Hopping 2000, J. Harrison pers. comm., Karanaukas 2001, Metzler and Barrett 2001, NRCS 2004, Nichols et al. 2001, Sperduto 2000b, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000



Figure 36. Northeastern Buttonbush Shrub Swamp in Cape Cod National Seashore (CACO.097). Summer 2004. NAD 1983 / UTM easting 419396, northing 4632320.

COMMON NAME (PARK-SPECIFIC): SWAMP-LOOSESTRIFE SHRUB SWAMP

SYNONYMS
USNVC English Name: **Swamp-loosestrife Semipermanently Flooded Shrubland**
USNVC Scientific Name: ***Decodon verticillatus* Semipermanently Flooded Shrubland**
USNVC Identifier: **CEGL005089**

LOCAL INFORMATION

Environmental Description: This community occurs along the borders of slow-moving streams. Occurrences can be very small and linear.
Vegetation Description: The dominant plant in this community is *Decodon verticillatus* (swamp loosestrife) which can form a monoculture. Common associates include *Nymphaea odorata* (American white waterlily), *Pontederia cordata* (pickerelweed), and *Utricularia* (bladderwort) spp.
Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Decodon verticillatus* (swamp loosestrife)
Floating aquatic	Aquatic herb (floating & submergent)	*Nymphaea odorata* (American white waterlily)

Characteristic Species: *Decodon verticillatus* (swamp loosestrife)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S5*	B	1	Shrub Swamp	Swain and Kearsley 2001

Local Range: This community is found along the borders of ponds and streams throughout the park.
Classification Comments: No plots were sampled in this community during this study because most occurrences are very small. Most *Decodon* (decodon)-dominated occurrences in Cape Cod National Seashore are narrow and linear.
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: None.
AA(2004) Points: None.
Cape Cod National Seashore Inventory Notes: Mapped in the Shrub Swamp aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	Semipermanently flooded cold-deciduous shrubland (III.B.2.N.f.)
Alliance	*Decodon verticillatus* Semipermanently Flooded Shrubland Alliance (A.1013)
Alliance (English name)	Swamp-loosestrife Semipermanently Flooded Shrubland Alliance
Association	*Decodon verticillatus* Semipermanently Flooded Shrubland
Association (English name)	Swamp-loosestrife Semipermanently Flooded Shrubland
Ecological System(s):	Southeastern Coastal Plain Interdunal Wetland (CES203.258). Northern Atlantic Coastal Plain Pondshore (CES203.518). Northern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.516).

GLOBAL DESCRIPTION

Concept Summary: This shrub border occurs as a fringe along aquatic edges of lakes and streams in the northeastern states. *Decodon verticillatus* (swamp loosestrife) forms a dense, often monotypic, tangle. *Cephalanthus occidentalis* (common buttonbush) can occur, but with less abundance than *Decodon verticillatus* (swamp loosestrife). Herbaceous species vary widely, but may include *Nuphar lutea ssp. variegata* (variegated yellow pond-lily), *Nymphaea odorata* (American white waterlily), *Peltandra virginica* (green arrow arum), *Pontederia cordata* (pickerelweed), *Utricularia* (bladderwort) spp., and *Potamogeton* (pondweed) spp. Where *Decodon* (decodon)-dominated vegetation occurs adjacent to bog mats, it is considered a part of *Chamaedaphne calyculata - (Gaylussacia dumosa) - Decodon verticillatus / Woodwardia virginica* Dwarf-shrubland (CEGL006008).

Environmental Description: Vegetation forms as a fringe along aquatic edges of lakes and streams.

Vegetation Description: *Decodon verticillatus* (swamp loosestrife) forms a dense, often monotypic, tangle. *Cephalanthus occidentalis* (common buttonbush) can occur, but with less abundance than *Decodon verticillatus* (swamp loosestrife). Herbaceous species vary widely, but may include *Nuphar lutea ssp. variegata* (variegated yellow pond-lily), *Nymphaea odorata* (American white waterlily), *Peltandra virginica* (green arrow arum), *Pontederia cordata* (pickerelweed), *Utricularia* (bladderwort) spp., and *Potamogeton* (pondweed) spp.

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Decodon verticillatus* (swamp loosestrife)

Characteristic Species: *Decodon verticillatus* (swamp loosestrife)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine

DISTRIBUTION

Range: Information not available.

States/Provinces: CT, DE, MA, MD, NH, NJ, NY, ON:S4, PA, VT, WV

Federal Lands: NPS (Cape Cod); USFWS (Prime Hook)

CONSERVATION STATUS

Rank: GNR (15-Dec-1994)

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 3 - Weak

Comments: Information not available.

Similar Associations:

- *Decodon verticillatus* Seasonally Flooded Shrubland (CEGL003905)

Related Concepts: Information not available.

SOURCES

Description Authors: S.L. Neid

References: Bowman 2000, Breden et al. 2001, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fike 1999, Harrison 2004, Metzler and Barrett 2001, Swain and Kearsley 2001



Figure 37. Swamp-loosestrife Shrub Swamp in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 414708, northing 4645800.



Figure 38. Swamp-loosestrife Shrub Swamp in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 414708, northing 4645800.

COMMON NAME (PARK-SPECIFIC): NORTHERN COASTAL SHRUB SWALE

SYNONYMS
USNVC English Name: **Sweet Gale - Northern Bayberry Saturated Shrubland**
USNVC Scientific Name: ***Myrica gale* - *Morella pensylvanica* Saturated Shrubland**
USNVC Identifier: **CEGL006339**

LOCAL INFORMATION

Environmental Description: This association occurs in two settings: in a basin within outwash deposits and along a slow-moving Coastal Plain river. Within the Cranberry Bog, this community occupies an abandoned commercial bog with a small out-flowing stream. The wetland is fed by groundwater and usually has saturated soils, but can be very dry during long periods of drought. There are remnant ditches from the old bog. At the Pamet River, this association occurs on a slightly higher elevation "levee" along the stream. This portion of the Pamet River was once tidal, but is now primarily fresh because a one-way valve has been constructed in the stream channel to eliminate tidal flooding. There are, however, dead shrubs along the western section of the river that suggest that the valve has occasionally failed and that there remains a periodic saltwater influence on communities. The Monomoy Creek occurrence of this type is found along a freshwater tidal stream.
Vegetation Description: This community is highly variable and is usually dominated by *Myrica gale* (sweetgale), *Ilex verticillata* (common winterberry), *Clethra alnifolia* (coastal sweetpepperbush), *Toxicodendron radicans* (eastern poison ivy), *Photinia floribunda* (purple chokeberry), and *Rhododendron viscosum* (swamp azalea). Herbaceous plants are generally low cover, but include *Thelypteris palustris* (eastern marsh fern), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Juncus effusus* (common rush), and *Glyceria obtusa* (Atlantic mannagrass). In one unusual variant, the dominant species are *Schoenoplectus tabernaemontani* (softstem bulrush), *Typha latifolia* (broadleaf cattail), *Pluchea odorata* (sweetscent), and *Eleocharis parvula* (dwarf spikerush).
Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Ilex verticillata* (common winterberry)
		Toxicodendron radicans (eastern poison ivy)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Myrica gale* (sweetgale)
Herb (field)	Forb	*Triadenum virginicum* (Virginia marsh St. Johnswort)
Herb (field)	Fern or fern ally	*Thelypteris palustris* (eastern marsh fern)

Characteristic Species: *Myrica gale* (sweetgale), *Schoenoplectus tabernaemontani* (softstem bulrush)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S1*	B	1	Coastal Interdunal Marsh/Swale	Swain and Kearsley 2001

Local Range: This association occurs in Truro at the Cranberry Bog and along the non-tidal portion of the Pamet River. Another variant of this type occurs along the Monomoy Creek outside Cape Cod National Seashore.
Classification Comments: This community as described is highly variable and may well be more than one association. The examples in the abandoned cranberry bog are artificial in that they are post agricultural and currently ditched. The example on the Pamet River is in a location

that was once tidal, but is now fresh because a "flapper valve" allows water to exit from the system but not enter during high tides. The flapper valve is, however, occasionally breached during major storms, resulting in irregular flooding by salt water. Only the Monomoy River occurrence is in a setting that is not artificial. This occurrence shares few of the species found in the other three examples.
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: CACO.017, CACO.059, and CACO.111.
AA (2004) Points: CACO.137, CACO.167, CACO.290, CACO.592.
Cape Cod National Seashore Inventory Notes: Mapped in the Shrub Swale aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	Saturated cold-deciduous shrubland (III.B.2.N.g.)
Alliance	*Myrica gale* Saturated Shrubland Alliance (A.1022)
Alliance (English name)	Sweet Gale Saturated Shrubland Alliance
Association	*Myrica gale - Morella pensylvanica* Saturated Shrubland
Association (English name)	Sweet Gale - Northern Bayberry Saturated Shrubland
Ecological System(s):	Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264).

GLOBAL DESCRIPTION

Concept Summary: This association comprises freshwater swales along the north Atlantic coast dominated by shrubs. It occurs in depressions behind primary or secondary dunes where the water table intersects the soil surface for part of the growing season. It occurs less commonly on slow-moving rivers of outwash deposits. Substrate is sand with or without peat development. This interdunal swale is dominated by a variety of shrubs such as *Morella pensylvanica* (northern bayberry), *Myrica gale* (sweetgale), *Photinia floribunda* (purple chokeberry), *Ilex verticillata* (common winterberry), *Vaccinium corymbosum* (highbush blueberry), *Spiraea tomentosa* (steeplebush), *Spiraea alba var. latifolia* (white meadowsweet), *Viburnum recognitum* (southern arrowwood), *Lyonia ligustrina* (maleberry), and occasionally *Alnus* (alder) spp. and *Salix* (willow) spp. Herbaceous species tend to occur in openings and include *Triadenum virginicum* (Virginia marsh St. Johnswort), *Scirpus cyperinus* (woolgrass), *Thelypteris palustris* (eastern marsh fern), *Toxicodendron radicans* (eastern poison ivy), and *Parthenocissus quinquefolia* (Virginia creeper). *Sphagnum* (sphagnum) spp. are likely present in some examples, but this type needs further investigation.
Environmental Description: This association occurs in freshwater swales on dunes or other low areas or depressions behind primary dunes or secondary dunes where the water table intersects the soil surface for part of the growing season. It occurs less commonly on slow-moving rivers of outwash deposits. Substrate is sand with or without peat development.
Vegetation Description: This freshwater shrubland community is dominated by a variety of shrubs such as *Morella pensylvanica* (northern bayberry), *Myrica gale* (sweetgale), *Photinia floribunda* (purple chokeberry), *Ilex verticillata* (common winterberry), *Vaccinium corymbosum* (highbush blueberry), *Spiraea tomentosa* (steeplebush), *Spiraea alba var. latifolia* (white

meadowsweet), *Viburnum recognitum* (southern arrowwood), *Lyonia ligustrina* (maleberry), and occasionally *Alnus* (alder) spp. and *Salix* (willow) spp. Herbaceous species tend to occur in openings and include *Triadenum virginicum* (Virginia marsh St. Johnswort), *Scirpus cyperinus* (woolgrass), and *Thelypteris palustris* (eastern marsh fern). Vines including *Toxicodendron radicans* (eastern poison ivy) and *Parthenocissus quinquefolia* (Virginia creeper) are also present in this community. *Sphagnum* (sphagnum) spp. are likely present in some examples, but this type needs further investigation.

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Photinia floribunda* (purple chokeberry)
		Vaccinium corymbosum (highbush blueberry)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Morella pensylvanica* (northern bayberry)
		Myrica gale (sweetgale)
Herb (field)	Fern or fern ally	*Thelypteris palustris* (eastern marsh fern)

Characteristic Species: *Morella pensylvanica* (northern bayberry), *Myrica gale* (sweetgale)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine

DISTRIBUTION
Range: Currently described from New Hampshire, Massachusetts, Rhode Island, and New York.
States/Provinces: MA, NH, NY, RI?
Federal Lands: NPS (Cape Cod); USFWS (Nomans Land Island?)

CONSERVATION STATUS
Rank: GNR (28-Aug-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 3 - Weak
Comments: The full geographic extent of this association needs to be determined, as well as its successional relationship with other freshwater and brackish interdunal swale communities and with vegetation bordering coastal salt ponds. Further study may indicate a division into two associations, one on interdunal swales and another on streamside settings.

Similar Associations:
- *Cladium mariscoides / Vaccinium macrocarpon - Morella pensylvanica* Dwarf-shrubland (CEGL006141)

Related Concepts:
- *Myrica gale* Interdunal Swale (Lundgren 1998) ?
- Wet swale (Dunlop and Crow 1985) ?
- Wet swale (McDonnell 1979) ?

SOURCES
Description Authors: S.L. Neid
References: Dunlop and Crow 1985, Eastern Ecology Working Group n.d., Edinger et al. 2002, Lundgren 1998, McDonnell 1979, Reschke 1990



Figure 39. Northern Coastal Shrub Swale in Cape Cod National Seashore (CACO.017). Summer 2003. NAD 1983 / UTM easting 414826, northing 4650610.



Figure 40. Northern Coastal Shrub Swale in Cape Cod National Seashore (Duck Harbor, no specific plot). September 2004. UTM coordinates not available.

COMMON NAME (PARK-SPECIFIC): HIGHBUSH BLUEBERRY BOG THICKET

SYNONYMS
USNVC English Name: **Highbush Blueberry / Peatmoss species Shrubland**
USNVC Scientific Name: ***Vaccinium corymbosum* / *Sphagnum* spp. Shrubland**
USNVC Identifier: **CEGL006190**

LOCAL INFORMATION

Environmental Description: This community occurs in two settings: one along a coastal outwash stream and another in a glacial outwash basin. The soils are oligotrophic and subject to varying water depths. The branches of the *Vaccinium* (blueberry) are uniformly bare up about 50 cm from the soil surface suggesting long periods of high water in the community. One occurrence is located at a very old agricultural site. There are remnants of old drainage ditches that probably facilitate the movement of water off the site, but water levels are also related to local groundwater which must discharge locally into the stream. The other occurrence is in a large depression with steep slopes.
Vegetation Description: This community is dominated by tall multi-stemmed *Vaccinium corymbosum* (highbush blueberry) with scattered *Acer rubrum* (red maple). Associated shrubs include *Toxicodendron vernix* (poison sumac), *Rhododendron viscosum* (swamp azalea), and *Lyonia ligustrina* (maleberry) along the streamside example and *Decodon verticillatus* (swamp loosestrife), *Ilex verticillata* (common winterberry), and *Rhododendron viscosum* (swamp azalea) at the basin example. The understory is sparsely vegetated primarily with *Toxicodendron radicans* (eastern poison ivy) along the stream and *Woodwardia virginica* (Virginia chainfern) in the basin. There is also a high cover of *Sphagnum* (sphagnum) and other bryophytes.
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Lyonia ligustrina* (maleberry)
		Rhododendron viscosum (swamp azalea)
		Toxicodendron vernix (poison sumac)
		Vaccinium corymbosum (highbush blueberry)
Short shrub/sapling	Broad-leaved deciduous shrub	*Rubus hispidus* (bristly dewberry)
		Toxicodendron radicans (eastern poison ivy)

Characteristic Species: *Acer rubrum* (red maple), *Vaccinium corymbosum* (highbush blueberry)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S4	=	1	Highbush Blueberry Thicket	Swain and Kearsley 2001

Local Range: This association is known from glacial outwash basins in Truro and the non-tidal section of the Herring River in Wellfleet. It probably also occurs in other parts of the Herring River/Bound Brook system.
Classification Comments: Two occurrences of this type of *Vaccinium* (blueberry) shrub thicket were documented in this project. There are probably many more examples of this association found throughout the Herring River/Bound Brook area and possibly associated with some of the larger ponds. *Vaccinium corymbosum* (highbush blueberry)-dominated communities that occur on dune sand associated with interdunal swales are identified as *Vaccinium corymbosum* - *Rhododendron viscosum* - *Clethra alnifolia* Shrubland (CEGL006371).
Other Comments: Information not available.

Local Description Authors: R.E. Zaremba
Plots: CACO.012, CACO.123.
AA (2004) Points: CACO.110, CACO.136, CACO.199, CACO.251, CACO.263, CACO.303, CACO.339, CACO.477, CACO.524, CACO.575, CACO.583.
Cape Cod National Seashore Inventory Notes: Mapped in the Shrub Swamp aggregated map class in the vegetation map. Photograph not available.

GLOBAL INFORMATION

USNVC 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	Saturated cold-deciduous shrubland (III.B.2.N.g.)
Alliance	*Vaccinium corymbosum* Saturated Shrubland Alliance (A.1018)
Alliance (English name)	Highbush Blueberry Saturated Shrubland Alliance
Association	*Vaccinium corymbosum / Sphagnum* spp. Shrubland
Association (English name)	Highbush Blueberry / Peatmoss species Shrubland
Ecological System(s):	Boreal-Laurentian-Acadian Acidic Basin Fen (CES201.583). North-Central Interior and Appalachian Acidic Peatland (CES202.606). Northern Atlantic Coastal Plain Pitch Pine Lowland (CES203.374).

GLOBAL DESCRIPTION

Concept Summary: Highbush blueberry peat bog of glaciated regions in the eastern and northeastern United States. This tall-shrub bog thicket occurs on oligotrophic to weakly minerotrophic peat soils, commonly as a border thicket around more open dwarf heath shrub peatlands or within small, isolated basins. Significant seasonal water level fluctuation can occur, especially in isolated basins without inlet or outlet streams. A tall-shrub layer is characterized by abundant *Vaccinium corymbosum* (highbush blueberry) plus *Gaylussacia baccata* (black huckleberry), *Chamaedaphne calyculata* (leatherleaf), *Kalmia angustifolia* (sheep laurel), *Rhododendron canadense* (rhodora), *Lyonia ligustrina* (maleberry), and *Nemopanthus mucronatus* (catberry) in more northern or cooler microclimates, and *Ilex verticillata* (common winterberry) and *Rhododendron viscosum* (swamp azalea) in the south. In locally wetter areas, *Cephalanthus occidentalis* (common buttonbush) or *Decodon verticillatus* (swamp loosestrife) can occur. Coastal occurrences may have additional shrub species such as *Leucothoe racemosa* (swamp doghobble), *Clethra alnifolia* (coastal sweetpepperbush), and *Gaylussacia dumosa* (dwarf huckleberry). Sparse, scattered trees may occur, including *Acer rubrum* (red maple), *Picea mariana* (black spruce), *Larix laricina* (tamarack), *Pinus strobus* (eastern white pine), *Pinus rigida* (pitch pine), *Betula populifolia* (gray birch), or *Nyssa sylvatica* (blackgum), with species dependent on environmental setting. The herbaceous layer tends to be sparse, although can be locally abundant. Common herbs include *Osmunda cinnamomea* (cinnamon fern), *Woodwardia virginica* (Virginia chainfern), *Carex trisperma* (threeseeded sedge), *Sarracenia purpurea* (purple pitcherplant), *Thelypteris palustris* (eastern marsh fern), *Triadenum virginicum* (Virginia marsh St. Johnswort), and *Maianthemum trifolium* (threeleaf false lily of the valley). *Sphagnum* (sphagnum) mosses blanket well-developed hummocks and hollows, including *Sphagnum magellanicum* (Magellan's sphagnum), *Sphagnum centrale* (sphagnum), *Sphagnum rubellum* (sphagnum), *Sphagnum capillifolium* (sphagnum), *Sphagnum fimbriatum* (sphagnum), and *Sphagnum fuscum* (sphagnum).

Environmental Description: This tall-shrub bog thicket occurs on oligotrophic to weakly minerotrophic peat soils, commonly as a border thicket around more open dwarf heath shrub peatlands or within small, isolated basins. Significant seasonal water level fluctuation can occur, especially in isolated basins without inlet or outlet streams.
Vegetation Description: A tall-shrub layer is characterized by abundant *Vaccinium corymbosum* (highbush blueberry) plus *Gaylussacia baccata* (black huckleberry), *Chamaedaphne calyculata* (leatherleaf), *Kalmia angustifolia* (sheep laurel), *Rhododendron canadense* (rhodora), *Lyonia ligustrina* (maleberry), and *Nemopanthus mucronatus* (catberry) in more northern or cooler microclimates, and *Ilex verticillata* (common winterberry) and *Rhododendron viscosum* (swamp azalea) in the south. In locally wetter areas, *Cephalanthus occidentalis* (common buttonbush) or *Decodon verticillatus* (swamp loosestrife) can occur. Sparse, scattered trees may occur, including *Acer rubrum* (red maple), *Picea mariana* (black spruce), *Larix laricina* (tamarack), *Pinus strobus* (eastern white pine), *Pinus rigida* (pitch pine), *Betula populifolia* (gray birch), or *Nyssa sylvatica* (blackgum), with species dependent on environmental setting. The herbaceous layer tends to be sparse, although can be locally abundant. Common herbs include *Osmunda cinnamomea* (cinnamon fern), *Woodwardia virginica* (Virginia chainfern), *Carex trisperma* (threeseeded sedge), *Sarracenia purpurea* (purple pitcherplant), *Thelypteris palustris* (eastern marsh fern), *Triadenum virginicum* (Virginia marsh St. Johnswort), and *Maianthemum trifolium* (threeleaf false lily of the valley). *Sphagnum* (sphagnum) mosses blanket well-developed hummocks and hollows, including *Sphagnum magellanicum* (Magellan's sphagnum), *Sphagnum centrale* (sphagnum), *Sphagnum rubellum* (sphagnum), *Sphagnum capillifolium* (sphagnum), *Sphagnum fimbriatum* (sphagnum), and *Sphagnum fuscum* (sphagnum).
Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Lyonia ligustrina* (maleberry)
		Vaccinium corymbosum (highbush blueberry)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Chamaedaphne calyculata* (leatherleaf)

Characteristic Species: *Chamaedaphne calyculata* (leatherleaf), *Gaylussacia baccata* (black huckleberry), *Lyonia ligustrina* (maleberry), *Osmunda cinnamomea* (cinnamon fern), *Rhododendron viscosum* (swamp azalea), *Vaccinium corymbosum* (highbush blueberry), *Woodwardia virginica* (Virginia chainfern)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine

DISTRIBUTION
Range: Occurs from Pennsylvania and New Jersey north to New Hampshire and Maine and possibly Vermont.
States/Provinces: CT, MA:S4, ME?, NH, NJ:S1S3, NY, PA, RI, VT
Federal Lands: NPS (Cape Cod, Delaware Water Gap, Upper Delaware); USFWS (Assabet River?, Great Meadows?)

CONSERVATION STATUS
Rank: G3G5 (31-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: These tall heath shrub bog thickets tend to occur in wetter, more minerotrophic settings relative to dwarf heath shrub bogs.

Similar Associations:

- *Vaccinium corymbosum - Gaylussacia baccata - Photinia melanocarpa / Calla palustris* Shrubland (CEGL005085)
- *Vaccinium corymbosum - Rhododendron viscosum - Clethra alnifolia* Shrubland (CEGL006371)

Related Concepts:

- *Vaccinium corymbosum-Rhododendron viscosum* tall shrub bog and bog border association [Type A] (Kearsley 1999a) ?
- Highbush blueberry shrub swamp (CAP pers. comm. 1998) ?
- New England coastal plain pondshore (Rawinski 1984) ?
- Northern New Jersey Shrub Swamp (Breden 1989) ?
- Shrub Swamp (Lundgren et al. 2000) ?

SOURCES

Description Authors: S.L. Neid, mod. S.C. Gawler

References: Breden 1989, Breden et al. 2001, CAP pers. comm. 1998, Conard 1935, Damman and French 1987, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fike 1999, Gawler 2002, Johnson 1981b, Karlin and Lynn 1988, Kearsley 1999a, Lundgren et al. 2000, Lynn and Karlin 1985, Metzler and Barrett 1982, Metzler and Barrett 2001, Perles et al. 2007, Radis 1986, Rawinski 1984, Rozsa and Metzler n.d., Sperduto 2000a, Sperduto and Nichols 2004, Swain and Kearsley 2000, Swain and Kearsley 2001

COMMON NAME (PARK-SPECIFIC): NORTH ATLANTIC FRESH TIDAL SHRUB SWAMP

SYNONYMS
USNVC English Name: **(Speckled Alder, Smooth Alder) - Silky Dogwood Shrubland**
USNVC Scientific Name: ***Alnus* (*incana* ssp. *rugosa, serrulata*) - *Cornus amomum* Shrubland**
USNVC Identifier: **CEGL006337**

LOCAL INFORMATION

Environmental Description: This association occurs in a freshwater tidal section of a Coastal Plain stream. The substrate is alluvial and fine silty loam with many small tidal drainage streams. The substrate surface is very irregular.
Vegetation Description: This dense shrubland is dominated by *Alnus serrulata* (hazel alder) with lower densities of other wetland shrubs including *Rhododendron viscosum* (swamp azalea), *Clethra alnifolia* (coastal sweetpepperbush), *Ilex glabra* (inkberry), *Toxicodendron vernix* (poison sumac), and *Lyonia ligustrina* (maleberry). There are many vines, including *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy), and *Rubus hispidus* (bristly dewberry). The community grades into *Acer rubrum* (red maple) swamp, and there are scattered individuals of *Acer rubrum* (red maple). The understory is sparse but diverse and includes *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* (royal fern), *Lysimachia terrestris* (earth loosestrife), *Thelypteris palustris* (eastern marsh fern), and *Lycopus uniflorus* (northern bugleweed). There is considerable elevation variation in the substrate, with *Sphagnum* (sphagnum) and other bryophytes around the bases of shrubs.
Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Alnus serrulata* (hazel alder)
		Clethra alnifolia (coastal sweetpepperbush)
		Rhododendron viscosum (swamp azalea)
Herb (field)	Fern or fern ally	*Osmunda cinnamomea* (cinnamon fern)

Characteristic Species: *Alnus serrulata* (hazel alder), *Osmunda cinnamomea* (cinnamon fern)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S1	=	1	Fresh / Brackish Tidal Shrubland	Swain and Kearsley 2001

Local Range: This association is known only from one area in Wellfleet.
Classification Comments: There is only one known example of this community within the vicinity of Cape Cod National Seashore. There could be additional occurrences in remote sections of the Herring River/Bound Brook wetland system. There are scattered occurrences of *Alnus* (alder) at other Cape Cod National Seashore sites, but these are generally very small and can be considered part of other wetland shrub communities.
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: CACO.062 (outside boundary).
AA (2004) Points: None.
Cape Cod National Seashore Inventory Notes: Photograph not available.

GLOBAL INFORMATION

USNVC 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	*Alnus (incana, serrulata, maritima)* Tidal Shrubland Alliance (A.1024)
Alliance (English name)	(Speckled Alder, Smooth Alder, Seaside Alder) Tidal Shrubland Alliance
Association	*Alnus (incana* ssp. *rugosa, serrulata)* - *Cornus amomum* Shrubland
Association (English name)	(Speckled Alder, Smooth Alder) - Silky Dogwood Shrubland
Ecological System(s):	Northern Atlantic Coastal Plain Tidal Swamp (CES203.282). Northern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.516). Acadian Estuary Marsh (CES201.579).

GLOBAL DESCRIPTION

Concept Summary: This type comprises tidal freshwater, or perhaps also oligohaline, shrublands dominated by *Alnus serrulata* (hazel alder) and/or *Alnus incana ssp. rugosa* (speckled alder). It is found in coastal areas with tidally influenced river systems in the North Atlantic. Flood waters are typically slightly acid (pH less than 5) and soils are usually mineral without significant peat deposits. In some examples one or both of these may be characteristically dominant or nearly so. Other examples may be more semi-open with a mixed canopy of *Alnus* (alder) with other shrubs such as *Cornus amomum* (silky dogwood), *Rosa palustris* (swamp rose), *Ilex verticillata* (common winterberry), *Viburnum dentatum* (southern arrowwood), *Clethra alnifolia* (coastal sweetpepperbush), and *Lindera benzoin* (northern spicebush). Other woody plants which may be present include *Sambucus canadensis* (common elderberry), *Salix* (willow) spp., *Amorpha fruticosa* (desert false indigo), *Cephalanthus occidentalis* (common buttonbush), *Decodon verticillatus* (swamp loosestrife), *Toxicodendron vernix* (poison sumac), and *Toxicodendron radicans* (eastern poison ivy). More northern examples may contain *Viburnum recognitum* (southern arrowwood) and *Spiraea alba var. latifolia* (white meadowsweet). Some shrub associates include *Decodon verticillatus* (swamp loosestrife) and *Toxicodendron vernix* (poison sumac); some herbaceous associates are *Osmunda regalis var. spectabilis* (royal fern), *Thelypteris palustris var. pubescens* (eastern marsh fern), *Galium* (bedstraw) spp., *Onoclea sensibilis* (sensitive fern), *Polygonum punctatum* (dotted smartweed), *Apios americana* (groundnut), *Typha latifolia* (broadleaf cattail), *Peltandra virginica* (green arrow arum), *Pontederia cordata* (pickerelweed), *Mikania scandens* (climbing hempvine), *Symphyotrichum novi-belgii* (New York aster), *Boehmeria cylindrica* (smallspike false nettle), *Impatiens capensis* (jewelweed), *Triadenum walteri* (greater marsh St. Johnswort), *Asclepias incarnata* (swamp milkweed), *Carex atlantica* (prickly bog sedge), *Platanthera clavellata* (small green wood orchid), and *Xyris torta* (slender yelloweyed grass). *Carex stricta* (upright sedge) may also be present, and there is a great deal of micro-relief (tussocks and furrows) leading to high species diversity.

Environmental Description: This association occurs in freshwater tidal systems in fresh to brackish reaches of tidal rivers along the marsh-upland transition. This shrubland is best developed along major tidal river systems that have a gradual elevation gradient, and it generally occurs between mean high tide level and mean high water level of annual river flooding in the spring; it is generally flooded irregularly by spring tides. Substrate is alluvial and fine silty loam,

loamy sand, or fine- or medium-grained sand without significant peat deposits. There is distinct hummock-and-hollow micro-relief.

Vegetation Description: This shrubland is dominated by *Alnus serrulata* (hazel alder) at the southern end of the range and/or *Alnus incana ssp. Rugosa* in more northerly examples, where one or both of these may be characteristically dominant or nearly so. Other examples may be more semi-open with a mixed canopy of *Alnus* (alder) with other shrubs such as *Cornus amomum* (silky dogwood), *Rosa palustris* (swamp rose), *Ilex verticillata* (common winterberry), *Viburnum dentatum* (southern arrowwood), *Clethra alnifolia* (coastal sweetpepperbush), and *Lindera benzoin* (northern spicebush). Other woody plants which may be present include *Sambucus canadensis* (common elderberry), *Salix* (willow) spp., *Amorpha fruticosa* (desert false indigo), *Cephalanthus occidentalis* (common buttonbush), *Decodon verticillatus* (swamp loosestrife), *Toxicodendron vernix* (poison sumac), and *Toxicodendron radicans* (eastern poison ivy). More northern examples may contain *Viburnum recognitum* (southern arrowwood) and *Spiraea alba var. latifolia* (white meadowsweet). *Carex stricta* (upright sedge) may also be present, and there is a great deal of micro-relief (tussocks and furrows) leading to high species diversity. Some herbaceous associates are *Osmunda regalis var. spectabilis* (royal fern), *Thelypteris palustris var. pubescens* (eastern marsh fern), *Galium* (bedstraw) spp., *Onoclea sensibilis* (sensitive fern), *Pilea fontana* (lesser clearweed), *Polygonum punctatum* (dotted smartweed), *Apios americana* (groundnut), *Typha latifolia* (broadleaf cattail), *Peltandra virginica* (green arrow arum), *Pontederia cordata* (pickerelweed), *Mikania scandens* (climbing hempvine), *Symphyotrichum novi-belgii* (New York aster), *Boehmeria cylindrica* (smallspike false nettle), *Impatiens capensis* (jewelweed), *Triadenum walteri* (greater marsh St. Johnswort), *Asclepias incarnata* (swamp milkweed), *Carex atlantica* (prickly bog sedge), *Platanthera clavellata* (small green wood orchid), and *Xyris torta* (slender yelloweyed grass).

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Alnus incana* ssp. *rugosa* (speckled alder)
		Alnus serrulata (hazel alder)

Characteristic Species: *Alnus incana* ssp. *rugosa* (speckled alder), *Alnus serrulata* (hazel alder)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

DISTRIBUTION

Range: This association is found in coastal areas with tidally influenced river systems from Maine to Virginia in the North Atlantic.
States/Provinces: CT, DE, MA:S1, MD:S4, ME:SU, NJ, NY, PA, VA
Federal Lands: NPS (Cape Cod)

CONSERVATION STATUS

Rank: GNR (15-Aug-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 2 - Moderate
Comments: This type does not extend into the embayed coastal area of Virginia (G. Fleming pers. comm.) and as currently defined is not believed to be present in the Chesapeake Bay region of either VA or MD (P. Coulling pers. comm.).

Similar Associations:

- *Acer rubrum - Fraxinus pennsylvanica / Polygonum* spp. Forest (CEGL006165)
- *Alnus incana - Cornus (amomum, sericea) / Clematis virginiana* Shrubland (CEGL006062)
- *Alnus serrulata - Salix nigra / Pilea (fontana, pumila)* Tidal Shrubland (CEGL006843)
- *Cornus amomum - Alnus serrulata* Shrubland (CEGL006414)

Related Concepts:

- *Alnus serrulata - Viburnum recognitum / Impatiens capensis* Tidal Shrubland (Harrison and Stango 2003) =
- Freshwater tidal marsh (Collins and Anderson 1994) ?
- Freshwater tidal swamp (Breden 1989) ?
- Southern New England / Gulf of Maine Fresh/ Brackish Tidal Swamp (Rawinski 1984) B

SOURCES

Description Authors: S.L. Neid

References: Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1996, Collins and Anderson 1994, Coulling pers. comm., Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming pers. comm., Gawler 2001, Gawler 2002, Harrison and Stango 2003, Hart 1990, McCoy and Fleming 2000, Metzler and Barrett 2001, Metzler and Barrett 2004, Rawinski 1984, Reschke 1990, Sneddon et al. 1996, Sperduto 2000b, Swain and Kearsley 2000, Swain and Kearsley 2001, Tiner 1995

COMMON NAME (PARK-SPECIFIC): IRREGULARLY FLOODED EASTERN TIDAL SALT SHRUB

SYNONYMS
USNVC English Name: **Groundsel-tree - Maritime Marsh-elder / Switchgrass Shrubland**
USNVC Scientific Name: ***Baccharis halimifolia* - *Iva frutescens* / *Panicum virgatum* Shrubland**
USNVC Identifier: **CEGL003921**

LOCAL INFORMATION

Environmental Description: This tidal shrubland is found at the upper edges of salt marshes. It is generally flooded only during spring and storm tides. It is found at the upper edges of very broad marshes with gradual elevation change, at the upland fringe in marsh embayments, and along dredge spoil deposits associated with mosquito ditching. Most of the occurrences that are not near the upland border are associated with past or ongoing disturbances. The substrate is generally a mixture of sand and fine organics, although this association can form on old salt marsh peat deposits following a disturbance. There are often dense layers of organic drift material, usually *Spartina alterniflora* (smooth cordgrass) and *Phragmites australis* (common reed), which cover the surface smothering all plant except for shrubs. The substrate can be covered with larger drift material, including boards and plastic debris.
Vegetation Description: This tidal shrubland is dominated by *Baccharis halimifolia* (eastern baccharis) or *Iva frutescens* (Jesuit's bark). Generally only one or the other of these shrubs is present at a site. The only other shrub frequently found in this community is *Morella pensylvanica* (northern bayberry). *Juniperus virginiana* (eastern redcedar) and *Prunus maritima* (beach plum) may also be present. Some examples have dense organic driftlines and few herbaceous plants; others support typical high marsh vegetation, including *Spartina patens* (saltmeadow cordgrass), *Juncus gerardii* (saltmeadow rush), *Distichlis spicata* (inland saltgrass), *Solidago sempervirens* (seaside goldenrod), and *Euthamia caroliniana* (slender goldentop).
Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Iva frutescens* (Jesuit's bark)
Short shrub/sapling	Broad-leaved evergreen shrub	*Baccharis halimifolia* (eastern baccharis)
		Morella pensylvanica (northern bayberry)
Herb (field)	Forb	*Solidago sempervirens* (seaside goldenrod)
Herb (field)	Graminoid	*Juncus gerardii* (saltmeadow rush)
		Spartina patens (saltmeadow cordgrass)

Characteristic Species: *Baccharis halimifolia* (eastern baccharis), *Iva frutescens* (Jesuit's bark)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S3*	B	1	Salt Marsh	Swain and Kearsley 2001

Local Range: There are scattered small occurrences of this association throughout upper salt marshes in Cape Cod National Seashore.
Classification Comments: This community is not well-developed at Cape Cod National Seashore relative to sites in marshes on Long Island. In some cases, the community examples are

little more than a few scattered *Baccharis* (baccharis) or *Iva* (marshelder) plants and could be considered a part of another high marsh community.
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: CACO.022, CACO.025, CACO.090.
AA (2004) Points: CACO.193, CACO.218, CACO.273, CACO.306.
Cape Cod National Seashore Inventory Notes: Mapped in the Salt Shrub aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

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

GLOBAL DESCRIPTION

Concept Summary: This maritime shrubland of the eastern states occurs in association with salt marshes. *Iva frutescens* (Jesuit's bark) is the most characteristic and dominant shrub species, and *Baccharis halimifolia* (eastern baccharis) is a common associate. Other associated shrubs include *Morella pensylvanica* (northern bayberry) in the northern portion of the range, while *Borrichia frutescens* (bushy seaside tansy), *Morella cerifera* (wax myrtle), and *Juniperus virginiana var. silicicola* (southern redcedar) are frequent associates in the southern part of the range. *Spartina patens* (saltmeadow cordgrass) is a characteristic and usually abundant grass; other common herbaceous associates include *Panicum virgatum* (switchgrass), *Distichlis spicata* (inland saltgrass), *Hibiscus moscheutos* (crimsoneyed rosemallow), *Toxicodendron radicans* (eastern poison ivy), *Teucrium canadense* (Canada germander), *Festuca rubra* (red fescue), *Limonium carolinianum* (Carolina sealavender), *Atriplex prostrata* (triangle orache), *Sabatia stellaris* (rose of Plymouth), *Sabatia dodecandra* (marsh rose gentian), and in the north *Hierochloe odorata* (vanilla grass) and *Juncus gerardii* (saltmeadow rush), and in the south *Setaria parviflora* (marsh bristlegrass). This community often forms an abrupt transition from salt marsh to upland reflecting the relatively higher elevation and less frequent tidal flooding. Shrub cover in this situation tends to be fairly dense, and herbs are sparsely distributed. Storm-induced disturbance causes periodic die-back of the shrubs restricting the extent of their spread.
Environmental Description: This maritime and estuarine shrubland of the northeastern seaboard states occurs in association with salt marshes. It forms an ecotone between high salt marsh and adjacent upland vegetation. This shrubland occurs above mean high tide but can be flooded by storm tides. Substrate is organic peat over glacial till, sand, or sandy loam.

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

Most Abundant Species:

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

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

Other Noteworthy Species: Information not available.

USFWS Wetland System: Estuarine

DISTRIBUTION

Range: This association ranges from Massachusetts to South Carolina.

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

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

CONSERVATION STATUS

Rank: G5 (1-Dec-1997)

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

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

Similar Associations:

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

Related Concepts:

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

SOURCES

Description Authors: L.A. Sneddon

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



Figure 41. Irregularly Flooded Eastern Tidal Salt Shrub in Cape Cod National Seashore (near plot CACO.064, shrubland in center of photo). NAD 1983 / UTM easting 418188, northing 4640708.

COMMON NAME (PARK-SPECIFIC): NORTHERN BEACH-HEATHER DUNE SHRUBLAND

SYNONYMS
USNVC English Name: **Woolly Beach-heather - Bearberry or Kinikinnick Dwarf-shrubland**
USNVC Scientific Name: ***Hudsonia tomentosa* - *Arctostaphylos uva-ursi* Dwarf-shrubland**
USNVC Identifier: **CEGL006143**

LOCAL INFORMATION

Environmental Description: This association occurs on stabilized dunes and on outwash deposits near the coast where winds have blown beach sand over glacially deposited sands and gravels. Soils are acidic and extremely well-drained but constantly moist at a depth of 8 to 10 cm. Plants are deep-rooted and adapted to survive high surface temperatures and high winds.
Vegetation Description: This dwarf-shrubland community is dominated by *Hudsonia tomentosa* (woolly beachheather) and *Arctostaphylos uva-ursi* (kinnikinnick). Associated species occur in low abundance and include *Polygonella articulata* (coastal jointweed), *Cyperus lupulinus* (Great Plains flatsedge), and *Lechea maritima* (beach pinweed). *Morella pensylvanica* (northern bayberry), *Prunus maritima* (beach plum), and *Pinus rigida* (pitch pine) may also be present. In the occurrence on the bluffs overlooking the Atlantic Ocean, the community includes some dune-related species including *Ammophila breviligulata* (American beachgrass), *Lathyrus japonicus* (beach pea), and *Chamaesyce polygonifolia* (seaside sandmat).
Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved evergreen shrub	*Arctostaphylos uva-ursi* (kinnikinnick)
		Hudsonia tomentosa (woolly beachheather)
Herb (field)	Forb	*Lechea maritima* (beach pinweed)
		Pityopsis falcata (sickleleaf silkgrass)
		Polygonella articulata (coastal jointweed)
Herb (field)	Graminoid	*Ammophila breviligulata* (American beachgrass)

Characteristic Species: *Arctostaphylos uva-ursi* (kinnikinnick), *Hudsonia tomentosa* (woolly beachheather)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S2*	I	1	Maritime Dune	Swain and Kearsley 2001
MA	S1*	I	1	Sandplain Heathland	Swain and Kearsley 2001

Local Range: This association is found in the Provincelands, on the Nauset Spit system, and along the tops of the cliffs in Eastham, Wellfleet, and Truro.
Classification Comments: There are good examples of this community throughout the Provincelands and along the Nauset Spit system. An unusual form of this community occurs from Coast Guard Beach north into Truro along the eroding outwash cliffs. Sand has blown over existing vegetation which in part grows through the sand. *Hudsonia tomentosa* (woolly beachheather) and *Arctostaphylos* (manzanita) are abundant in this area. Some sections receive high levels of sand deposition some years, and only *Ammophila breviligulata* (American beachgrass) and *Hudsonia tomentosa* (woolly beachheather) are able to grow through the sand. In some areas there is a mixture of *Hudsonia tomentosa* (woolly beachheather) and *Hudsonia ericoides* (pinebarren goldenheather), where this community is nearly indistinguishable from the

Sandplain Heathland, *Gaylussacia baccata - Vaccinium angustifolium - Arctostaphylos uva-ursi / Schizachyrium littorale* Dwarf-shrubland (CEGL006066).
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: Gwilliam (1998) plots: H9906220, H9907110, H9907120, H9908110, H9908120, H9909120, H9910210, H9909120, H9910110, H9909220, H9910120, H9904110, H9904120, H9904220, H9906210, H9906220, H9907220, H991120.
AA (2004) Points: CACO.446, CACO.475, CACO.374, CACO.264, CACO.160, CACO.358.
Cape Cod National Seashore Inventory Notes: Mapped in the Heathland Grassland aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Dwarf-shrubland (IV)
Physiognomic Subclass	Evergreen dwarf-shrubland (IV.A.)
Physiognomic Group	Needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1.)
Physiognomic Subgroup	Natural/Semi-natural needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1.N.)
Formation	Cespitose needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1.N.a.)
Alliance	*Hudsonia tomentosa* Dwarf-shrubland Alliance (A.1062)
Alliance (English name)	Woolly Beach-heather Dwarf-shrubland Alliance
Association	*Hudsonia tomentosa - Arctostaphylos uva-ursi* Dwarf-shrubland
Association (English name)	Woolly Beach-heather - Bearberry or Kinikinnick Dwarf-shrubland
Ecological System(s):	Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264).

GLOBAL DESCRIPTION

Concept Summary: This association comprises dune heathlands of the north Atlantic coast from southern Maine to Long Island, New York, dominated by *Hudsonia tomentosa* (woolly beachheather). It occurs in well-developed dune systems in the lee side of primary dunes or on secondary dunes with active sand deposition and movement. *Hudsonia tomentosa* (woolly beachheather) is a dominant as well as keystone species of this community, binding sand in place and forming more suitable habitat for other plants to become established. Associated herbs generally occur in low abundance and include *Polygonella articulata* (coastal jointweed), *Lechea maritima* (beach pinweed), *Deschampsia flexuosa* (wavy hairgrass), *Minuartia caroliniana* (pinebarren stitchwort), *Ionactis linariifolius* (flaxleaf whitetop aster), *Solidago sempervirens* (seaside goldenrod), *Lathyrus japonicus* (beach pea), *Artemisia stelleriana* (oldwoman), *Carex silicea* (beach sedge), *Chamaesyce polygonifolia* (seaside sandmat), *Cyperus polystachyos* (manyspike flatsedge), and scattered *Ammophila breviligulata* (American beachgrass). Older, more stabilized dunes tend to have greater species diversity and less sand deposition. In these areas *Arctostaphylos uva-ursi* (kinnikinnick) can displace *Hudsonia tomentosa* (woolly beachheather) or codominate, and Asteraceae species and *Cladina* (reindeer lichen) spp. are common. Scattered individuals of *Morella pensylvanica* (northern bayberry), *Rosa rugosa* (rugosa rose), *Prunus maritima* (beach plum), or *Gaylussacia baccata* (black huckleberry) may occur within this community.
Environmental Description: This association occurs in well-developed sand dune systems in the lee side of primary dunes or on secondary dunes with active sand deposition and movement. Conditions are xeric; plants must be adapted to low moisture, high surface temperature, and high light intensity.

Vegetation Description: This dwarf-shrubland is dominated by *Hudsonia tomentosa* (woolly beachheather). Associated species generally occur in low abundance and include *Polygonella articulata* (coastal jointweed), *Lechea maritima* (beach pinweed), *Minuartia caroliniana* (pinebarren stitchwort), *Ionactis linariifolius* (flaxleaf whitetop aster), *Solidago sempervirens* (seaside goldenrod), *Lathyrus japonicus* (beach pea), *Artemisia stelleriana* (oldwoman), *Carex silicea* (beach sedge), *Chamaesyce polygonifolia* (seaside sandmat), *Cyperus polystachyos* (manyspike flatsedge), and scattered *Ammophila breviligulata* (American beachgrass). Older, more stabilized dunes tend to have greater species diversity and less sand deposition. In these areas *Arctostaphylos uva-ursi* (kinnikinnick) can displace *Hudsonia tomentosa* (woolly beachheather) or codominate, and Asteraceae species and *Cladina* (reindeer lichen) spp. are common. Scattered individuals of *Morella pensylvanica* (northern bayberry), *Rosa rugosa* (rugosa rose), *Prunus maritima* (beach plum), or *Gaylussacia baccata* (black huckleberry) may occur within this community.

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Dwarf-shrub	*Hudsonia tomentosa* (woolly beachheather)

Characteristic Species: *Hudsonia tomentosa* (woolly beachheather)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable

DISTRIBUTION
Range: This association is restricted to coastal sand dunes from southern Maine to Long Island, New York.
States/Provinces: CT, MA, ME, NJ, NY, RI
Federal Lands: NPS (Cape Cod, Fire Island, Gateway); USFWS (Monomoy, Parker River)

CONSERVATION STATUS
Rank: G2G3 (30-Jan-2007)
Reasons: This small-patch community is restricted to coastal sand dunes from southern Maine to Long Island, New York, and is faced with threats to most coastal areas of the Northeast in general: commercial and residential development, trampling by beach users, and beach stabilization in particular. An estimated 70 occurrences covering 1000–1300 acres in total exist rangewide.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: *Hudsonia tomentosa / Panicum amarum var. amarulum* Dwarf-shrubland (CEGL003950) is a southern analog of this association.
Similar Associations:
- *Ammophila breviligulata - Lathyrus japonicus* Herbaceous Vegetation (CEGL006274)
- *Hudsonia tomentosa / Panicum amarum* var. *amarulum* Dwarf-shrubland (CEGL003950)

Related Concepts:
- Coastal dune community (Rawinski 1984)
- Dune heath (Johnson 1985b)
- Interdune (McDonnell 1979)
- New England heath sand barrens / coastal heathland (Rawinski 1984)

SOURCES

Description Authors: S.L. Neid

References: Conard 1935, Dowhan and Rozsa 1989, Dunlop and Crow 1985, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Gawler 2002, Godfrey et al. 1978, Gwilliam unpubl. data 1998, Johnson 1985b, Lundgren 1998, Lundgren et al. 2000, McDonnell 1979, Metzler and Barrett 2001, NRCS 2001b, Nelson and Fink 1980, Rawinski 1984, Reschke 1990, Robichaud and Buell 1973, Swain and Kearsley 2001, Van Luven 1990, Zaremba 1989



Figure 42. Northern Beach-heather Dune Shrubland in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 39890, northing 4659057.

COMMON NAME (PARK-SPECIFIC): SOUTHERN NEW ENGLAND BOG

SYNONYMS

USNVC English Name: **Leatherleaf - (Dwarf Huckleberry) - Swamp-loosestrife / Virginia Chainfern Dwarf-shrubland**

USNVC Scientific Name: ***Chamaedaphne calyculata* - (*Gaylussacia dumosa*) - *Decodon verticillatus* / *Woodwardia virginica* Dwarf-shrubland**

USNVC Identifier: **CEGL006008**

LOCAL INFORMATION

Environmental Description: This association occurs on outwash deposits in depressions that intersect groundwater. There is some nutrient input from groundwater, but generally no surface flow or inflowing streams. Dense *Sphagnum* (sphagnum) forms a mat that supports shrubs and floats during high water periods. Older bogs may have more solid, peaty substrate. An unusual example occurs in Clapps Pond where one large embayment of the pond supports a floating mat, a part of which supports this community.

Vegetation Description: This dense shrubland is dominated by *Chamaedaphne calyculata* (leatherleaf), *Gaylussacia dumosa* (dwarf huckleberry), and *Kalmia angustifolia* (sheep laurel). *Gaylussacia baccata* (black huckleberry), *Vaccinium corymbosum* (highbush blueberry), *Morella pensylvanica* (northern bayberry), and *Rhododendron viscosum* (swamp azalea) may also be present but at lower cover. There are frequent clusters of taller shrubs and stunted trees, including *Pinus rigida* (pitch pine) and *Acer rubrum* (red maple). Deer paths cut through the shrub thicket and support *Woodwardia virginica* (Virginia chainfern), *Drosera intermedia* (spoonleaf sundew), *Eriophorum virginicum* (tawny cottongrass), and *Triadenum virginicum* (Virginia marsh St. Johnswort). Some areas support *Vaccinium macrocarpon* (cranberry). *Sphagnum* (sphagnum) species may be 50–90% cover.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus rigida* (pitch pine)
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
Short shrub/sapling	Broad-leaved deciduous shrub	*Kalmia angustifolia* (sheep laurel)
		Vaccinium corymbosum (highbush blueberry)
Short shrub/sapling	Broad-leaved evergreen shrub	*Chamaedaphne calyculata* (leatherleaf)
		Gaylussacia dumosa (dwarf huckleberry)
Herb (field)	Forb	*Drosera intermedia* (spoonleaf sundew)
Herb (field)	Graminoid	*Rhynchospora alba* (white beaksedge)
Herb (field)	Fern or fern ally	*Woodwardia virginica* (Virginia chainfern)

Characteristic Species: *Chamaedaphne calyculata* (leatherleaf), *Gaylussacia dumosa* (dwarf huckleberry)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNR*	I	1	Kettlehole Level Bog	Swain and Kearsley2001
MA	SNR*	I	1	Level Bog	Swain and Kearsley 2001

Local Range: This association occurs at Wellfleet and Truro and in Clapps Pond.

Classification Comments: The example at Clapps Pond deserves additional sampling. *Vaccinium oxycoccos* (small cranberry) is locally abundant and the overall shrub density and stature are extremely low.

Other Comments: The concept of this USNVC association intersects with the concepts of two communities described in Swain and Kearsley 2001.
Local Description Authors: R.E. Zaremba
Plots: CACO.010, CACO.011, CACO.018, CACO.044, CACO.054, CACO.061, CACO.127.
AA (2004) Points: CACO.109, CACO.149, CACO.177, CACO.260.
Cape Cod National Seashore Inventory Notes: Mapped in the Bog aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Dwarf-shrubland (IV)
Physiognomic Subclass	Evergreen dwarf-shrubland (IV.A.)
Physiognomic Group	Needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1.)
Physiognomic Subgroup	Natural/Semi-natural needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1.N.)
Formation	Saturated needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1.N.g.)
Alliance	*Chamaedaphne calyculata* Saturated Dwarf-shrubland Alliance (A.1092)
Alliance (English name)	Leatherleaf Saturated Dwarf-shrubland Alliance
Association	*Chamaedaphne calyculata - (Gaylussacia dumosa) - Decodon verticillatus / Woodwardia virginica* Dwarf-shrubland
Association (English name)	Leatherleaf - (Dwarf Huckleberry) - Swamp-loosestrife / Virginia Chainfern Dwarf-shrubland
Ecological System(s):	Atlantic Coastal Plain Northern Bog (CES203.893). North-Central Interior and Appalachian Acidic Peatland (CES202.606).

GLOBAL DESCRIPTION

Concept Summary: This dwarf-shrub quaking or floating bog occurs in the southern portion of the glaciated Northeast, extending west to the Western Allegheny Plateau. It occupies oligotrophic, peat-accumulating basins. *Chamaedaphne calyculata* (leatherleaf) is strongly dominant, with associate species including *Kalmia angustifolia* (sheep laurel), *Kalmia polifolia* (bog laurel), *Vaccinium oxycoccos* (small cranberry), *Vaccinium macrocarpon* (cranberry), *Gaylussacia dumosa* (dwarf huckleberry) (on the coast), and *Gaylussacia baccata* (black huckleberry). Associate shrubs generally occur with low cover, although they may be locally common. Scattered tall shrubs, such as *Vaccinium corymbosum* (highbush blueberry), *Rhododendron viscosum* (swamp azalea), *Larix laricina* (tamarack), *Picea mariana* (black spruce), and *Acer rubrum* (red maple), may occur but always with low cover. Herbaceous cover is quite low but can include *Carex trisperma* (threeseeded sedge), *Pogonia ophioglossoides* (snakemouth orchid), *Calopogon tuberosus* (tuberous grasspink), *Eriophorum virginicum* (tawny cottongrass), *Drosera rotundifolia* (roundleaf sundew), *Drosera intermedia* (spoonleaf sundew), *Sarracenia purpurea* (purple pitcherplant), and *Woodwardia virginica* (Virginia chainfern) scattered throughout and with *Carex canescens* (silvery sedge), *Carex limosa* (mud sedge), *Glyceria canadensis* (rattlesnake mannagrass), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Utricularia cornuta* (horned bladderwort), *Rhynchospora alba* (white beaksedge), and sometimes *Scheuchzeria palustris* (rannoch-rush) occurring in wetter fen windows. Edges of floating mats tend to receive more nutrient enrichment and support such species as *Peltandra virginica* (green arrow arum), *Decodon verticillatus* (swamp loosestrife), and *Dulichium arundinaceum* (threeway sedge). The bryophyte layer is well-developed, dominated by *Sphagnum capillifolium* (sphagnum), *Sphagnum magellanicum* (Magellan's sphagnum), *Sphagnum rubellum* (sphagnum), and *Sphagnum fuscum* (sphagnum) with *Sphagnum*

bartlettianum (Bartlett's sphagnum), *Sphagnum cuspidatum* (toothed sphagnum), *Sphagnum fallax* (sphagnum), and *Sphagnum recurvum* (recurved sphagnum) also occurring in some examples.

Environmental Description: This dwarf-shrub quaking or floating bog occupies oligotrophic, peat-accumulating basins.

Vegetation Description: *Chamaedaphne calyculata* (leatherleaf) is strongly dominant, with associate species including *Kalmia angustifolia* (sheep laurel), *Kalmia polifolia* (bog laurel), *Vaccinium oxycoccos* (small cranberry), *Vaccinium macrocarpon* (cranberry), *Gaylussacia dumosa* (dwarf huckleberry) (near the coast), and *Gaylussacia baccata* (black huckleberry). Associate shrubs generally occur with low cover, although they may be locally common. Scattered tall shrubs, such as *Vaccinium corymbosum* (highbush blueberry), *Rhododendron viscosum* (swamp azalea), *Lyonia ligustrina* (maleberry), *Larix laricina* (tamarack), *Picea mariana* (black spruce), and *Acer rubrum* (red maple), may occur but always with low cover. Herbaceous cover is quite low but can include *Carex trisperma* (threeseeded sedge), *Pogonia ophioglossoides* (snakemouth orchid), *Calopogon tuberosus* (tuberous grasspink), *Eriophorum virginicum* (tawny cottongrass), *Decodon verticillatus* (swamp loosestrife), *Drosera rotundifolia* (roundleaf sundew), *Drosera intermedia* (spoonleaf sundew), *Sarracenia purpurea* (purple pitcherplant), and *Woodwardia virginica* (Virginia chainfern) scattered throughout and with *Carex canescens* (silvery sedge), *Carex limosa* (mud sedge), *Carex folliculata* (northern long sedge), *Carex atlantica* (prickly bog sedge), *Glyceria canadensis* (rattlesnake mannagrass), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Utricularia cornuta* (horned bladderwort), *Rhynchospora alba* (white beaksedge), and sometimes *Scheuchzeria palustris* (rannoch-rush) occurring in wetter fen windows. Edges of floating mats tend to receive more nutrient enrichment and support such species as *Peltandra virginica* (green arrow arum), *Decodon verticillatus* (swamp loosestrife), and *Dulichium arundinaceum* (threeway sedge). The bryophyte layer is well-developed, dominated by *Sphagnum capillifolium* (sphagnum), *Sphagnum magellanicum* (Magellan's sphagnum), *Sphagnum rubellum* (sphagnum), and *Sphagnum fuscum* (sphagnum) with *Sphagnum bartlettianum* (Bartlett's sphagnum), *Sphagnum cuspidatum* (toothed sphagnum), *Sphagnum fallax* (sphagnum), and *Sphagnum recurvum* (recurved sphagnum) also occurring in some examples.

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Dwarf-shrub	*Chamaedaphne calyculata* (leatherleaf)
Herb (field)	Forb	*Drosera rotundifolia* (roundleaf sundew)

Characteristic Species: *Chamaedaphne calyculata* (leatherleaf), *Drosera rotundifolia* (roundleaf sundew), *Eriophorum virginicum* (tawny cottongrass), *Rhynchospora alba* (white beaksedge), *Sarracenia purpurea* (purple pitcherplant), *Vaccinium macrocarpon* (cranberry)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine

DISTRIBUTION

Range: Information not available.

States/Provinces: CT, MA, ME, NH, NJ:S1, NY, OH, ON:S3, PA, RI

Federal Lands: NPS (Cape Cod, Delaware Water Gap?, Minute Man, Upper Delaware); USFWS (Assabet River, Nomans Land Island?)

CONSERVATION STATUS
Rank: G5 (1-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 1 - Strong
Comments: Information not available.
Similar Associations:
- *Chamaedaphne calyculata / Eriophorum virginicum / Sphagnum rubellum* Dwarf-shrubland (CEGL006513)

Related Concepts:
- Glacial Bog (Breden 1989) ?

SOURCES
Description Authors: S.L. Neid and L.A. Sneddon, mod. S.C. Gawler
References: Anderson 1982, Breden 1989, Breden et al. 2001, Damman and French 1987, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fike 1999, Gawler 2002, Lynn and Karlin 1985, Metzler and Barrett 2001, Perles et al. 2007, Radis 1986, Sperduto 2000b, Sperduto and Nichols 2004, Swain and Kearsley 2000

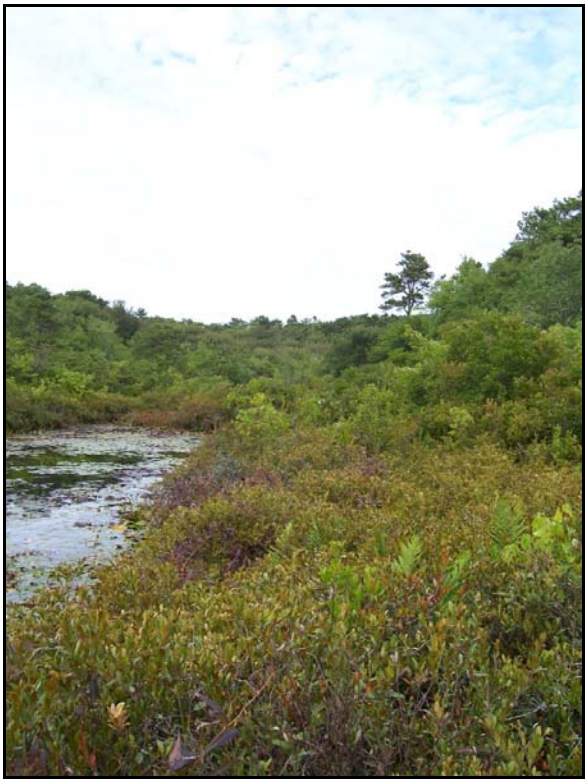


Figure 43. Southern New England Bog in Cape Cod National Seashore (plot CACO.044). September 2004. NAD 1983 / UTM easting 416396, northing 4647241.

COMMON NAME (PARK-SPECIFIC): NORTHERN INTERDUNAL CRANBERRY SWALE

SYNONYMS

USNVC English Name: **Twig-rush / Large Cranberry - Northern Bayberry Dwarf-shrubland**

USNVC Scientific Name: ***Cladium mariscoides* / *Vaccinium macrocarpon* - *Morella pensylvanica* Dwarf-shrubland**

USNVC Identifier: **CEGL006141**

LOCAL INFORMATION

Environmental Description: This association occurs in depressions among dunes on barrier beaches and barrier spits. During the formation of the dune system, the elevation of the sand is locally lowered in depressions by winds during dry periods such that the base of the depression intersects groundwater. Sea-level rise may have also resulted in higher water levels in some very old interdunal swales. Water levels fluctuate both seasonally and over longer periods of time related to general rainfall. These depressions range from very wet and graminoid to moderately wet and shrubby. Soils are sandy in drier swales and more peaty in wetter swales. Species composition may shift over many years based on periods or high water level or droughts.

Vegetation Description: This association includes a relatively broad range of variability. The most common species at the driest end of the spectrum of these swales is *Vaccinium macrocarpon* (cranberry) which can occur as nearly a monoculture or can be associated with a broad range or other shrubs and herbs. In this association, *Vaccinium macrocarpon* (cranberry) is often found with *Morella pensylvanica* (northern bayberry), *Spiraea tomentosa* (steeplebush) and *Spiraea alba var. latifolia* (white meadowsweet), *Drosera intermedia* (spoonleaf sundew), *Cladium mariscoides* (smooth sawgrass), *Euthamia caroliniana* (=*Euthamia tenuifolia*, slender goldentop), and *Thelypteris palustris* (eastern marsh fern). This community grades into shrub thickets of both *Vaccinium corymbosum* (highbush blueberry) and *Pinus rigida* (pitch pine) which can be locally abundant, particularly on slightly higher ground. Wetter variants of this community are dominated by *Cladium mariscoides* (smooth sawgrass) or *Schoenoplectus pungens* (common threesquare) with *Triadenum virginicum* (Virginia marsh St. Johnswort) and *Calamagrostis canadensis* (bluejoint). There are also high diversity examples, usually at the upper elevation ends of long swales, which include *Pogonia ophioglossoides* (snakemouth orchid), *Platanthera* (fringed orchid) spp., *Polygala sanguinea* (purple milkwort), *Eleocharis tenuis* (slender spikerush), and *Eupatorium perfoliatum* (common boneset). *Sphagnum* (sphagnum) is often present in the moderately wet examples, but absent from both the driest examples, which may support dense stands of *Vaccinium macrocarpon* (cranberry), or the wettest examples, which may have standing water most years.

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Spiraea tomentosa* (steeplebush)
Short shrub/sapling	Broad-leaved evergreen shrub	*Morella pensylvanica* (northern bayberry)
		Vaccinium macrocarpon (cranberry)
Herb (field)	Forb	*Drosera intermedia* (spoonleaf sundew)
Herb (field)	Graminoid	*Cladium mariscoides* (smooth sawgrass)
		Schoenoplectus pungens (common threesquare)

Characteristic Species: *Vaccinium macrocarpon* (cranberry)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S1*	B	1	Coastal Interdunal Marsh/Swale	Swain and Kearsley 2001

Local Range: This community is found throughout the Provincelands from Herring Cove to Pilgrim Lake.

Classification Comments: All of the examples of this community are found in the Provincelands, which is a very old barrier spit. Water levels and salinity vary considerably in these swales. There are isolated examples that occur in large variable forms. Two in particular are worthy of note: a large swale east of the Beech Forest and the extensive swale system in Hatches Harbor southeast of the Provincetown Airport. The swale near the Beech Forest ranges from a frequently dry swale with a monoculture of cranberry to a wetter swale with *Schoenoplectus pungens* (common threesquare) and *Calamagrostis canadensis* (bluejoint). At Hatches Harbor, there are cranberry-dominated examples as well as swales dominated by *Cladium mariscoides* (smooth sawgrass). Nearest the airport the swales are extremely diverse with numerous orchids, composites, and sedges. These areas, however, have likely been disturbed by the creation of the airport or by airport maintenance.

Other Comments: Information not available.

Local Description Authors: R.E. Zaremba

Plots: CACO.005, CACO.009. CACO.019, CACO.030, CACO.032.

AA (2004) Points: CACO.111, CACO.117, CACO.125, CACO.153, CACO.185, CACO.188, CACO.206, CACO.222, CACO.237, CACO.292, CACO.296, CACO.385, CACO.396, CACO.495, CACO.508, CACO.530, CACO.615.

Cape Cod National Seashore Inventory Notes: Mapped in the Cranberry Swale aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Dwarf-shrubland (IV)
Physiognomic Subclass	Evergreen dwarf-shrubland (IV.A.)
Physiognomic Group	Needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1.)
Physiognomic Subgroup	Natural/Semi-natural needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1.N.)
Formation	Saturated needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1.N.g.)
Alliance	*Vaccinium macrocarpon* Saturated Dwarf-shrubland Alliance (A.1094)
Alliance (English name)	Large Cranberry Saturated Dwarf-shrubland Alliance
Association	*Cladium mariscoides / Vaccinium macrocarpon - Morella pensylvanica* Dwarf-shrubland
Association (English name)	Twig-rush / Large Cranberry - Northern Bayberry Dwarf-shrubland
Ecological System(s):	Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264).

GLOBAL DESCRIPTION

Concept Summary: This association is a small-patch seasonally flooded wetland within low swales behind backdunes of major dune systems of the northeastern coast. Vegetation is characterized by *Vaccinium macrocarpon* (cranberry), *Sphagnum* (sphagnum) spp., and scattered *Morella pensylvanica* (northern bayberry), *Myrica gale* (sweetgale), and/or *Vaccinium corymbosum* (highbush blueberry). *Vaccinium macrocarpon* (cranberry) is generally dominant, but a number of rushes, sedges, grasses, and forbs co-occur and often obscure the low-growing *Vaccinium macrocarpon* (cranberry). *Morella pensylvanica* (northern bayberry), although a

minor component of the vegetation and generally restricted to the wetland edge, characterizes this community as coastal. The wetland is seasonally flooded and is often dry on the surface late in the growing season. A shallow layer of peat overtops deep sand deposits. Associated species commonly include *Juncus* (rush) spp. (*Juncus canadensis* (Canadian rush), *Juncus greenei* (Greene's rush), *Juncus balticus* (Baltic rush), *Juncus biflorus* (bog rush), *Juncus scirpoides* (needlepod rush), *Juncus pelocarpus* (brownfruit rush) and/or others), *Cladium mariscoides* (smooth sawgrass), *Xyris torta* (slender yelloweyed grass), *Xyris difformis* (bog yelloweyed grass), *Rhynchospora capitellata* (brownish beaksedge), *Rhynchospora alba* (white beaksedge), *Cyperus* (flatsedge) spp., *Drosera rotundifolia* (roundleaf sundew), *Drosera intermedia* (spoonleaf sundew), *Drosera filiformis* (threadleaf sundew), *Pogonia ophioglossoides* (snakemouth orchid), and scattered clumps of *Schoenoplectus pungens* (common threesquare) or *Scirpus cyperinus* (woolgrass) in small wet pockets. *Sphagnum* (sphagnum) spp. (*Sphagnum rubellum* (sphagnum), *Sphagnum compactum* (low sphagnum), and possibly others) cover the surface. Species occurring less frequently can include *Linum striatum* (ridged yellow flax), *Lycopodiella inundata* (inundated clubmoss), *Polygala cruciata* (drumheads), *Calopogon* (grasspink) spp., *Platanthera* (fringed orchid) spp., *Utricularia subulata* (zigzag bladderwort), *Triadenum* (marsh st. johnswort) sp., and others. Floristics can vary among swales due to hydrology, soils, or disturbance regime.

Environmental Description: This association occurs in small, low, wet swales between coastal backdunes. These wet swales occur where the dune surface intersects fresh groundwater lens. These swales are seasonally flooded and often surficially dry by late summer. The duration of flooding is long enough to prevent extensive shrub establishment and to allow carpets of *Sphagnum* (sphagnum) to develop. Substrate is shallow peat over sand.

Vegetation Description: Species composition can vary considerably between swales. This association comprises a later successional phase of freshwater coastal swale development. Vegetation is characterized by *Vaccinium macrocarpon* (cranberry), *Sphagnum* (sphagnum) spp., and scattered *Morella pensylvanica* (northern bayberry), *Myrica gale* (sweetgale), and/or *Vaccinium corymbosum* (highbush blueberry). *Vaccinium macrocarpon* (cranberry) can have up to 90% cover, but can be obscured by taller herbs. Associated species commonly include *Juncus* (rush) spp. (*Juncus canadensis* (Canadian rush), *Juncus greenei* (Greene's rush), *Juncus balticus* (Baltic rush), *Juncus biflorus* (bog rush), *Juncus pelocarpus* (brownfruit rush), and/or others), *Cladium mariscoides* (smooth sawgrass), *Xyris torta* (slender yelloweyed grass), *Xyris difformis* (bog yelloweyed grass), *Rhynchospora capitellata* (brownish beaksedge), *Rhynchospora scirpoides* (longbeak beaksedge), *Rhynchospora alba* (white beaksedge), *Cyperus* (flatsedge) spp., *Drosera rotundifolia* (roundleaf sundew), *Drosera intermedia* (spoonleaf sundew), *Drosera filiformis* (threadleaf sundew), *Pogonia ophioglossoides* (snakemouth orchid), and scattered clumps of *Schoenoplectus pungens* (common threesquare) or *Scirpus cyperinus* (woolgrass) in small wet pockets. *Sphagnum* (sphagnum) spp. (*Sphagnum rubellum* (sphagnum), *Sphagnum compactum* (low sphagnum), and possibly others) cover the surface. Species occurring less frequently can include *Linum striatum* (ridged yellow flax), *Lycopodiella inundata* (inundated clubmoss), *Polygala cruciata* (drumheads), *Calopogon* (grasspink) spp., *Platanthera* (fringed orchid) spp., *Utricularia subulata* (zigzag bladderwort), *Triadenum* (marsh st. johnswort) sp., and others. Floristics can vary between swales due to hydrology, soils, or disturbance regime.

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved evergreen shrub	*Vaccinium macrocarpon* (cranberry)
Nonvascular	Moss	*Sphagnum compactum* (low sphagnum)
		Sphagnum rubellum (sphagnum)

Characteristic Species: *Sphagnum compactum* (low sphagnum), *Sphagnum rubellum* (sphagnum), *Vaccinium macrocarpon* (cranberry)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine

DISTRIBUTION

Range: This community is confined to major dune systems of the northeastern coast (over an estimated 350 square km). Most occurrences are found in Massachusetts, New York, New Jersey, with occasional occurrences in Rhode Island and Delaware. There is one degraded occurrence in New Hampshire. There are no known occurrences in Connecticut.
States/Provinces: DE, MA, NH:S1, NJ:S1S2, NY, RI
Federal Lands: NPS (Cape Cod, Fire Island); USFWS (Monomoy?, Nomans Land Island?, Parker River)

CONSERVATION STATUS

Rank: G2G3 (31-Jan-2007)
Reasons: This association is a small-patch community with occurrences confined to low areas that are influenced by the water table between sand dunes. This vegetation is naturally limited by the intersection of two features: (1) swales dominated by large cranberry, which as a vegetation type occurs from Cape Henlopen, Delaware, north to Massachusetts; and (2) major dune systems of relatively broad extent that are characterized by dune and swale microtopography, a landform within that limited range that is restricted to Cape Cod, Long Island, and the barrier islands of New Jersey. The vegetation is restricted to large dune systems because it requires habitat to allow for the extirpation and re-creation of individual occurrences that may be naturally extirpated by coastal storms and overwash. Average size of this community is usually less than one acre, ranging to no more than a few acres at maximum. Fewer than 100 occurrences are estimated in five states, totaling no more than 125 acres. Coastal systems in general are severely threatened due to habitat loss imposed by housing expansion, and by foot traffic created by recreation seekers on beaches.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 2 - Moderate
Comments: Information not available.
Similar Associations:

- *Myrica gale - Morella pensylvanica* Saturated Shrubland (CEGL006339)
- *Pinus rigida / Vaccinium macrocarpon* Woodland (CEGL006127)
- *Vaccinium oxycoccos - (Vaccinium macrocarpon) / Rhynchospora alba - Drosera rotundifolia / Sphagnum* spp. Dwarf-shrubland (CEGL007856)

Related Concepts:

- *Vaccinium macrocarpon* - Mixed orchid / *Sphagnum* (McAvoy and Clancy 1994) ?
- Coastal interdunal marsh/swale (Rawinski 1984) ?
- Cranberry bog (Martin 1959b) ?
- Cranberry marsh (Johnson 1985b) ?
- Cranberry swale (McDonnell 1979) ?

- Cranberry swale (Lundgren 2000) ?
- Interdunal swales (Breden 1989) ?
- Wet poor fen (Dowhan and Rozsa 1989) ?
- Wet swale (Dunlop and Crow 1985) ?

SOURCES

Description Authors: S.L. Neid and L.A. Sneddon

References: Benedict 1977a, Bowman 2000, Breden 1989, Breden et al. 2001, Conard 1935, Dowhan and Rozsa 1989, Dunlop and Crow 1985, Eastern Ecology Working Group n.d., Edinger et al. 2002, Johnson 1981b, Johnson 1985b, Lundgren 1998, Lundgren 2000, Martin 1959b, McAvoy and Clancy 1994, McDonnell 1979, Moul 1969, Rawinski 1984, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2001



Figure 44. Northern Interdunal Cranberry Swale in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 399871, northing 4658322.

COMMON NAME (PARK-SPECIFIC): SANDPLAIN HEATHLAND

SYNONYMS

USNVC English Name: **Black Huckleberry - Northern Lowbush Blueberry - Bearberry or Kinikinnick / Seaside Bluestem Dwarf-shrubland**

USNVC Scientific Name: ***Gaylussacia baccata* - *Vaccinium angustifolium* - *Arctostaphylos uva-ursi* / *Schizachyrium littorale* Dwarf-shrubland**

USNVC Identifier: **CEGL006066**

LOCAL INFORMATION

Environmental Description: This association occurs on nutrient-poor sands and gravels of outwash deposits. Most of the sites are associated with soil disturbance and are maintained by wind and salt spray with slow succession to taller shrubs and trees.

Vegetation Description: Dwarf-shrubs generally described as ericaceous are dominant in this association. Most common are *Arctostaphylos uva-ursi* (kinnikinnick), *Hudsonia ericoides* (pinebarren goldenheather), *Gaylussacia baccata* (black huckleberry), *Vaccinium angustifolium* (lowbush blueberry) and *Vaccinium pallidum* (Blue Ridge blueberry), *Corema conradii* (broom crowberry), *Epigaea repens* (trailing arbutus), and *Gaultheria procumbens* (eastern teaberry). Frequent associates include *Morella pensylvanica* (northern bayberry), *Lechea maritima* (beach pinweed), *Baptisia tinctoria* (horseflyweed), *Ionactis linariifolius* (flaxleaf whitetop aster), and the grasses *Schizachyrium scoparium* (little bluestem), *Danthonia spicata* (poverty oatgrass), and *Deschampsia flexuosa* (wavy hairgrass). *Cladonia* (cup lichen) and *Cladina* (reindeer lichen) lichens may be abundant. The community only rarely supports invasive species. Scattered trees may also be present, including *Pinus rigida* (pitch pine), *Quercus ilicifolia* (bear oak), and *Quercus velutina* (black oak).

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
		Vaccinium angustifolium (lowbush blueberry)
Short shrub/sapling	Broad-leaved evergreen shrub	*Arctostaphylos uva-ursi* (kinnikinnick)
		Corema conradii (broom crowberry)
		Gaultheria procumbens (eastern teaberry)
		Hudsonia ericoides (pinebarren goldenheather)
		Hudsonia tomentosa (woolly beachheather)
		Morella pensylvanica (northern bayberry)
Herb (field)	Graminoid	*Danthonia spicata* (poverty oatgrass)
		Deschampsia flexuosa (wavy hairgrass)
		Schizachyrium scoparium (little bluestem)

Characteristic Species: *Arctostaphylos uva-ursi* (kinnikinnick), *Corema conradii* (broom crowberry)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNR	=	1	Sandplain Heathland	Swain and Kearsley 2001

Local Range: Known from High Head, Ballston Beach uplands, South Truro, Great Island, the Marconi Station site, the bluffs north of Coast Guard Beach, and scattered small sites on outwash deposits.

Classification Comments: The MA community, Sanplain Heathland, described in Swain and Kearsley 2001 is equivalent in concept to the USNVC association Sandplain Heathland.
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: Gwilliam (1998) plots: H9901110, H9901120, H9901210, H9902210, H9902220, H9905110, H9905120, H9905220, H9903110, H9903120, H9903210, H9903220, H9907210, H9908220, H9909110.
AA (2004) Points: CACO.325, CACO.330, CACO.612, CACO.408, CACO.395, CACO.368, CACO.1003, CACO.610, CACO.435, CACO.174, CACO.456, CACO.472, CACO.100, CACO.113, CACO.126, CACO.114, CACO.202, CACO.204, CACO.207, CACO.234, CACO.217, CACO.356, CACO.365, CACO.397, CACO.418, CACO.277, CACO.305, CACO.316, CACO.497, CACO.157.
Cape Cod National Seashore Inventory Notes: Mapped in the Heathland Grassland aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Dwarf-shrubland (IV)
Physiognomic Subclass	Deciduous dwarf-shrubland (IV.B.)
Physiognomic Group	Cold-deciduous dwarf-shrubland (IV.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous dwarf-shrubland (IV.B.2.N.)
Formation	Cespitose cold-deciduous dwarf-shrubland (IV.B.2.N.a.)
Alliance	*Vaccinium (angustifolium, myrtilloides, pallidum)* Dwarf-shrubland Alliance (A.1113)
Alliance (English name)	(Northern Lowbush Blueberry, Velvetleaf Blueberry, Hillside Blueberry) Dwarf-shrubland Alliance
Association	*Gaylussacia baccata - Vaccinium angustifolium - Arctostaphylos uva-ursi / Schizachyrium littorale* Dwarf-shrubland
Association (English name)	Black Huckleberry - Northern Lowbush Blueberry - Bearberry or Kinikinnick / Seaside Bluestem Dwarf-shrubland
Ecological System(s):	Northern Atlantic Coastal Plain Pitch Pine Barrens (CES203.269). Northern Atlantic Coastal Plain Heathland and Grassland (CES203.895).

GLOBAL DESCRIPTION

Concept Summary: This association includes sandplain heathlands of the northeastern Atlantic coast dominated by heath shrubs. They occur on nutrient-poor, sandy/gravelly moraine and outwash plains near the coast and are affected by onshore winds and salt spray. Dwarf-shrubs are often dominant, especially *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Arctostaphylos uva-ursi* (kinnikinnick), and *Gaylussacia baccata* (black huckleberry). Associated species include *Vaccinium myrtilloides* (velvetleaf huckleberry), *Hudsonia ericoides* (pinebarren goldenheather), *Comptonia peregrina* (sweet fern), *Kalmia angustifolia* (sheep laurel), *Baptisia tinctoria* (horseflyweed), or *Rubus hispidus* (bristly dewberry). *Corema conradii* (broom crowberry) may be locally abundant. The herbaceous layer is similar to sandplain grasslands, only less diverse. Common species include *Deschampsia flexuosa* (wavy hairgrass), *Schizachyrium littorale* (shore little bluestem), *Carex pensylvanica* (Pennsylvania sedge), *Lespedeza* (lespedeza) spp., *Solidago puberula* (downy goldenrod), *Viola sagittata var. ovata* (arrowleaf violet), *Eurybia spectabilis* (western showy aster), *Viola pedata* (birdfoot violet), *Comandra umbellata* (bastard toadflax), *Epigaea repens* (trailing arbutus), *Tephrosia virginiana* (Virginia tephrosia), *Gaultheria procumbens* (eastern teaberry), *Juncus*

greenei (Greene's rush), *Ionactis linariifolius* (flaxleaf whitetop aster), *Helianthemum dumosum* (bushy frostweed), *Liatris scariosa var. novae-angliae* (New England blazing star), *Sericocarpus asteroides* (toothed whitetop aster), *Solidago nemoralis* (gray goldenrod), *Euthamia* (goldentop) spp., and others. Graminoids do not form extensive turf. Small to locally abundant patches of tall shrubs are often present, including *Quercus ilicifolia* (bear oak), *Photinia pyrifolia* (red chokeberry), *Corylus cornuta* (beaked hazelnut), *Prunus maritima* (beach plum), *Rubus flagellaris* (northern dewberry), *Rosa carolina* (Carolina rose), *Rosa virginiana* (Virginia rose), or *Morella pensylvanica* (northern bayberry).

Environmental Description: This association occurs on nutrient-poor, sandy/gravelly moraine and outwash plains near the coast and are affected by onshore winds and salt spray.

Vegetation Description: Dwarf-shrubs are often dominant, especially *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Arctostaphylos uva-ursi* (kinnikinnick), and *Gaylussacia baccata* (black huckleberry). Associated species include *Vaccinium myrtilloides* (velvetleaf huckleberry), *Hudsonia ericoides* (pinebarren goldenheather), *Comptonia peregrina* (sweet fern), *Kalmia angustifolia* (sheep laurel), *Baptisia tinctoria* (horseflyweed), or *Rubus hispidus* (bristly dewberry). *Corema conradii* (broom crowberry) may be locally abundant. The herbaceous layer is similar to sandplain grasslands, only less diverse. Common species include *Deschampsia flexuosa* (wavy hairgrass), *Schizachyrium littorale* (shore little bluestem), *Carex pensylvanica* (Pennsylvania sedge), *Lespedeza* (lespedeza) spp., *Solidago puberula* (downy goldenrod), *Viola sagittata var. ovata* (arrowleaf violet), *Eurybia spectabilis* (western showy aster), *Viola pedata* (birdfoot violet), *Comandra umbellata* (bastard toadflax), *Epigaea repens* (trailing arbutus), *Tephrosia virginiana* (Virginia tephrosia), *Gaultheria procumbens* (eastern teaberry), *Juncus greenei* (Greene's rush), *Ionactis linariifolius* (flaxleaf whitetop aster), *Helianthemum dumosum* (bushy frostweed), *Liatris scariosa var. novae-angliae* (New England blazing star), *Sericocarpus asteroides* (toothed whitetop aster), *Solidago nemoralis* (gray goldenrod), *Euthamia* (goldentop) spp., and others. Graminoids do not form extensive turf. Small to locally abundant patches of tall shrubs are often present, including *Quercus ilicifolia* (bear oak), *Photinia pyrifolia* (red chokeberry), *Corylus cornuta* (beaked hazelnut), *Prunus maritima* (beach plum), *Rubus flagellaris* (northern dewberry), *Rosa carolina* (Carolina rose), *Rosa virginiana* (Virginia rose), or *Morella pensylvanica* (northern bayberry).

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
		Vaccinium angustifolium (lowbush blueberry)
		Vaccinium pallidum (Blue Ridge blueberry)
Short shrub/sapling	Broad-leaved evergreen shrub	*Arctostaphylos uva-ursi* (kinnikinnick)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)
		Deschampsia flexuosa (wavy hairgrass)
		Schizachyrium littorale (shore little bluestem)

Characteristic Species: *Arctostaphylos uva-ursi* (kinnikinnick), *Gaylussacia baccata* (black huckleberry), *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium pallidum* (Blue Ridge blueberry)

Other Noteworthy Species:

Species	GRank	Type	Note
Helianthemum dumosum (bushy frostweed)	G3	plant	
Liatris scariosa var. *novae-angliae* (New England blazing star)	G5?T3	plant	

USFWS Wetland System: Not applicable

DISTRIBUTION

Range: Currently described from Massachusetts and New York.
States/Provinces: MA, NY:S1
Federal Lands: NPS (Cape Cod)

CONSERVATION STATUS

Rank: G3 (10-May-2002)
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 2 - Moderate
Comments: This sandplain heathland association is similar to sandplain grassland, *Morella pensylvanica / Schizachyrium littorale - Danthonia spicata* Shrub Herbaceous Vegetation (CEGL006067), but differs in that shrubs are more abundant and the herbaceous layer is less abundant and less diverse. Soils tend to be less nutrient-poor than sandplain grasslands and likely have been disturbed less frequently.

Similar Associations:

- *Morella pensylvanica / Schizachyrium littorale - Danthonia spicata* Shrub Herbaceous Vegetation (CEGL006067)
- *Vaccinium angustifolium / Schizachyrium scoparium - Carex lucorum* Shrub Herbaceous Vegetation (CEGL006393)

Related Concepts:

- Bearberry heathland (Dunwiddie et al. 1996) ?
- Broom crowberry heathland (Dunwiddie et al. 1996) ?
- Huckleberry-scrub oak heathland (Dunwiddie et al. 1996) ?
- Moorland (Lundgren 2000) ?

SOURCES

Description Authors: S.L. Neid and L.A. Sneddon
References: Dunwiddie et al. 1996, Dunwiddie et al. 1997, Eastern Ecology Working Group n.d., Edinger et al. 2002, Gwilliam unpubl. data 1998, Lundgren 1998, Lundgren 2000, Reschke 1990, Swain and Kearsley 2000, Swain and Kearsley 2001, Thompson 1997, Zaremba 1989



Figure 45. Sandplain Heathland in the Marconi area of Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 418690, northing 4639474.



Figure 46. Sandplain Heathland in the Marconi area of Cape Cod National Seashore (AA point CACO.330). September 2007. NAD 1983 / UTM easting 410933, northing 4643864.

COMMON NAME (PARK-SPECIFIC): NORTHERN BEACHGRASS DUNE

SYNONYMS
USNVC English Name: **American Beachgrass - Beach Pea Herbaceous Vegetation**
USNVC Scientific Name: ***Ammophila breviligulata* - *Lathyrus japonicus* Herbaceous Vegetation**
USNVC Identifier: **CEGL006274**

LOCAL INFORMATION

Environmental Description: This association occurs on sites with windblown sand from open beaches and on barrier beaches and barrier spits. Soils are sand with little or no soil profile development. Occurrences are maintained over time in areas with continued sand movement. Plants are adapted to survive under conditions of high light intensity and high temperatures. Surface soils are generally dry to 8–10 cm where it is continually moist from evaporation from the groundwater.
Vegetation Description: This association is dominated by *Ammophila breviligulata* (American beachgrass), which in some cases is the only species present. Other common associates include *Lathyrus japonicus* (beach pea), *Artemisia stelleriana* (oldwoman), and *Rosa rugosa* (rugosa rose). Along the adjoining beach, driftline species may be found including *Cakile edentula* (American searocket) and *Chamaesyce polygonifolia* (seaside sandmat). Farther away from the beach, *Solidago sempervirens* (seaside goldenrod), *Morella pensylvanica* (northern bayberry), and *Artemisia campestris ssp. caudata* (field sagewort) may be abundant.
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Lathyrus japonicus* (beach pea)
Herb (field)	Graminoid	*Ammophila breviligulata* (American beachgrass)

Characteristic Species: *Ammophila breviligulata* (American beachgrass), *Lathyrus japonicus* (beach pea)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S2*	B	1	Maritime Dune	Swain and Kearsley2001

Local Range: This association occurs throughout Cape Cod National Seashore on barrier beaches and along ocean and bay beaches with local embayments where sand is not actively eroded.
Classification Comments: Best examples of large dune communities occur on the Nauset Spit, Coast Guard Beach, along the Great Island/The Gut beaches, in the Provincelands, and on Long Point. Unusual examples are found in areas with moving sand in the interior of the Provincelands. The community develops quickly and can be destroyed during major storms.
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: CACO.046, CACO.69, CACO.086, CACO.087, CACO.104.
AA (2004) Points: CACO.115, CACO.162, CACO.195, CACO.210, CACO.254, CACO.320, CACO.359, CACO.389, CACO.412, CACO.448, CACO.479, CACO.577, CACO.588, CACO.597, CACO.609.
Cape Cod National Seashore Inventory Notes: Mapped in the Beachgrass Dune aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c.)
Alliance	*Ammophila breviligulata* Herbaceous Alliance (A.1207)
Alliance (English name)	American Beachgrass Herbaceous Alliance
Association	*Ammophila breviligulata - Lathyrus japonicus* Herbaceous Vegetation
Association (English name)	American Beachgrass - Beach Pea Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264).

GLOBAL DESCRIPTION

Concept Summary: This dune grassland of maritime beaches occurs along the North Atlantic coast from New Jersey north to central Maine. This association primarily occurs on active maritime dunes, on both foredunes that are exposed to onshore winds and salt spray as well as more protected interdunes. The substrate is wind-deposited sand with no soil development. *Ammophila breviligulata* (American beachgrass) is the dominant species, often occurring monotypically. *Lathyrus japonicus* (beach pea) is a common associate and can be codominant. Other associated species include *Solidago sempervirens* (seaside goldenrod), *Lechea maritima* (beach pinweed), *Aristida tuberculosa* (seaside threeawn), *Schizachyrium scoparium* (little bluestem), *Carex silicea* (beach sedge), *Polygonella articulata* (coastal jointweed), and *Artemisia stelleriana* (oldwoman). Dwarf-shrubs, such as *Hudsonia tomentosa* (woolly beachheather), can occur sporadically and form locally dominant patches. Vegetation cover is often sparse, and bare sand is usually evident.

Environmental Description: This association primarily occurs on active maritime dunes, on both foredunes that are exposed to onshore winds and salt spray as well as more protected interdunes. This grassland generally occurs beyond the influence of storm tides. Substrate is sand with no soil profile development.

Vegetation Description: This association is characterized and dominated by *Ammophila breviligulata* (American beachgrass), which can occur monotypically, especially on foredunes or other areas of active and rapid sand deposition. *Lathyrus japonicus* (beach pea) is the most common associate and can be codominant. Other associated species include *Solidago sempervirens* (seaside goldenrod), *Lechea maritima* (beach pinweed), *Aristida tuberculosa* (seaside threeawn), *Schizachyrium scoparium* (little bluestem), *Carex silicea* (beach sedge), *Polygonella articulata* (coastal jointweed), and *Artemisia stelleriana* (oldwoman). Dwarf-shrubs, such as *Hudsonia tomentosa* (woolly beachheather), *Rosa rugosa* (rugosa rose), *Morella pensylvanica* (northern bayberry), or stunted *Prunus maritima* (beach plum), can occur sporadically and form locally dominant patches within the grassland.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Lathyrus japonicus* (beach pea)
Herb (field)	Graminoid	*Ammophila breviligulata* (American beachgrass)

Characteristic Species: *Ammophila breviligulata* (American beachgrass)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable

DISTRIBUTION
Range: This association occurs along the northern Atlantic Coast from Maine to New Jersey.
States/Provinces: CT, DE?, MA, ME:S2, NH:S1, NJ:S2S3, NY, RI
Federal Lands: NPS (Acadia, Boston Harbor Islands, Cape Cod, Fire Island, Gateway, Muskeget Island, Sagamore Hill); USFWS (Monomoy, Nomans Land Island, Parker River)

CONSERVATION STATUS
Rank: G4? (1-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: The southern analog of this dune grassland association is *Ammophila breviligulata - Panicum amarum var. amarum* Herbaceous Vegetation (CEGL004043), which is differentiated by having *Panicum amarum* (bitter panicgrass) as a codominant species in addition to the presence of more southern species such as *Cenchrus tribuloides* (sanddune sandbur) and *Oenothera humifusa* (seabeach evening-primrose), plus the absence of *Lathyrus japonicus* (beach pea). These two *Ammophila breviligulata* (American beachgrass)-dominated associations overlap geographically in New Jersey. This association is often adjacent to *Hudsonia tomentosa* (woolly beachheather) dwarf-shrublands and they have much species overlap; when dwarf-shrub cover exceeds 25%, the community is considered *Hudsonia tomentosa - Arctostaphylos uva-ursi* Dwarf-shrubland (CEGL006143).
Similar Associations:
- *Ammophila breviligulata - Panicum amarum* var. *amarum* Herbaceous Vegetation (CEGL004043)
- *Hudsonia tomentosa - Arctostaphylos uva-ursi* Dwarf-shrubland (CEGL006143)

Related Concepts:
- Coastal dune community (Rawinski 1984) ?
- Coastal dune grass community (Breden 1989) B
- Dune grass community (Nelson and Fink 1980) =
- Dunegrass (Martin 1959b) ?

SOURCES
Description Authors: S.L. Neid
References: Breden 1989, Breden et al. 2001, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Gawler 2001, Gawler 2002, Johnson 1981b, Johnson 1985b, Martin 1959b, Metzler and Barrett 2001, Moul 1969, NRCS 2001b, Nelson and Fink 1980, Rawinski 1984, Reschke 1990, Sperduto 1997a, Swain and Kearsley 2001, Zaremba and Leatherman 1984

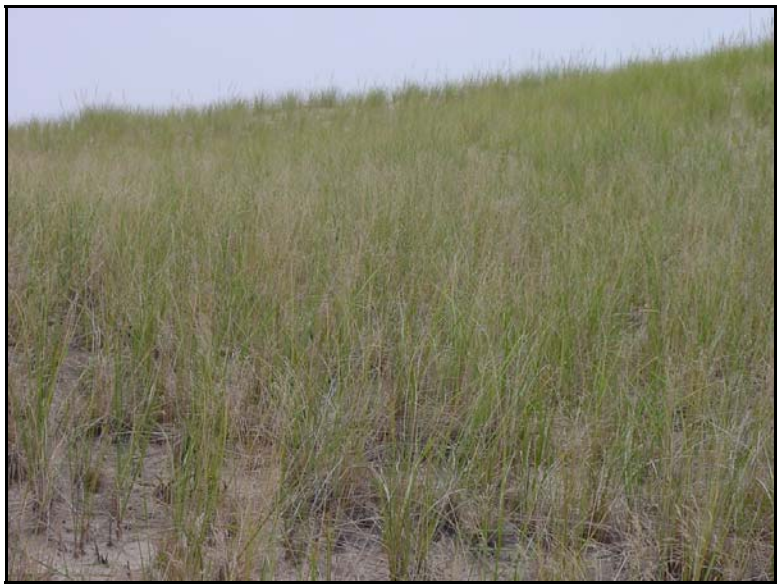


Figure 47. Northern Beachgrass Dune in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 398949, northing 4659087.

COMMON NAME (PARK-SPECIFIC): LITTLE BLUESTEM OLD FIELD

SYNONYMS

USNVC English Name: **Little Bluestem - (Broomsedge Bluestem) - Goldenrod species Herbaceous Vegetation**

USNVC Scientific Name: ***Schizachyrium scoparium* - (*Andropogon virginicus*) - *Solidago* spp. Herbaceous Vegetation**

USNVC Identifier: **CEGL006333**

LOCAL INFORMATION

Environmental Description: This community occurs on old fields on well-drained sandy soils.
Vegetation Description: *Schizachyrium scoparium* (little bluestem) is the dominant grass, and *Solidago rugosa* (wrinkleleaf goldenrod) is typically the dominant forb. Other goldenrods, including *Solidago juncea* (early goldenrod), *Solidago nemoralis* (gray goldenrod), and *Solidago odora* (anisescented goldenrod), may also be present. Associated herbaceous species include *Deschampsia flexuosa* (wavy hairgrass), *Symphyotrichum ericoides var. ericoides* (white heath aster), *Festuca filiformis* (=*Leptochloa panacea* ssp. *brachiata*, fineleaf sheep fescue), *Euthamia graminifolia* (flat-top goldentop), and *Carex pensylvanica* (Pennsylvania sedge). Scattered shrubs are often present, including *Morella pensylvanica* (northern bayberry), *Prunus maritima* (beach plum), *Vaccinium angustifolium* (lowbush blueberry), *Gaylussacia baccata* (black huckleberry), *Viburnum dentatum* (southern arrowwood), and scattered tree saplings, such as *Prunus serotina* (black cherry). Vines including *Parthenocissus quinquefolia* (Virginia creeper) and *Toxicodendron radicans* (eastern poison ivy) may also be present.

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Dwarf-shrub	*Rubus flagellaris* (northern dewberry)
Herb (field)	Forb	*Solidago rugosa* (wrinkleleaf goldenrod)
Herb (field)	Graminoid	*Schizachyrium scoparium* (little bluestem)

Characteristic Species: *Solidago rugosa* (wrinkleleaf goldenrod)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNA	NA	NA	not crosswalked]	Swain and Kearsley 2001

Local Range: This community occurs on old fields within Cape Cod National Seashore.
Classification Comments: The concept for this vegetation association was developed after plot sampling and accuracy assessment at CACO. Two of the CEGL006107 Northeastern Old Field accuracy assessment plots were reassigned to this Little Bluestem Grassland type based on dominance of *Schizachyrium scoparium* (little bluestem) and *Solidago rugosa* (wrinkleleaf goldenrod) and lack of or low cover of weedy old-field species typical of Northeastern Old Field, such as *Dactylis glomerata* (orchardgrass), *Phleum pratense* (timothy), *Anthoxanthum odoratum* (sweet vernalgrass), and *Agrostis* (bentgrass) spp.
Other Comments: Information not available.
Local Description Authors: E. Largay
Plots: None.
AA (2004) Points: CACO. 192, CACO.269.
Cape Cod National Seashore Inventory Notes: Mapped in the Old Field aggregated map class in the vegetation map. No photograph available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c.)
Alliance	*Andropogon virginicus* Herbaceous Alliance (A.1208)
Alliance (English name)	Broomsedge Bluestem Herbaceous Alliance
Association	*Schizachyrium scoparium* - *(Andropogon virginicus)* - *Solidago* spp. Herbaceous Vegetation
Association (English name)	Little Bluestem - (Broomsedge Bluestem) - Goldenrod species Herbaceous Vegetation
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This broadly defined vegetation type includes old fields of well-drained soils, either sandy or shallow to bedrock. They are characterized by dominance of warm-season grasses. *Schizachyrium scoparium* (little bluestem) is characteristic and nearly always present. Species composition is variable, depending on land-use history, but in general this vegetation is quite wide-ranging in northeastern and midwestern states. In addition to the nominal species, other associates may include *Andropogon virginicus* (broomsedge bluestem), *Eragrostis spectabilis* (purple lovegrass), *Festuca rubra* (red fescue), *Deschampsia flexuosa* (wavy hairgrass), *Danthonia spicata* (poverty oatgrass), *Nuttallanthus canadensis* (Canada toadflax), *Rubus flagellaris* (northern dewberry), *Panicum virgatum* (switchgrass), *Dichanthelium depauperatum* (starved panicgrass), *Potentilla simplex* (common cinquefoil), *Dichanthelium meridionale* (matting rosette grass), *Dichanthelium dichotomum* (cypress panicgrass), *Solidago rugosa* (wrinkleleaf goldenrod), and *Carex pensylvanica* (Pennsylvania sedge). Scattered shrubs are often present, including *Comptonia peregrina* (sweet fern), *Morella pensylvanica* (northern bayberry), *Gaylussacia baccata* (black huckleberry), and scattered tree saplings, such as *Prunus serotina* (black cherry), *Sassafras albidum* (sassafras), and *Juniperus virginiana* (eastern redcedar). *Polytrichum juniperinum* (juniper polytrichum moss) and other *Polytrichum* (polytrichum moss) spp. are common bryophytes.

Environmental Description: This vegetation occurs on well-drained soils, either on sandy flats or on dry knolls with shallow soils. The vegetation arises spontaneously after soil disturbance.

Vegetation Description: *Schizachyrium scoparium* (little bluestem) is characteristic and nearly always present. Species composition is variable, depending on land-use history, but in general, this vegetation is quite wide-ranging in northeastern and midwestern states. In addition to the nominal species, other associates may include *Andropogon virginicus* (broomsedge bluestem), *Eragrostis spectabilis* (purple lovegrass), *Festuca rubra* (red fescue), *Deschampsia flexuosa* (wavy hairgrass), *Centaurea biebersteinii* (spotted knapweed), *Danthonia spicata* (poverty oatgrass), *Hypericum perforatum* (common St. Johnswort), *Nuttallanthus canadensis* (Canada toadflax), *Rubus flagellaris* (northern dewberry), *Panicum virgatum* (switchgrass), *Dichanthelium depauperatum* (starved panicgrass), *Potentilla simplex* (common cinquefoil), *Dichanthelium meridionale* (matting rosette grass), *Dichanthelium dichotomum* (cypress panicgrass), *Solidago juncea* (early goldenrod), *Solidago nemoralis* (gray goldenrod), *Solidago rugosa* (wrinkleleaf goldenrod), *Hieracium* (hawkweed) spp., and *Carex pensylvanica* (Pennsylvania sedge). Scattered shrubs are often present, including *Comptonia peregrina* (sweet

fern), *Morella pensylvanica* (northern bayberry), *Gaylussacia baccata* (black huckleberry), and scattered tree saplings, such as *Prunus serotina* (black cherry), *Sassafras albidum* (sassafras), and *Juniperus virginiana* (eastern redcedar).

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Dwarf-shrub	*Rubus flagellaris* (northern dewberry)
Herb (field)	Forb	*Solidago juncea* (early goldenrod)
		Solidago nemoralis (gray goldenrod)
		Solidago rugosa (wrinkleleaf goldenrod)
Herb (field)	Graminoid	*Schizachyrium scoparium* (little bluestem)

Characteristic Species: *Andropogon virginicus* (broomsedge bluestem), *Schizachyrium scoparium* (little bluestem), *Solidago juncea* (early goldenrod), *Solidago nemoralis* (gray goldenrod), *Solidago rugosa* (wrinkleleaf goldenrod)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable

DISTRIBUTION

Range: This vegetation is quite wide-ranging in northeastern and midwestern states, and possibly occurs at higher elevations in the southeastern states.

States/Provinces: CT, MA, ME, NH, NJ, NY, PA, RI, VT

Federal Lands: NPS (Boston Harbor Islands, Cape Cod, Delaware Water Gap, Fire Island, Gateway, Saratoga, Upper Delaware, Weir Farm); USFWS (Great Swamp)

CONSERVATION STATUS

Rank: GNA (invasive) (19-Jan-2006)

Reasons: This vegetation type includes pasture and post-agricultural fields.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 3 - Weak

Comments: This type is distinguished, in theory, from the very similar *Dactylis glomerata - Phleum pratense - Festuca* spp. - *Solidago* (goldenrod) spp. Herbaceous Vegetation (CEGL006107) by the dominance of warm-season grasses as opposed to cool-season grasses (*Phleum* (timothy), *Festuca* (fescue)) dominating CEGL006017. Additional data will be required to see how this distinction holds up and what geographic differences might accompany such a distinction.

Similar Associations:

- *Dactylis glomerata - Phleum pratense - Festuca* spp. - *Solidago* spp. Herbaceous Vegetation (CEGL006107)
- *Lolium (arundinaceum, pratense)* Herbaceous Vegetation (CEGL004048)
- *Phleum pratense - Bromus pubescens - Helenium autumnale* Herbaceous Vegetation (CEGL004018)

Related Concepts: Information not available.

SOURCES

Description Authors: L.A. Sneddon, mod. S.C. Gawler

References: Eastern Ecology Working Group n.d., Edinger et al. 2002, House 1917, NRCS 2001b, NRCS 2004, Newbold et al. 1988, Niering et al. 1970

COMMON NAME (PARK-SPECIFIC): NORTHEASTERN OLD FIELD

SYNONYMS

USNVC English Name: **Orchard Grass - Timothy - Fescue species - Goldenrod species Herbaceous Vegetation**

USNVC Scientific Name: ***Dactylis glomerata* - *Phleum pratense* - *Festuca* spp. - *Solidago* spp. Herbaceous Vegetation**

USNVC Identifier: **CEGL006107**

LOCAL INFORMATION

Environmental Description: This association occurs on recently abandoned farm fields and vacant lots, in irregularly mowed fields, along roadsides, and around buildings. It is differentiated from lawn by less frequent mowing which allows more species to persist. Soils are variable, but generally sandy and well-drained.

Vegetation Description: This association is highly variable. It is usually dominated by *Dactylis glomerata* (orchardgrass), *Phleum pratense* (timothy), *Anthoxanthum odoratum* (sweet vernalgrass), and *Agrostis* (bentgrass) spp., although *Schizachyrium scoparium* (little bluestem) and *Andropogon virginicus* (broomsedge bluestem) are also common in these occurrences. Other frequent associates include *Asclepias syriaca* (common milkweed), *Rudbeckia hirta* (blackeyed Susan), *Solidago rugosa* (wrinkleleaf goldenrod) and *Solidago juncea* (early goldenrod), *Daucus carota* (Queen Anne's lace), and *Trifolium* (clover) spp. Many occurrences are highly invaded with nonnative shrubs and vines, including *Lonicera morrowii* (Morrow's honeysuckle), *Elaeagnus* (elaeagnus) spp., and *Celastrus orbiculatus* (Oriental bittersweet).

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Lonicera morrowii* (Morrow's honeysuckle)
		Rosa multiflora (multiflora rose)
Herb (field)	Forb	*Asclepias syriaca* (common milkweed)
Herb (field)	Graminoid	*Dactylis glomerata* (orchardgrass)
		Phleum pratense (timothy)

Characteristic Species: *Dactylis glomerata* (orchardgrass), *Phleum pratense* (timothy)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNR*	B	1	Cultural Grassland	Swain and Kearsley 2000

Local Range: This association occurs throughout Cape Cod National Seashore.

Classification Comments: There are many examples of this association throughout Cape Cod National Seashore. The park maintains a large expanse of old field at the Fort Hill site, where there are a broad range of examples of this association. Other good examples occur around the park buildings in Truro. There are many fewer examples of this community than there were even 20 years ago. There are no longer farms being abandoned, and old fields grow up rapidly into shrubland vegetation. Many of the old fields that were visible along Route 6 in Eastham and Wellfleet before the 1960s are now either developed or in tall shrubland.

Other Comments: Information not available.

Local Description Authors: R.E. Zaremba

Plots: CACO.117.

AA (2004) Points: CACO.102, CACO.112, CACO.252, CACO.400.

Cape Cod National Seashore Inventory Notes: Mapped in the Old Field aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c.)
Alliance	*Dactylis glomerata* - *Rumex acetosella* Herbaceous Alliance (A.1190)
Alliance (English name)	Orchard Grass - Common Sheep Sorrel Herbaceous Alliance
Association	*Dactylis glomerata* - *Phleum pratense* - *Festuca* spp. - *Solidago* spp. Herbaceous Vegetation
Association (English name)	Orchard Grass - Timothy - Fescue species - Goldenrod species Herbaceous Vegetation
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This broadly defined vegetation type includes pastures and post-agricultural fields and is largely composed of nonnative cool-season grasses and herbs (generally of European origin) in the early stages of succession. The fields are typically mowed at least annually. Physiognomically, these grasslands are generally comprised of mid-height (1–3 feet tall) grasses and forbs, with occasional scattered shrubs. Species composition varies from site to site, depending on land-use history and perhaps soil type, but in general this vegetation is quite wide-ranging in northeastern and midwestern states and at higher elevations (610–1220 m [2000–4000 feet]) in the southeastern states. Dominant grasses vary from site to site but generally feature the nominal species. Other graminoid associates may include *Agrostis stolonifera* (creeping bentgrass), *Agrostis hyemalis* (winter bentgrass), *Elymus repens* (quackgrass), *Bromus inermis* (smooth brome), *Bromus tectorum* (cheatgrass), *Lolium perenne* (perennial ryegrass), *Poa pratensis* (Kentucky bluegrass), *Poa compressa* (Canada bluegrass), *Schizachyrium scoparium* (little bluestem) (not in abundance), and *Anthoxanthum odoratum* (sweet vernalgrass). Forbs scattered among the grasses are varied but include *Hieracium* (hawkweed) spp., *Oxalis stricta* (common yellow oxalis), *Achillea millefolium* (common yarrow), *Asclepias syriaca* (common milkweed), *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago nemoralis* (gray goldenrod), *Solidago juncea* (early goldenrod), *Solidago canadensis* (Canada goldenrod), *Solidago altissima*, *Euthamia graminifolia* (flat-top goldentop), *Cerastium arvense* (field chickweed), *Oenothera biennis* (common evening-primrose), *Potentilla simplex* (common cinquefoil), *Symphyotrichum lateriflorum* (calico aster), *Symphyotrichum novae-angliae* (New England aster), *Symphyotrichum lanceolatum* (white panicle aster), *Daucus carota* (Queen Anne's lace), *Ambrosia artemisiifolia* (annual ragweed), *Vicia cracca* (bird vetch), *Trifolium* (clover) spp., and many others.

Environmental Description: This association occurs on pastures and land that has been tilled. Generally the fields are mowed at least annually.

Vegetation Description: In addition to *Dactylis glomerata* (orchardgrass) and *Phleum pratense* (timothy), these grassy fields are characterized by graminoids including *Agrostis stolonifera* (creeping bentgrass), *Agrostis hyemalis* (winter bentgrass), *Elymus repens* (quackgrass), *Bromus inermis* (smooth brome), *Bromus tectorum* (cheatgrass), *Lolium perenne* (perennial ryegrass),

Poa pratensis (Kentucky bluegrass), *Poa compressa* (Canada bluegrass), *Schizachyrium scoparium* (little bluestem) (not in abundance), and *Anthoxanthum odoratum* (sweet vernalgrass). Forbs scattered among the grasses are varied but include *Hieracium* (hawkweed) spp., *Oxalis stricta* (common yellow oxalis), *Achillea millefolium* (common yarrow), *Asclepias syriaca* (common milkweed), *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago nemoralis* (gray goldenrod), *Solidago juncea* (early goldenrod), *Solidago canadensis* (Canada goldenrod), *Solidago altissima*, *Euthamia graminifolia* (flat-top goldentop), *Cerastium arvense* (field chickweed), *Oenothera biennis* (common evening-primrose), *Potentilla simplex* (common cinquefoil), *Symphyotrichum lateriflorum* (calico aster), *Symphyotrichum novae-angliae* (New England aster), *Symphyotrichum lanceolatum* (white panicle aster), *Daucus carota* (Queen Anne's lace), *Ambrosia artemisiifolia* (annual ragweed), *Vicia cracca* (bird vetch), *Trifolium* (clover) spp., and many others.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Rumex acetosella* (common sheep sorrel)
Herb (field)	Graminoid	*Dactylis glomerata* (orchardgrass)
		Festuca rubra (red fescue)
		Phleum pratense (timothy)

Characteristic Species: *Achillea millefolium* (common yarrow), *Anthoxanthum odoratum* (sweet vernalgrass), *Dactylis glomerata* (orchardgrass), *Euthamia graminifolia* (flat-top goldentop), *Phleum pratense* (timothy), *Rumex acetosella* (common sheep sorrel), *Solidago canadensis* (Canada goldenrod), *Solidago canadensis* var. *scabra* (tall goldenrod), *Solidago rugosa* (wrinkleleaf goldenrod)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable

DISTRIBUTION

Range: This vegetation is quite wide-ranging in northeastern and midwestern states and possibly occurs at higher elevations in the southeastern states.

States/Provinces: CT, DE, KY, MA, MD, ME, NB?, NH, NJ, NS?, NY, PA, QC?, RI, TN, VA, VT, WV

Federal Lands: NPS (Allegheny Portage Railroad, Appomattox Court House, Booker T. Washington, Boston Harbor Islands, Cape Cod, Colonial, Delaware Water Gap, Fire Island, Fort Necessity, Fredericksburg-Spotsylvania, Friendship Hill, Gateway, George Washington Birthplace, Gettysburg, Johnstown Flood, Marsh-Billings-Rockefeller, Minute Man, Morristown, Petersburg, Richmond, Saint-Gaudens, Saratoga, Upper Delaware, Valley Forge, Weir Farm); USFWS (Aroostook, Assabet River, Carlton Pond, Erie, Great Meadows, Moosehorn, Nulhegan Basin, Oxbow, Parker River)

CONSERVATION STATUS

Rank: GNA (modified/managed) (8-Dec-2005)

Reasons: This vegetation type includes pasture and post-agricultural fields and is largely composed of nonnative grasses and herbs (generally of European origin).

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 3 - Weak

Comments: *Schizachyrium scoparium - (Andropogon virginicus) - Solidago* spp. Herbaceous Vegetation (CEGL006333) is similar to this type but is dominated by warm-season grasses.

Similar Associations:

- *Lolium (arundinaceum, pratense)* Herbaceous Vegetation (CEGL004048)
- *Phleum pratense - Bromus pubescens - Helenium autumnale* Herbaceous Vegetation (CEGL004018)
- *Schizachyrium scoparium - (Andropogon virginicus) - Solidago* spp. Herbaceous Vegetation (CEGL006333)--has a greater component of native species and occurs on drier soils.

Related Concepts: Information not available.

SOURCES

Description Authors: S.C. Gawler

References: Clark 1986, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Ehrenfeld 1977, Elliman 2003, Keever 1979, NRCS 2004, Newbold et al. 1988, Perles et al. 2006a, Perles et al. 2006b, Perles et al. 2006c, Perles et al. 2007, Sneddon et al. 1995, TDNH unpubl. Data



Figure 48. Northeastern Old Field in Cape Cod National Seashore (plot CACO.117). Summer 2004. NAD 1983/ UTM easting 420141, northing 4630180.

COMMON NAME (PARK-SPECIFIC): HAIRGRASS BACKDUNE GRASSLAND

SYNONYMS
USNVC English Name: **Wavy Hairgrass Herbaceous Vegetation**
USNVC Scientific Name: ***Deschampsia flexuosa* Herbaceous Vegetation**
USNVC Identifier: **CEGL006621**

LOCAL INFORMATION

Environmental Description: This association occurs on barrier beaches and other accreted sand deposits along the coast where dunes are no longer building with windblown sand and are not being actively deflated. Most sites are flat or have only slight slope. The substrate is leached sand, white or grayish with only minor accumulation of fine organics. There is often a light salt layer on the surface which increases substrate stability. Surface temperatures can be extremely high during the summer. Soils dry to 7 to 10 cm each day during dry periods in the growing season, but remain moist below this level from evaporation from groundwater.
Vegetation Description: This stabilized dune community can have variable dominants but is usually dominated by *Deschampsia flexuosa* (wavy hairgrass). Senescent *Ammophila breviligulata* (American beachgrass) is nearly always present. *Artemisia campestris ssp. caudata* (field sagewort), *Lechea maritima* (beach pinweed), and *Polygonella articulata* (coastal jointweed) are frequent associates, as are *Conyza canadensis var. canadensis* (Canadian horseweed) and *Conyza canadensis var. pusilla* (Canadian horseweed). There is always a high cover of lichens, including *Cladina rangiferina* (greygreen reindeer lichen) and *Cladina stellaris* (star reindeer lichen), as well as a black lichen. *Geaster hygrometricus* (earth star) is often present. Some occurrences have high cover of *Schizachyrium scoparium* (little bluestem) and *Pityopsis falcata* (sickleleaf silkgrass). Occurrences near the ocean may have high concentrations of *Solidago sempervirens* (seaside goldenrod) and *Rosa rugosa* (rugosa rose). Other common species in this association include *Cyperus lupulinus* (Great Plains flatsedge), *Achillea millefolium* (common yarrow), and *Juncus greenei* (Greene's rush). In older, stable examples there may be *Juniperus virginiana* (eastern redcedar), *Pinus rigida* (pitch pine), and *Prunus maritima* (beach plum).
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Artemisia campestris* ssp. *caudata* (field sagewort)
Herb (field)	Graminoid	*Ammophila breviligulata* (American beachgrass)
		Deschampsia flexuosa (wavy hairgrass)
Nonvascular	Lichen	*Cladina stellaris* (star reindeer lichen)

Characteristic Species: Information not available.
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNR	NA	NA	[not crosswalked]	Swain and Kearsley 2001

Local Range: This association occurs on the Nauset Spit system in Orleans and Chatham, on the small barrier beaches around Great Island in Wellfleet, in the Provincelands, and on Long Point in Provincetown.
Classification Comments: Some areas are dominated by *Deschampsia flexuosa* (wavy hairgrass). In the Provincelands and on Long Point, there are large expanses of this community dominated by *Deschampsia* (hairgrass). On the Nauset Spit and at the Great Island area in

Wellfleet, there is *Deschampsia* (hairgrass), but in much lower concentration. *Ammophila breviligulata* (American beachgrass) is nearly always present in this community but in low cover, and it is generally senescent. Without new sand accumulation to stimulate root production, *Ammophila* (beachgrass) does not produce new tillers and over time loses vigor as its roots become less effective at obtaining water and nutrients.
Other Comments: There is no clear crosswalk in the MA classification to this USNVC association.
Local Description Authors: R.E. Zaremba
Plots: CACO.004, CACO.026, CACO.034, CACO.037, CACO.066. Gwilliam 1998 plots: H9910220, H9911110, H9911120.
AA (2004) Points: CACO.130, CACO.247, CACO.265, CACO.279, CACO.297, CACO.369, CACO.371, CACO.399, CACO.429, CACO.454, CACO.485, CACO.520, CACO.534, CACO.553, CACO.564, CACO.567, CACO.567, CACO.602, CACO.614.
Cape Cod National Seashore Inventory Notes: Mapped in the Beachgrass Dune aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c.)
Alliance	*Deschampsia flexuosa* Herbaceous Alliance (A.3039)
Alliance (English name)	Wavy Hairgrass Herbaceous Alliance
Association	*Deschampsia flexuosa* Herbaceous Vegetation
Association (English name)	Wavy Hairgrass Herbaceous Vegetation
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This backdune grassland of large northeastern dune systems occurs on eolian sand of interdunes that is sheltered from the direct impacts of overwash and wind. The substrate becomes stabilized over time as grasses and lichens become established. The vegetation is strongly dominated by *Deschampsia flexuosa* (wavy hairgrass). Other associates may include *Ammophila breviligulata* (American beachgrass), *Schizachyrium scoparium* (little bluestem), *Lechea maritima* (beach pinweed), and *Solidago sempervirens* (seaside goldenrod) at low cover.
Environmental Description: This community occurs on deep stabilized sands of old leveled interdunes and backdunes.
Vegetation Description: The current description is based almost entirely on plots taken at Cape Cod National Seashore. *Deschampsia flexuosa* (wavy hairgrass) is strongly dominant. Other associates may include *Ammophila breviligulata* (American beachgrass), *Schizachyrium scoparium* (little bluestem), *Lechea maritima* (beach pinweed), and *Solidago sempervirens* (seaside goldenrod) at low cover.
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Deschampsia flexuosa* (wavy hairgrass)

Characteristic Species: *Deschampsia flexuosa* (wavy hairgrass)
Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable

DISTRIBUTION

Range: This association occurs at Cape Cod, Massachusetts, and may also occur at Parker River National Wildlife Refuge and on Long Island, New York. Its potential occurrence elsewhere has not been evaluated.
States/Provinces: MA, NY?
Federal Lands: NPS (Cape Cod); USFWS (Parker River?)

CONSERVATION STATUS

Rank: GNR (14-Feb-2008)
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 3 - Weak
Comments: This association is not well-studied. It is related ecologically to *(Morella pensylvanica) / Schizachyrium littorale - Aristida tuberculosa* Shrub Herbaceous Vegetation (CEGL006161) in that it occupies naturally stabilized backdunes. *Deschampsia flexuosa* (wavy hairgrass) is reported to be present in backdunes of Parker River National Wildlife Refuge (McDonnell 1979) and at Ocean Dunes on Long Island, New York (Johnson 1985b), but there is insufficient information in hand to determine whether *Deschampsia flexuosa* (wavy hairgrass) occurs in large enough patches to constitute an occurrence of the association at these sites. It is possible that this association may have arisen in part through anthropogenic activity at Cape Cod National Seashore because *Deschampsia flexuosa* (wavy hairgrass) occurs where past land use has altered the native vegetation (Motzkin and Foster 2002).
Similar Associations:

- *(Morella pensylvanica) / Schizachyrium littorale - Aristida tuberculosa* Shrub Herbaceous Vegetation (CEGL006161)

Related Concepts:

- Interdune (McDonnell 1979) ?

SOURCES

Description Authors: L.A. Sneddon
References: Eastern Ecology Working Group n.d., Johnson 1985b, McDonnell 1979, Motzkin and Foster 2002



Figure 49. Hairgrass Backdune Grassland in Cape Cod National Seashore (plot CACO.004). Summer 2003. NAD 1983 / UTM easting 411146, northing 4642568



Figure 50. Hairgrass Backdune Grassland in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 398808, northing 4659007.

COMMON NAME (PARK-SPECIFIC): SALT HAY DUNE

SYNONYMS

USNVC English Name: **Saltmeadow Cordgrass - Tick Quackgrass Herbaceous Vegetation**

USNVC Scientific Name: ***Spartina patens* - *Thinopyrum pycnanthum* Herbaceous Vegetation**

USNVC Identifier: **CEGL006149**

LOCAL INFORMATION

Environmental Description: These low dunes are usually less than 1 meter high and are found at the interface between upper salt marsh and dunes. They are most frequently found on barrier beaches, but can also occur at the edges of salt marshes that border sandy uplands. These dunes are developed from windblown sand that accumulates at the edge of the salt marsh. Annual accumulations of sand limit species composition to those species that can tolerate low levels of annual burial. These low dunes may be periodically flooded by storm tides, most frequently during the winter when plants are dormant. These low dunes appear to move around over time as the position of dunes and the salt marsh edge fluctuate in relation to storms and other major disturbances. Many of these dunes are associated with sand roads that are often located at the upland edge of salt marshes. In some cases loose sand displaced by vehicles is blown into low dunes bordering roads.

Vegetation Description: This low dune association is characterized by a dominance of *Spartina patens* (saltmeadow cordgrass), *Elymus repens* (quackgrass), or *Thinopyrum pycnanthum* (tick quackgrass). All three species may be present or one may occur alone. Most frequently *Spartina patens* (saltmeadow cordgrass) is present with one of the two formerly named *Agropyron* (wheatgrass) species. The two formerly named *Agropyron* (wheatgrass) species can co-occur, but usually occur alone. There are often no other species present. When other species do occur, common associates include *Ammophila breviligulata* (American beachgrass), *Oenothera biennis* (common evening-primrose), *Artemisia campestris ssp. caudata* (field sagewort), *Solidago sempervirens* (seaside goldenrod), and *Rosa rugosa* (rugosa rose).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Ammophila breviligulata* (American beachgrass)
		Artemisia campestris ssp. *caudata* (field sagewort)
		Oenothera biennis (common evening-primrose)
Herb (field)	Graminoid	*Elymus repens* (quackgrass)
		Thinopyrum pycnanthum (tick quackgrass)

Characteristic Species: *Elymus repens* (quackgrass), *Spartina patens* (saltmeadow cordgrass)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNR	NA	NA	not crosswalked]	Swain and Kearsley 2001

Local Range: Known from the borders of salt marshes in the Provincelands, Great Island and Massachusetts Audubon Sanctuary, Wellfleet, and the Nauset Spit.

Classification Comments: This association is found throughout the Outer Cape bordering salt marshes. It is unclear how persistent this vegetation type is at a site over time. It is likely

displaced quickly with either a reduction of annual sand deposits or high levels of deposition that favor *Ammophila breviligulata* (American beachgrass) foredune development.
Other Comments: There is no clear crosswalk in the MA classification to this USNVC association.
Local Description Authors: R.E. Zaremba
Plots: CACO.015, CACO.033, CACO.071 (outside boundary).
AA (2004) Points: CACO.181, CACO.203, CACO.329, CACO.492.
Cape Cod National Seashore Inventory Notes: Mapped in the Salt Marsh aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Short sod temperate or subpolar grassland (V.A.5.N.e.)
Alliance	*Spartina patens - (Schoenoplectus pungens)* Herbaceous Alliance (A.1274)
Alliance (English name)	Saltmeadow Cordgrass - (Common Threesquare) Herbaceous Alliance
Association	*Spartina patens - Thinopyrum pycnanthum* Herbaceous Vegetation
Association (English name)	Saltmeadow Cordgrass - Tick Quackgrass Herbaceous Vegetation
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This dune grassland of central New England occurs on the interface between upper salt marshes and sand dunes. These low dunes may be periodically flooded by storm tides, most frequently during the winter when plants are dormant. The association is characterized by a dominance of *Spartina patens* (saltmeadow cordgrass), *Elymus repens* (quackgrass), or *Thinopyrum pycnanthum* (tick quackgrass). All three species may be present or one may occur alone. Other associates are rare, but when present may include *Ammophila breviligulata* (American beachgrass), *Oenothera biennis* (common evening-primrose), *Artemisia campestris ssp. caudata* (field sagewort), *Solidago sempervirens* (seaside goldenrod), and *Rosa rugosa* (rugosa rose).
Environmental Description: This dune grassland of central New England occurs on the interface between upper salt marshes and sand dunes. These low dunes may be periodically flooded by storm tides, most frequently during the winter when plants are dormant.
Vegetation Description: The association is characterized by a dominance of *Spartina patens* (saltmeadow cordgrass), *Elymus repens* (quackgrass), or *Thinopyrum pycnanthum* (tick quackgrass). All three species may be present or one may occur alone. Other associates are rare but, when present, may include *Ammophila breviligulata* (American beachgrass), *Oenothera biennis* (common evening-primrose), *Artemisia campestris ssp. caudata* (field sagewort), *Solidago sempervirens* (seaside goldenrod), and *Rosa rugosa* (rugosa rose).
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Elymus repens* (quackgrass)
		Thinopyrum pycnanthum (tick quackgrass)

Characteristic Species: *Elymus repens* (quackgrass), *Spartina patens* (saltmeadow cordgrass), *Thinopyrum pycnanthum* (tick quackgrass)

Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This association is documented from Massachusetts.
States/Provinces: MA
Federal Lands: NPS (Cape Cod)

CONSERVATION STATUS
Rank: GNR (21-Apr-2004)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 3 - Weak
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: R.E. Zaremba and L.A. Sneddon
References: Eastern Ecology Working Group n.d., McDonnell 1979



Figure 51. Salt Hay Dune in Cape Cod National Seashore (plot CACO. 015). Summer 2003. NAD 1983 / UTM easting 411089, northing 4642265.

COMMON NAME (PARK-SPECIFIC): BLUEJOINT PONDSHORE MARGIN

SYNONYMS

USNVC English Name: **Bluejoint - Matting Witchgrass - (Mixed Shrub) Herbaceous Vegetation**

USNVC Scientific Name: ***Calamagrostis canadensis* - *Dichanthelium meridionale* - (Mixed Shrub) Herbaceous Vegetation**

USNVC Identifier: **CEGL006243**

LOCAL INFORMATION

Environmental Description: This variable Coastal Plain pondshore margin community occurs on the higher reaches of pondshore basins, adjacent to fringing shrub or swamp forest communities. An organic layer of variable depth overlies sand or sandy loam on gently sloping pondshores.

Vegetation Description: Characteristic species include *Calamagrostis canadensis* (bluejoint), *Euthamia caroliniana* (*=Euthamia tenuifolia*, slender goldentop), *Juncus pelocarpus* (brownfruit rush), *Cyperus dentatus* (toothed flatsedge), *Viola lanceolata* (bog white violet), and *Scirpus cyperinus* (woolgrass) often with variable presence at low cover of shrub species such as *Vaccinium corymbosum* (highbush blueberry), *Chamaedaphne calyculata* (leatherleaf), and *Kalmia angustifolia* (sheep laurel). *Woodwardia virginica* (Virginia chainfern) and *Thelypteris palustris* (eastern marsh fern) may be present. There may also be a thin layer *Sphagnum* (sphagnum) present.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Euthamia caroliniana* (*=Euthamia tenuifolia*, slender goldentop)
Herb (field)	Graminoid	*Calamagrostis canadensis* (bluejoint)
		Juncus pelocarpus (brownfruit rush)

Characteristic Species: *Calamagrostis canadensis* (bluejoint), *Juncus pelocarpus* (brownfruit rush)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S2*	B	1	Coastal Plain Pondshore	Swain and Kearsley 2001

Local Range: This association is known from the Coastal Plain ponds in Wellfleet.

Classification Comments: This vegetation occurs on Herring Pond in Cape Cod National Seashore. Additional data should be collected on this type, including information on its areal extent (does it ever occur as large stands, lacking shrub cover?), and does it occur in pristine habitats not subject to unnatural disturbance or nutrient input?

Other Comments: Information not available.

Local Description Authors: R.E. Zaremba

Plots: Sneddon et al. (1999).

AA (2004) Points: None.

Cape Cod National Seashore Inventory Notes: Mapped in the Coastal Plain Pondshore aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
Alliance	*Calamagrostis canadensis* Seasonally Flooded Herbaceous Alliance (A.1400)
Alliance (English name)	Bluejoint Seasonally Flooded Herbaceous Alliance
Association	*Calamagrostis canadensis* - *Dichanthelium meridionale* - (Mixed Shrub) Herbaceous Vegetation
Association (English name)	Bluejoint - Matting Witchgrass - (Mixed Shrub) Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Pondshore (CES203.518).

GLOBAL DESCRIPTION

Concept Summary: This pondshore margin community of southern New England and New York generally occurs as a narrow band at the periphery of Coastal Plain pondshore basins, adjacent to the shrub zone or upland forest, if a shrub zone is absent. The substrate is sandy with a shallow organic layer or deeper muck. Characteristic species include *Calamagrostis canadensis* (bluejoint), *Dichanthelium meridionale* (matting rosette grass), *Panicum virgatum* (switchgrass), *Euthamia caroliniana* (slender goldentop), *Viola lanceolata* (bog white violet), and *Polygala cruciata* (drumheads). *Sphagnum cuspidatum* (toothed sphagnum) can be abundant. Shrubs from the adjacent border may be admixed at variable cover. Shrubs may include *Spiraea alba* (white meadowsweet), *Clethra alnifolia* (coastal sweetpepperbush), *Vaccinium corymbosum* (highbush blueberry), *Chamaedaphne calyculata* (leatherleaf), *Leucothoe racemosa* (swamp doghobble), or *Vaccinium macrocarpon* (cranberry).

Environmental Description: This pondshore margin community of southern New England and New York generally occurs as a narrow band at the periphery of Coastal Plain pondshore basins, adjacent to the shrub zone or upland forest, if a shrub zone is absent. The substrate is sandy with a shallow organic layer or deeper muck.

Vegetation Description: Characteristic species include *Calamagrostis canadensis* (bluejoint), *Dichanthelium meridionale* (matting rosette grass), *Panicum virgatum* (switchgrass), *Euthamia caroliniana* (slender goldentop), *Viola lanceolata* (bog white violet), and *Polygala cruciata* (drumheads). *Sphagnum cuspidatum* (toothed sphagnum) can be abundant. Shrubs from the adjacent border may be admixed at variable cover. Shrubs may include *Spiraea alba* (white meadowsweet), *Clethra alnifolia* (coastal sweetpepperbush), *Vaccinium corymbosum* (highbush blueberry), *Chamaedaphne calyculata* (leatherleaf), *Leucothoe racemosa* (swamp doghobble), or *Vaccinium macrocarpon* (cranberry).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Euthamia caroliniana* (slender goldentop)
Herb (field)	Graminoid	*Calamagrostis canadensis* (bluejoint)
		Juncus pelocarpus (brownfruit rush)
Nonvascular	Moss	*Sphagnum cuspidatum* (toothed sphagnum)

Characteristic Species: *Calamagrostis canadensis* (bluejoint), *Dichanthelium meridionale* (matting rosette grass), *Euthamia caroliniana* (slender goldentop), *Panicum virgatum* (switchgrass), *Polygala cruciata* (drumheads), *Viola lanceolata* (bog white violet)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine

DISTRIBUTION
Range: Information not available.
States/Provinces: CT, MA, ME, NH, NY?, ON, RI?
Federal Lands: NPS (Cape Cod)

CONSERVATION STATUS
Rank: GNR (1-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: At one site, this association occupies the majority of a shallow basin in Massachusetts.
Similar Associations: Information not available.
Related Concepts:
- New England coastal plain pondshore (Rawinski 1984) ?

SOURCES
Description Authors: L.A. Sneddon
References: Eastern Ecology Working Group n.d., Gawler 2002, Metzler and Barrett 2001, Rawinski 1984, Sneddon et al. 1999, Sperduto 2000b, Sperduto and Nichols 2004, Swain and Kearsley 2001



Figure 52. Bluejoint Pondshore Margin at Higgins Pond in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 416239, northing 4646020.

COMMON NAME (PARK-SPECIFIC): NORTHERN COASTAL PLAIN PONDSHORE MARGIN

SYNONYMS

USNVC English Name: **Swamp-candles - Threeway Sedge - Virginia Meadowbeauty Herbaceous Vegetation**

USNVC Scientific Name: ***Lysimachia terrestris* - *Dulichium arundinaceum* - *Rhexia virginica* Herbaceous Vegetation**

USNVC Identifier: **CEGL006035**

LOCAL INFORMATION

Environmental Description: This pondshore community occurs in shallow water of Coastal Plain ponds. It usually forms a narrow band out from the edge of the pond where water persists during all periods except extreme droughts. The pond water level is associated with general groundwater conditions and fluctuates broadly with long-term rainfall. This community can be dry during long periods of drought. The substrate is sandy and acidic. This community can also form in a Coastal Plain pond on a loose organic mat which floats during high water periods.

Vegetation Description: Characteristic species include *Calamagrostis canadensis* (bluejoint), *Lycopus uniflorus* (northern bugleweed), *Lysimachia terrestris* (earth loosestrife), *Dulichium arundinaceum* (threeway sedge), and *Juncus canadensis* (Canadian rush). Other associates occurring at low frequency include *Glyceria acutiflora* (creeping mannagrass), *Glyceria canadensis* (rattlesnake mannagrass), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Viola lanceolata* (bog white violet), *Gratiola aurea* (golden hedgehyssop), *Euthamia caroliniana* (=*Euthamia tenuifolia*, slender goldentop), *Schoenoplectus pungens* (common threesquare), *Cladium mariscoides* (smooth sawgrass), and *Galium palustre* (common marsh bedstraw).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Lysimachia terrestris* (earth loosestrife)
Herb (field)	Graminoid	*Calamagrostis canadensis* (bluejoint)
		Dulichium arundinaceum (threeway sedge)

Characteristic Species: *Calamagrostis canadensis* (bluejoint), *Euthamia caroliniana* (=*Euthamia tenuifolia*, slender goldentop), *Lysimachia terrestris* (earth loosestrife)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S2*	B	1	Coastal Plain Pondshore	Swain and Kearsley 2001

Local Range: This association occurs in the Coastal Plain ponds in Eastham, Wellfleet, and Truro and in the Provinceland ponds. It occurs on Higgins Pond and Horseleach Pond.

Classification Comments: Information not available.

Other Comments: Information not available.

Local Description Authors: R.E. Zaremba

Plots: Sneddon et al. (1999).

AA (2004) Points: None.

Cape Cod National Seashore Inventory Notes: Mapped in the Coastal Plain Pondshore aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
Alliance	*Dulichium arundinaceum* Seasonally Flooded Herbaceous Alliance (A.1398)
Alliance (English name)	Threeway Sedge Seasonally Flooded Herbaceous Alliance
Association	*Lysimachia terrestris* - *Dulichium arundinaceum* - *Rhexia virginica* Herbaceous Vegetation
Association (English name)	Swamp-candles - Threeway Sedge - Virginia Meadowbeauty Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Pondshore (CES203.518).

GLOBAL DESCRIPTION

Concept Summary: This Coastal Plain pondshore community occurs in central New England and Ontario. Seasonally flooded basins supporting this community usually have a permanent central water body without emergent vegetation. The shoreline is gently sloping, generally less than 10% where measured. A thin to moderately deep layer of muck overlies sand, and total vegetation cover is generally over 75%. This vegetation generally occurs on the higher margins of ponds, indicating a relatively short hydroperiod. Characteristic species include *Calamagrostis canadensis* (bluejoint), *Lycopus uniflorus* (northern bugleweed), *Lysimachia terrestris* (earth loosestrife), *Dulichium arundinaceum* (threeway sedge), and *Juncus canadensis* (Canadian rush). Other associates occurring at low frequency include *Glyceria acutiflora* (creeping mannagrass), *Glyceria canadensis* (rattlesnake mannagrass), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Viola lanceolata* (bog white violet), *Gratiola aurea* (golden hedgehyssop), *Euthamia caroliniana* (slender goldentop), *Schoenoplectus pungens* (common threesquare), *Cladium mariscoides* (smooth sawgrass), and *Galium palustre* (common marsh bedstraw).

Environmental Description: This Coastal Plain pondshore community occurs in central New England and in Ontario. Seasonally flooded basins supporting this community usually have a permanent central water body without emergent vegetation. The shoreline is gently sloping, generally less than 10% where measured. A thin to moderately deep layer of muck overlies sand, and total vegetation cover is generally over 75%.

Vegetation Description: Characteristic species include *Calamagrostis canadensis* (bluejoint), *Lycopus uniflorus* (northern bugleweed), *Lysimachia terrestris* (earth loosestrife), *Dulichium arundinaceum* (threeway sedge), and *Juncus canadensis* (Canadian rush). Other associates occurring at low frequency include *Glyceria acutiflora* (creeping mannagrass), *Glyceria canadensis* (rattlesnake mannagrass), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Viola lanceolata* (bog white violet), *Gratiola aurea* (golden hedgehyssop), *Euthamia caroliniana* (slender goldentop), *Schoenoplectus pungens* (common threesquare), *Cladium mariscoides* (smooth sawgrass), and *Galium palustre* (common marsh bedstraw).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Lycopus uniflorus* (northern bugleweed)
		Lysimachia terrestris (earth loosestrife)
Herb (field)	Graminoid	*Calamagrostis canadensis* (bluejoint)
		Dulichium arundinaceum (threeway sedge)

Characteristic Species: *Calamagrostis canadensis* (bluejoint), *Dulichium arundinaceum* (threeway sedge), *Juncus canadensis* (Canadian rush), *Lycopus uniflorus* (northern bugleweed), *Lysimachia terrestris* (earth loosestrife)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine

DISTRIBUTION

Range: This Coastal Plain pondshore community occurs in central New England and Ontario.
States/Provinces: CT, MA, ME, NH, ON, VT
Federal Lands: NPS (Cape Cod); USFWS (Parker River?)

CONSERVATION STATUS

Rank: G2G3 (23-Nov-1998)
Reasons: This small-patch Coastal Plain pondshore community has an estimated 35–45 EOs and up to 4500 total acreage rangewide. The range is restricted to New England and Ontario. This community is threatened by hydrologic manipulation and eutrophication.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 1 - Strong
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts:

- Lacustrine Littoral Mud Flat, Intermittently Exposed (L2FL3G) (Cowardin et al. 1979) ?
- New England coastal plain pondshore (Rawinski 1984) ?
- Outwash Plain Pondshore (Thompson 1996) ?
- Upper shoreline (Keddy and Reznicek 1982) ?

SOURCES

Description Authors: L.A. Sneddon
References: Cowardin et al. 1979, Eastern Ecology Working Group n.d., Gawler 2002, Keddy and Reznicek 1982, Metzler and Barrett 2001, Rawinski 1984, Sneddon et al. 1999, Sperduto 2000b, Sperduto and Nichols 2004, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000



Figure 53. Northern Coastal Plain Pondshore Margin at Higgins Pond in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 416339, northing 4645853.

COMMON NAME (PARK-SPECIFIC): BULBLET FLATSEDGE COASTAL PLAIN SANDY PONDSHORE

SYNONYMS

USNVC English Name: **Northern Beaksedge - Bulblet Flatsedge - Virginia Meadowbeauty - Bog Yellow-eyed-grass Herbaceous Vegetation**

USNVC Scientific Name: ***Rhynchospora capitellata* - *Cyperus dentatus* - *Rhexia virginica* - *Xyris difformis* Herbaceous Vegetation**

USNVC Identifier: **CEGL006210**

LOCAL INFORMATION

Environmental Description: The association occupies the highly variable intermediate zones exposed by water level drawdown late in the growing season. The substrate is most frequently sand or gravelly sand. The amount of organic material at the surface or mixed with sand is highly variable, ranging from an absent O horizon (pure sand) to a deep A horizon of sandy loam.

Vegetation Description: This association is often characterized by conspicuous zones of varying dominants, but analysis reveals that the overall species composition of these zones is strikingly similar and does not warrant further separation by dominant species. Vegetation cover is usually high and characterized by graminoids with a high component of forbs. Characteristic dominant species include *Rhynchospora capitellata* (brownish beaksedge), *Hypericum canadense* (lesser Canadian St. Johnswort), and *Juncus canadensis* (Canadian rush). Other frequent associates include *Euthamia caroliniana* (=*Euthamia tenuifolia*, slender goldentop), *Drosera intermedia* (spoonleaf sundew), *Viola lanceolata* (bog white violet), *Agalinis purpurea* (purple false foxglove), *Agrostis scabra* (rough bentgrass), *Drosera filiformis* (threadleaf sundew), *Xyris difformis* (bog yelloweyed grass), *Cyperus dentatus* (toothed flatsedge), *Rhexia virginica* (handsome Harry), *Fimbristylis autumnalis* (slender fimbry), *Xyris torta* (slender yelloweyed grass), *Juncus pelocarpus* (brownfruit rush), and *Gratiola aurea* (golden hedgehyssop).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Drosera intermedia* (spoonleaf sundew)
		Hypericum canadense (lesser Canadian St. Johnswort)
Herb (field)	Graminoid	*Cyperus dentatus* (toothed flatsedge)
		Juncus canadensis (Canadian rush)
		Rhynchospora capitellata (brownish beaksedge)

Characteristic Species: *Rhynchospora capitellata* (brownish beaksedge)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S2*	B	1	Coastal Plain Pondshore	Swain and Kearsley 2001

Local Range: This association is found around the ponds in Eastham, Wellfleet, and Truro and in the ponds near the Beech Forest in the Provincelands. It occurs at Cape Cod National Seashore at Great Pond, Spectacle Pond, Little Spectacle Pond, Kinnacum Pond, Duck Pond, and Gull Pond.

Classification Comments: Information not available.

Other Comments: Information not available.

Local Description Authors: R.E. Zaremba
Plots: Sneddon et al. (1999).
AA (2004) Points: None.
Cape Cod National Seashore Inventory Notes: Mapped in the Coastal Plain Pondshore aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
Alliance	*Rhynchospora* spp. - *Panicum (rigidulum, verrucosum)* - *Rhexia virginica* Seasonally Flooded Herbaceous Alliance (A.1384)
Alliance (English name)	Beaksedge species - (Redtop Panicgrass, Warty Panicgrass) - Virginia Meadowbeauty Seasonally Flooded Herbaceous Alliance
Association	*Rhynchospora capitellata - Cyperus dentatus - Rhexia virginica - Xyris difformis* Herbaceous Vegetation
Association (English name)	Northern Beaksedge - Bulblet Flatsedge - Virginia Meadowbeauty - Bog Yellow-eyed-grass Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Pondshore (CES203.518).

GLOBAL DESCRIPTION

Concept Summary: This oligotrophic Coastal Plain pondshore community occurs on the shores of ponds formed in glacial outwash from Ontario and possibly Nova Scotia south to Long Island, New York, and possibly to the Coastal Plain of New Jersey. The substrate is generally sand or gravelly sand with a shallow or negligible organic layer. The amount of organic material at the surface or mixed with sand is highly variable, ranging from an absent O horizon (pure sand) to a deep A horizon of sandy loam. The vegetation occupies the highly variable intermediate zones exposed by water level draw-down late in the growing season. This vegetation is often characterized by conspicuous zones of varying dominants, but analysis reveals that the overall species composition of these zones is strikingly similar, and does not warrant further separation by dominant species. Vegetation cover is usually high and is characterized by graminoids with a high component of forbs. Characteristic species include *Rhexia virginica* (handsome Harry), *Rhynchospora capitellata* (brownish beaksedge), *Cyperus dentatus* (toothed flatsedge), *Viola lanceolata* (bog white violet), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Juncus canadensis* (Canadian rush), *Juncus pelocarpus* (brownfruit rush), *Juncus militaris* (bayonet rush), *Drosera filiformis* (threadleaf sundew), *Drosera intermedia* (spoonleaf sundew), *Euthamia caroliniana* (slender goldentop), *Hypericum mutilum* (dwarf St. Johnswort), *Hypericum canadense* (lesser Canadian St. Johnswort), *Fimbristylis autumnalis* (slender fimbry), *Rhynchospora fusca* (brown beaksedge), *Muhlenbergia uniflora* (bog muhly), *Juncus pelocarpus* (brownfruit rush), *Gratiola aurea* (golden hedgehyssop), *Xyris difformis* (bog yelloweyed grass), *Agalinis purpurea* (purple false foxglove), *Coreopsis rosea* (pink tickseed), and *Agrostis scabra* (rough bentgrass). Many rare species may be found in this vegetation, such as *Sabatia kennedyana* (Plymouth rose gentian), *Eupatorium leucolepis var. novae-angliae* (justiceweed), and *Sagittaria teres* (slender arrowhead).
Environmental Description: This oligotrophic Coastal Plain pondshore community occurs on the shores of ponds formed in glacial outwash in Massachusetts and Rhode Island, or on the

margins of large lakes in Nova Scotia. The substrate is generally sandy with a shallow or absent organic layer.

Vegetation Description: Characteristic species include *Rhexia virginica* (handsome Harry), *Rhynchospora capitellata* (brownish beaksedge), *Cyperus dentatus* (toothed flatsedge), *Viola lanceolata* (bog white violet), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Juncus canadensis* (Canadian rush), *Juncus pelocarpus* (brownfruit rush), *Sabatia kennedyana* (Plymouth rose gentian), *Juncus militaris* (bayonet rush), *Drosera filiformis* (threadleaf sundew), *Drosera intermedia* (spoonleaf sundew), *Euthamia caroliniana* (slender goldentop), *Hypericum mutilum* (dwarf St. Johnswort), *Xyris difformis* (bog yelloweyed grass), *Coreopsis rosea* (pink tickseed), and *Agrostis scabra* (rough bentgrass).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Rhexia virginica* (handsome Harry)
Herb (field)	Graminoid	*Cyperus dentatus* (toothed flatsedge)
		Juncus canadensis (Canadian rush)
		Rhynchospora capitellata (brownish beaksedge)

Characteristic Species: *Cyperus dentatus* (toothed flatsedge), *Drosera filiformis* (threadleaf sundew), *Drosera intermedia* (spoonleaf sundew), *Rhexia virginica* (handsome Harry), *Rhynchospora capitellata* (brownish beaksedge), *Sabatia kennedyana* (Plymouth rose gentian), *Viola lanceolata* (bog white violet), *Xyris difformis* (bog yelloweyed grass)

Other Noteworthy Species:

Species	GRank	Type	Note
Eupatorium leucolepis var. *novae-angliae* (justiceweed)	G5T1	plant	
Sabatia kennedyana (Plymouth rose gentian)	G3	plant	
Sagittaria teres (slender arrowhead)	G3	plant	

USFWS Wetland System: Palustrine

DISTRIBUTION

Range: This association is restricted to Ontario and possibly Nova Scotia, southern New England, New York, possibly ranging to New Jersey.

States/Provinces: CT, MA, ME, NH, NJ?, NS?, NY, ON, RI, VT

Federal Lands: NPS (Cape Cod)

CONSERVATION STATUS

Rank: G2 (10-Dec-1998)

Reasons: This Coastal Plain pondshore community is restricted to the sandy perimeter of seasonally flooded basins in Rhode Island, Massachusetts, New Hampshire, and on certain lakeshores of Ontario. The range of this community is naturally limited by an uncommon habitat, which is unfortunately extremely desirable to people seeking sandy beaches and clear water for swimming and fishing. Although there are likely 50 or more potential occurrences, this community is extremely threatened by a host of human activities: altered hydrology caused by over-pumping of groundwater, building, trampling, ORVs, water quality degradation caused by fertilizer runoff, and loss of buffer due to development of surrounding uplands. Few truly high-quality examples of this community remain.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 1 - Strong

Comments: Proposed name change of Sneddon et al. (1999) was not implemented in the USNVC. This vegetation is similar to vegetation described from Nova Scotia, but classification relationship has not been definitively determined.

Similar Associations: Information not available.

Related Concepts:

- *Euthamia tenuifolia - Rhexia virginica - Hypericum mutilum - Xyris difformis* Herbaceous Vegetation (Sneddon et al. 1999) =
- New England coastal plain pondshore (Rawinski 1984) ?
- Southern New England Coastal Plain Pondshore (Sneddon et al. 1999) ?

SOURCES

Description Authors: L.A. Sneddon, mod. R.E. Zaremba

References: Eastern Ecology Working Group n.d., Edinger et al. 2002, Keddy 1981, Keddy 1983, Keddy and Wisheu 1989, Rawinski 1984, Sneddon et al. 1999, Swain and Kearsley 2001, Wisheu et al. 1994



Figure 54. Bulblet Flatsedge Coastal Plain Sandy Pondshore at Gull Pond in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 416118, northing 4645594.

COMMON NAME (PARK-SPECIFIC): WOOLGRASS MARSH

SYNONYMS
USNVC English Name: **Woolgrass Bulrush Seasonally Flooded Herbaceous Vegetation**
USNVC Scientific Name: ***Scirpus cyperinus* Seasonally Flooded Herbaceous Vegetation**
USNVC Identifier: **CEGL006349**

LOCAL INFORMATION

Environmental Description: This association occurs in a range of settings with variable water levels and organic soils. It is defined by high percent cover of *Scirpus cyperinus* (woolgrass) and likely represents a range of community types. One example is found along Coastal Plain streams with a *Sphagnum* (sphagnum) mat that is floating during years with high water. Another example is in an interdunal swale with standing water even during extremely dry periods. A third example is on a floating mat in a Coastal Plain pond. All these settings have variable water levels but usually saturated acidic soils.

Vegetation Description: This association is dominated by *Scirpus cyperinus* (woolgrass) with a high cover of *Sphagnum* (sphagnum). Common associates include *Juncus effusus* (common rush), *Thelypteris palustris* (eastern marsh fern), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Decodon verticillatus* (swamp loosestrife), and *Toxicodendron radicans* (eastern poison ivy). Other associates include *Rubus flagellaris* (northern dewberry) and *Rubus hispidus* (bristly dewberry), *Euthamia graminifolia* (flat-top goldentop), *Spiraea tomentosa* (steeplebush), and *Schoenoplectus acutus* (hardstem bulrush).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Triadenum virginicum* (Virginia marsh St. Johnswort)
Herb (field)	Graminoid	*Juncus effusus* (common rush)
		Scirpus cyperinus (woolgrass)
Herb (field)	Fern or fern ally	*Thelypteris palustris* (eastern marsh fern)

Characteristic Species: *Juncus effusus* (common rush), *Scirpus cyperinus* (woolgrass)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S4*	B	1	Deep Emergent Marsh	Swain and Kearsley 2001

Local Range: This association occurs at scattered locations throughout Cape Cod National Seashore.

Classification Comments: This association is highly variable in environment and species composition. More work is needed to better classify and describe this association. Many of the examples noted within Cape Cod National Seashore may not be stable over time, but may represent a successional stage.

Other Comments: Information not available.

Local Description Authors: R.E. Zaremba

Plots: CACO.016, CACO.040, CACO.063.

AA (2004) Points: None.

Cape Cod National Seashore Inventory Notes: Mapped in the Wooded Marsh aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
Alliance	*Scirpus cyperinus* Seasonally Flooded Herbaceous Alliance (A.1386)
Alliance (English name)	Woolgrass Bulrush Seasonally Flooded Herbaceous Alliance
Association	*Scirpus cyperinus* Seasonally Flooded Herbaceous Vegetation
Association (English name)	Woolgrass Bulrush Seasonally Flooded Herbaceous Vegetation
Ecological System(s):	Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582). Laurentian-Acadian Freshwater Marsh (CES201.594). High Allegheny Wetland (CES202.069).

GLOBAL DESCRIPTION

Concept Summary: This seasonally flooded marsh occurs in the northeastern United States. It is dominated or characterized by *Scirpus cyperinus* (woolgrass), but composition is variable. Associates include *Glyceria* (mannagrass) spp., *Thelypteris palustris* (eastern marsh fern), as well as other species of *Scirpus* (bulrush) including *Scirpus microcarpus* (panicled bulrush) and *Scirpus atrovirens* (green bulrush).

Environmental Description: These are seasonally flooded marshes.

Vegetation Description: This community is dominated or characterized by *Scirpus cyperinus* (woolgrass). Composition is variable. Associates include *Glyceria* (mannagrass) spp., *Thelypteris palustris* (eastern marsh fern), as well as other species of *Scirpus* (bulrush), including *Scirpus microcarpus* (panicled bulrush) and *Scirpus atrovirens* (green bulrush).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Scirpus cyperinus* (woolgrass)

Characteristic Species: *Scirpus cyperinus* (woolgrass)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine

DISTRIBUTION

Range: This seasonally flood marsh occurs throughout the northeastern U.S. from Maine to West Virginia.

States/Provinces: CT, DC?, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, WV:S3

Federal Lands: NPS (C&O Canal?, Cape Cod, Gateway, National Capital-East?, Saratoga, Thomas Stone); USFS (Monongahela); USFWS (Assabet River?, Canaan Valley, Chincoteague, Erie, Great Meadows?)

CONSERVATION STATUS

Rank: GNR (1-Dec-1997)

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 3 - Weak

Comments: Information not available.

Similar Associations:

- *Calamagrostis canadensis - Scirpus* spp. - *Dulichium arundinaceum* Herbaceous Vegetation (CEGL006519)

Related Concepts:

- *Scirpus cyperinus* herbaceous vegetation (Byers et al. 2007) =
- Shallow emergent marsh (Cowardin et al. 1979) ?

SOURCES

Description Authors: R.E. Zaremba and L.A. Sneddon

References: Breden et al. 2001, Byers et al. 2007, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Fike 1999, Gawler 2002, Harrison 2004, NRCS 2001b, NRCS 2004, Walbridge 1982



Figure 55. Woolgrass Marsh in Cape Cod National Seashore (plot CACO.016). Summer 2003. NAD 1983 / UTM easting 410839, northing 4644424.

COMMON NAME (PARK-SPECIFIC): PIPEWORT SANDY PONDSHORE

SYNONYMS

USNVC English Name: **Seven-angle Pipewort - Dortmann's Cardinal-flower Herbaceous Vegetation**

USNVC Scientific Name: ***Eriocaulon aquaticum* - *Lobelia dortmanna* Herbaceous Vegetation**

USNVC Identifier: **CEGL006346**

LOCAL INFORMATION

Environmental Description: This Coastal Plain pondshore vegetation occurs in shallow standing water on the shore of permanent water bodies. Substrate is sand or gravelly sand with or without an organic layer of peaty muck at the surface.

Vegetation Description: The vegetation is of low height, characterized by *Eriocaulon aquaticum* (sevenangle pipewort), *Eleocharis acicularis* (needle spikerush), and *Lobelia dortmanna* (Dortmann's cardinalflower). Associates include *Nymphoides cordata* (little floatingheart), *Myriophyllum tenellum* (slender watermilfoil), *Gratiola aurea* (golden hedgehyssop), and *Schoenoplectus pungens* (common threesquare). Few other species occur, and *Sphagnum* (sphagnum) is notably absent.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Lobelia dortmanna* (Dortmann's cardinalflower)
Herb (field)	Graminoid	*Eleocharis acicularis* (needle spikerush)

Characteristic Species: *Eriocaulon aquaticum* (sevenangle pipewort), *Lobelia dortmanna* (Dortmann's cardinalflower)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNR	NA	NA	[not crosswalked]	Swain and Kearsley 2001

Local Range: This association is limited to the Wellfleet and Truro ponds. This association occurs at Cape Cod National Seashore at Great Pond, Gull Pond, Horseleach Pond, and Slough Pond.

Classification Comments: There is no clear crosswalk in the MA classification to this USNVC association.

Other Comments: Information not available.

Local Description Authors: R.E. Zaremba

Plots: Sneddon et al. (1999).

AA (2004) Points: None.

Cape Cod National Seashore Inventory Notes: Mapped in the Coastal Plain Pondshore aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	Semipermanently flooded temperate or subpolar grassland (V.A.5.N.l.)
Alliance	*Eleocharis* spp. - *Eriocaulon aquaticum* Semipermanently Flooded Herbaceous Alliance (A.1429)
Alliance (English name)	Spikerush species - Seven-angle Pipewort Semipermanently Flooded Herbaceous Alliance
Association	*Eriocaulon aquaticum* - *Lobelia dortmanna* Herbaceous Vegetation
Association (English name)	Seven-angle Pipewort - Dortmann's Cardinal-flower Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Pondshore (CES203.518). Laurentian-Acadian Freshwater Marsh (CES201.594).

GLOBAL DESCRIPTION

Concept Summary: This Coastal Plain pondshore of New England and possibly Ontario occurs on oligotrophic, sandy-bottomed ponds with permanent water. The substrate is sand or gravelly sand with or without a thin organic layer of peaty muck at the surface. The vegetation is of low height, characterized by *Eriocaulon aquaticum* (sevenangle pipewort), *Eleocharis acicularis* (needle spikerush), and *Lobelia dortmanna* (Dortmann's cardinalflower). Associates include *Nymphoides cordata* (little floatingheart), *Gratiola aurea* (golden hedgehyssop), and *Schoenoplectus pungens* (common threesquare). Few other species occur, and *Sphagnum* (sphagnum) is notably absent.

Environmental Description: This Coastal Plain pondshore of New England and possibly Ontario occurs within the semipermanently flooded zone of oligotrophic, sandy-bottomed ponds with permanent water. The substrate is sand or gravelly sand with or without a thin organic layer of peaty muck at the surface.

Vegetation Description: The vegetation is of low height and characterized by *Eriocaulon aquaticum* (sevenangle pipewort), *Eleocharis acicularis* (needle spikerush), and *Lobelia dortmanna* (Dortmann's cardinalflower). Associates include *Nymphoides cordata* (little floatingheart), *Gratiola aurea* (golden hedgehyssop), and *Schoenoplectus pungens* (common threesquare). Few other species occur, and *Sphagnum* (sphagnum) is notably absent.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Eriocaulon aquaticum* (sevenangle pipewort)
Herb (field)	Graminoid	*Eleocharis acicularis* (needle spikerush)

Characteristic Species: *Eleocharis acicularis* (needle spikerush), *Eriocaulon aquaticum* (sevenangle pipewort), *Lobelia dortmanna* (Dortmann's cardinalflower)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine

DISTRIBUTION

Range: Information not available.

States/Provinces: CT, MA, ME, NH?, NY, ON?, RI, VT?

Federal Lands: NPS (Acadia, Cape Cod)

CONSERVATION STATUS
Rank: GNR (1-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: Similar vegetation is documented from Lake George, New York, where further analysis may suggest the recognition of a separate association due to the presence of such species as *Vallisneria americana* (American eelgrass), *Isoetes tenella* (spiny-spore quillwort), *Ranunculus longirostris* (longbeak buttercup), *Sagittaria graminea* (grassy arrowhead), as well as a diverse aquatic faunal component.
Similar Associations:
- *Juncus militaris - Eriocaulon aquaticum* Herbaceous Vegetation (CEGL006345)

Related Concepts:
- Pipewort - water lobelia aquatic bed (Cameron 2000) =

SOURCES
Description Authors: L.A. Sneddon
References: Cameron 2000, Eastern Ecology Working Group n.d., Edinger et al. 2002, Gawler 2002, Keddy 1981, Metzler and Barrett 2001, Sneddon et al. 1999, Sperduto and Nichols 2004



Figure 56. Pipewort Sandy Pondshore in Truro, Cape Cod National Seashore (no specific plot). September 2004. UTM coordinates not available.



Figure 57. Pipewort Sandy Pondshore at Gull Pond in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 416199, northing 4645733.

COMMON NAME (PARK-SPECIFIC): BAYONET RUSH PONDSHORE

SYNONYMS
USNVC English Name: **Bayonet Rush - Seven-angle Pipewort Herbaceous Vegetation**
USNVC Scientific Name: ***Juncus militaris* - *Eriocaulon aquaticum* Herbaceous Vegetation**
USNVC Identifier: **CEGL006345**

LOCAL INFORMATION

Environmental Description: This Coastal Plain pondshore association occurs in shallow water at the shore of permanent water bodies. The sandy or gravelly substrate generally supports an organic layer of variable depth.
Vegetation Description: *Juncus militaris* (bayonet rush) dominates the association. Regular associates include *Gratiola aurea* (golden hedgehyssop), *Nymphoides cordata* (little floatingheart), *Nymphaea odorata* (American white waterlily), *Brasenia schreberi* (watershield), and *Eriocaulon aquaticum* (sevenangle pipewort). Other species occurring in this type include *Pontederia cordata* (pickerelweed), *Hydrocotyle umbellata* (manyflower marshpennywort), *Eleocharis robbinsii* (Robbins' spikerush), *Eleocharis olivacea* (bright green spikerush), *Sagittaria teres* (slender arrowhead), *Lysimachia terrestris* (earth loosestrife), *Sium suave* (hemlock waterparsnip), *Schoenoplectus subterminalis* (swaying bulrush), *Dulichium arundinaceum* (threeway sedge), and *Triadenum virginicum* (Virginia marsh St. Johnswort).
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Eleocharis robbinsii* (Robbins' spikerush)
		Juncus militaris (bayonet rush)
Floating aquatic	Aquatic herb(floating & submergent)	*Nymphaea odorata* (American white waterlily)

Characteristic Species: *Eleocharis robbinsii* (Robbins' spikerush), *Juncus militaris* (bayonet rush)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S2*	B	1	Coastal Plain Pondshore	Swain and Kearsley 2001

Local Range: This association occurs in the Coastal Plain ponds in Eastham, Wellfleet, and Truro and around the ponds in the Provincelands.
Classification Comments: This association occurs at Cape Cod National Seashore at Kinnacum Pond, Ryder's Pond, Duck Pond, Great Pond, and Higgins Pond. This vegetation is similar to *Eriocaulon aquaticum* - *Lobelia dortmanna* Herbaceous Vegetation (CEGL006346) in its similar topographic position and apparently similar hydroperiod, and in the presence of *Eriocaulon aquaticum* (sevenangle pipewort), *Gratiola aurea* (golden hedgehyssop), and *Nymphoides cordata* (little floatingheart). It differs in its physiognomy, being dominated by a tall, coarse rhizomatous graminoid, and although environmental measures are lacking, organic layer depth is suspected to be deeper in this type because of the presence of such plants as *Pontederia cordata* (pickerelweed), *Eleocharis olivacea* (bright green spikerush), and *Triadenum virginicum* (Virginia marsh St. Johnswort).
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: CACO.094, CACO.096; Sneddon et al. (1999).

AA (2004) Points: CACO.525
Cape Cod National Seashore Inventory Notes: Mapped in the Coastal Plain Pondshore aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	Semipermanently flooded temperate or subpolar grassland (V.A.5.N.l.)
Alliance	*Juncus militaris* Semipermanently Flooded Herbaceous Alliance (A.1430)
Alliance (English name)	Bayonet Rush Semipermanently Flooded Herbaceous Alliance
Association	*Juncus militaris - Eriocaulon aquaticum* Herbaceous Vegetation
Association (English name)	Bayonet Rush - Seven-angle Pipewort Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Pondshore (CES203.518). Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582). Laurentian-Acadian Freshwater Marsh (CES201.594).

GLOBAL DESCRIPTION

Concept Summary: This Coastal Plain pondshore vegetation of southern New England and possibly Ontario occurs in shallow standing water at the shore of permanent water bodies. The sandy or gravelly substrate generally supports an organic layer of variable depth. *Juncus militaris* (bayonet rush) dominates the association. Regular associates include *Gratiola aurea* (golden hedgehyssop), *Nymphoides cordata* (little floatingheart), *Nymphaea odorata* (American white waterlily), and *Eriocaulon aquaticum* (sevenangle pipewort). Other species occurring in this type include *Pontederia cordata* (pickerelweed), *Hydrocotyle umbellata* (manyflower marshpennywort), *Eleocharis robbinsii* (Robbins' spikerush), *Eleocharis olivacea* (bright green spikerush), *Sagittaria teres* (slender arrowhead), *Lysimachia terrestris* (earth loosestrife), *Sium suave* (hemlock waterparsnip), and *Triadenum virginicum* (Virginia marsh St. Johnswort). This vegetation is similar to *Eriocaulon aquaticum - Lobelia dortmanna* Herbaceous Vegetation (CEGL006346) in its similar topographic position and apparently similar hydroperiod, and in the presence of *Eriocaulon aquaticum* (sevenangle pipewort), *Gratiola aurea* (golden hedgehyssop), and *Nymphoides cordata* (little floatingheart). It differs in its physiognomy, being dominated by a tall, coarse rhizomatous graminoid, and although environmental measures are lacking, organic layer depth is suspected to be deeper in this type because of the presence of such plants as *Pontederia cordata* (pickerelweed), *Eleocharis olivacea* (bright green spikerush), and *Triadenum virginicum* (Virginia marsh St. Johnswort).
Environmental Description: This Coastal Plain pondshore vegetation of southern New England and possibly Ontario occurs in shallow standing water at the shore of permanent water bodies. The sandy or gravelly substrate generally supports an organic layer of variable depth.
Vegetation Description: *Juncus militaris* (bayonet rush) dominates the association. Regular associates include *Gratiola aurea* (golden hedgehyssop), *Nymphoides cordata* (little floatingheart), *Nymphaea odorata* (American white waterlily), and *Eriocaulon aquaticum* (sevenangle pipewort). Other species occurring in this type include *Pontederia cordata* (pickerelweed), *Hydrocotyle umbellata* (manyflower marshpennywort), *Eleocharis robbinsii* (Robbins' spikerush), *Eleocharis olivacea* (bright green spikerush), *Sagittaria teres* (slender

arrowhead), *Lysimachia terrestris* (earth loosestrife), *Sium suave* (hemlock waterparsnip), and *Triadenum virginicum* (Virginia marsh St. Johnswort).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Juncus militaris* (bayonet rush)

Characteristic Species: *Eriocaulon aquaticum* (sevenangle pipewort), *Gratiola aurea* (golden hedgehyssop), *Juncus militaris* (bayonet rush), *Nymphaea odorata* (American white waterlily), *Nymphoides cordata* (little floatingheart)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine

DISTRIBUTION

Range: This vegetation of oligotrophic lake and pondshores occurs in New England and adjacent Canadian maritime provinces.

States/Provinces: MA, ME, NY, ON?, RI

Federal Lands: NPS (Acadia, Cape Cod)

CONSERVATION STATUS

Rank: GNR (1-Dec-1997)

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 3 - Weak

Comments: Information not available.

Similar Associations:

- *Eriocaulon aquaticum - Lobelia dortmanna* Herbaceous Vegetation (CEGL006346)

Related Concepts:

- New England coastal plain pondshore (Rawinski 1984) ?

SOURCES

Description Authors: L.A. Sneddon

References: Eastern Ecology Working Group n.d., Edinger et al. 2002, Gawler 2002, Keddy 1981, Rawinski 1984, Sneddon et al. 1999, Swain and Kearsley 2001



Figure 58. Bayonet Rush Pondshore in Cape Cod National Seashore (plot CACO.094). Summer 2003. NAD 1983 / UTM easting 400206, northing 4656981.

COMMON NAME (PARK-SPECIFIC): EASTERN REED MARSH

SYNONYMS

USNVC English Name: **Common Reed Eastern North America Temperate Semi-natural Herbaceous Vegetation**

USNVC Scientific Name: ***Phragmites australis* Eastern North America Temperate Semi-natural Herbaceous Vegetation**

USNVC Identifier: **CEGL004141**

LOCAL INFORMATION

Environmental Description: Stands of this community occur in semipermanently flooded freshwater marshes, ditches, impoundments, etc. that have often been disturbed by human activity.

Vegetation Description: This community is dominated by *Phragmites australis* (common reed), with few or no other vascular plants present.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Phragmites australis* (common reed)

Characteristic Species: *Phragmites australis* (common reed)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S4*	B	1	Deep Emergent Marsh	Swain and Kearsley 2001

Local Range: Freshwater-influenced *Phragmites australis* (common reed) patches are present and scattered throughout Cape Cod National Seashore.

Classification Comments: This community is distinguished from Reed-grass Tidal Marsh by the fact that it is not tidally influenced.

Other Comments: Examples of this community in Cape Cod National Seashore are below the minimum mapping unit size. This is an invasive community; *Phragmites australis* (common reed) will often invade into existing natural or semi-natural communities present on the site. Crosswalk Note: The communities described in the MA vegetation classification and the USNVC are not always equivalent in concept. The MA community type, Deep Emergent Marsh, is broader in concept than the USNVC association Eastern Reed Marsh. Under the MA classification, Deep Emergent Marsh is ranked as a S4 type and it can include multiple USNVC associations that occur in the same environmental setting. Eastern Reed Marsh, although invasive and not of conservation concern with a Grank of GNA (invasive) invades and persists in what is called Deep Emergent Marsh in the MA classification; therefore, it is crosswalked to the MA classification unit.

Local Description Authors: E. Largay

Plots: None.

AA (2004) Points: None.

Cape Cod National Seashore Inventory Notes: Mapped in the Phragmites aggregated map class in the vegetation map. Photograph not available.

GLOBAL INFORMATION

USNVC 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	Semipermanently flooded temperate or subpolar grassland (V.A.5.N.l.)
Alliance	*Phragmites australis* Semipermanently Flooded Herbaceous Alliance (A.1431)
Alliance (English name)	Common Reed Semipermanently Flooded Herbaceous Alliance
Association	*Phragmites australis* Eastern North America Temperate Semi-natural Herbaceous Vegetation
Association (English name)	Common Reed Eastern North America Temperate Semi-natural Herbaceous Vegetation
Ecological System(s):	Southeastern Coastal Plain Interdunal Wetland (CES203.258). Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519). Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582). Laurentian-Acadian Freshwater Marsh (CES201.594). North-Central Interior Freshwater Marsh (CES202.899).

GLOBAL DESCRIPTION

Concept Summary: This reed marsh type is found across the east-temperate regions of the United States and Canada. Stands occur in semipermanently flooded marshes, ditches, impoundments, etc., that have often been disturbed by human activity. The vegetation is variable, as *Phragmites australis* (common reed) will often invade into existing natural or semi-natural communities present on the site. Once firmly established, this community is usually strongly dominated by *Phragmites australis* (common reed), with few or no other vascular plants present.

Environmental Description: Stands occur in semipermanently flooded marshes, ditches, impoundments, etc. that have often been disturbed by human activity.

Vegetation Description: The vegetation is often variable, as *Phragmites australis* (common reed) will often invade into existing natural or semi-natural communities present on the site. Once firmly established, this community is usually strongly dominated by *Phragmites australis* (common reed), with few or no other vascular plants present.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Phragmites australis* (common reed)

Characteristic Species: *Phragmites australis* (common reed)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine

DISTRIBUTION

Range: This reed marsh type is found across the east-temperate regions of the United States and Canada, ranging from Maine west to the eastern Dakotas and Manitoba, south to Texas and east to Florida.

States/Provinces: AL, AR, CT, DE, FL, GA, IA, IN, LA, MA, MD, ME, MI, MN, MS, NC, NH, NJ, NY, OH, ON, PA, RI, SC, TX, VA, VT, WI, WV

Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Indiana Dunes, Minute Man, Saratoga, Upper Delaware, Voyageurs); USFWS (Alligator River, Aransas, Bon Secour, Brazoria, Great Dismal Swamp, Great Meadows, Great Swamp, Matagorda Island, Nomans Land Island?, Oxbow, Parker River, Prime Hook)

CONSERVATION STATUS

Rank: GNA (invasive) (23-Nov-1997)

Reasons: Although almost always occurring as a naturalized type that arises from human disturbance, some stands in northern Minnesota and further north in Canada may be native. If so, they should be tracked as a separate type.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 1 - Strong

Comments: This is not a native community but is the result of the invasion of alien *Phragmites australis* (common reed) into natural or semi-natural vegetation. The vegetation has variable hydrology and, unless *Phragmites* (reed) is clearly dominant, is often treated as part of other marsh and meadow types. The geographic distribution of the type is arbitrarily limited to Bailey's Humid Temperate Domain in eastern North America (Bailey 1997, 1998). Stands in northern Minnesota and farther north in Canada may represent native stands. If so, they should be tracked as a different type. Tidal vegetation of the Gulf Coast of Louisiana and Texas dominated by *Phragmites australis* (common reed) is classified in the *Phragmites australis* (common reed) Tidal Herbaceous Alliance (A.1477).

Similar Associations:

- *Phragmites australis* Tidal Herbaceous Vegetation (CEGL004187)
- *Phragmites australis* Western North America Temperate Semi-natural Herbaceous Vegetation (CEGL001475)

Related Concepts:

- *Phragmites australis* community (Metzler and Barrett 1992) ?
- *Phragmites australis* tidal marsh association (Clancy 1993b) ?
- Inland Emergent Marsh (Chapman et al. 1989) B
- Southern New England nutrient-poor streamside/lakeside marsh (Rawinski 1984) ?
- Southern New England nutrient-rich streamside/lakeside marsh (Rawinski 1984) ?

SOURCES

Description Authors: D. Faber-Langendoen

References: Bailey 1997, Bailey 1998, Bell et al. 2002, Chapman et al. 1989, Clancy 1993b, Harris et al. 1996, INAI unpubl. data, Metzler and Barrett 1992, Metzler and Barrett 2001, NRCS 2004, Nelson 1986, Rawinski 1984, Schafale and Weakley 1990, Schotz pers. comm., Southeastern Ecology Working Group n.d., Swain and Kearsley 2001

COMMON NAME (PARK-SPECIFIC): COASTAL FRESHWATER MARSH

SYNONYMS

USNVC English Name: **Common Threesquare - Canadian Rush Herbaceous Vegetation**

USNVC Scientific Name: ***Schoenoplectus pungens* var. *pungens* - *Juncus canadensis* Herbaceous Vegetation**

USNVC Identifier: **CEGL006935**

LOCAL INFORMATION

Environmental Description: This association occurs in freshwater interdunal swales that remain wet most of the time, drying out only during periods of extreme drought. Water levels are associated with a freshwater lens under a barrier beach. On rare occasions, usually during the winter, some of these community examples may be flooded with brackish tidal water.

Vegetation Description: This association is highly variable, but dominated by graminoids with a high diversity of forbs. Dominants may include *Schoenoplectus pungens* (common threesquare), *Scirpus cyperinus* (woolgrass), *Juncus effusus* (common rush), *Juncus canadensis* (Canadian rush), and *Calamagrostis canadensis* (bluejoint). Common associates include *Thelypteris palustris* (eastern marsh fern), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Euthamia graminifolia* (flat-top goldentop), and *Osmunda regalis* (royal fern). Stunted shrubs may be present, including *Morella pensylvanica* (northern bayberry), *Rosa carolina* (Carolina rose), and *Ilex verticillata* (common winterberry). Species composition may vary considerably between years. Some occurrences are invaded by *Phragmites australis* (common reed).

Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Rosa carolina* (Carolina rose)
		Spiraea tomentosa (steeplebush)
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Morella pensylvanica* (northern bayberry)
Herb (field)	Vine/Liana	*Rubus flagellaris* (northern dewberry)
		Rubus hispidus (bristly dewberry)
		Smilax rotundifolia (roundleaf greenbrier)
Herb (field)	Forb	*Euthamia graminifolia* (flat-top goldentop)
		Triadenum virginicum (Virginia marsh St. Johnswort)
Herb (field)	Graminoid	*Juncus effusus* (common rush)
		Schoenoplectus pungens (common threesquare)
Herb (field)	Fern or fern ally	*Thelypteris palustris* (eastern marsh fern)

Characteristic Species: *Schoenoplectus pungens* (common threesquare), *Scirpus cyperinus* (woolgrass)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNR	NA	NA	[not crosswalked]	Swain and Kearsley 2001

Local Range: This association occurs in Provincetown.

Classification Comments: This association is highly variable at Cape Cod National Seashore. Each occurrence is different floristically.

Other Comments: There is no clear crosswalk in the MA classification to this USNVC association.

Local Description Authors: R.E. Zaremba

Plots: CACO.007, CACO.029.
AA (2004) Points: CACO.310.
Cape Cod National Seashore Inventory Notes: Mapped in the Coastal Marsh aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	Semipermanently flooded temperate or subpolar grassland (V.A.5.N.l.)
Alliance	*Typha (angustifolia, latifolia)* - *(Schoenoplectus* spp.) Semipermanently Flooded Herbaceous Alliance (A.1436)
Alliance (English name)	(Narrowleaf Cattail, Broadleaf Cattail) - (Clubrush species) Semipermanently Flooded Herbaceous Alliance
Association	*Schoenoplectus pungens* var. *pungens* - *Juncus canadensis* Herbaceous Vegetation
Association (English name)	Common Threesquare - Canadian Rush Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.516). Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264).

GLOBAL DESCRIPTION

Concept Summary: This non-tidal freshwater marsh of the coastal Northeast occupies flooded depressions and swales in coastal dunes. The substrate varies from sand to peat or muck, depending on hydrological regime. Water is present most of the year and does not typically exhibit a seasonal drawdown. The vegetation is dominated by *Schoenoplectus pungens var. pungens* (common threesquare), in association with *Hibiscus moscheutos ssp. moscheutos* (crimsoneyed rosemallow), *Juncus canadensis* (Canadian rush), *Juncus effusus* (common rush), *Eleocharis erythropoda* (bald spikerush), *Osmunda regalis* (royal fern), *Osmunda cinnamomea* (cinnamon fern), *Thelypteris palustris* (eastern marsh fern), and *Triadenum virginicum* (Virginia marsh St. Johnswort). *Typha latifolia* (broadleaf cattail) may be present, but generally only occurs at low cover. A diverse range of other forbs may also be associated with this community.
Environmental Description: This non-tidal freshwater marsh of the coastal Northeast occupies flooded depressions and swales in coastal dunes. The substrate varies from sand to peat or muck, depending on hydrological regime. Water is present most of the year and does not typically exhibit a seasonal drawdown.
Vegetation Description: The vegetation is dominated by *Schoenoplectus pungens var. pungens* (common threesquare), in association with *Hibiscus moscheutos ssp. moscheutos* (crimsoneyed rosemallow), *Juncus canadensis* (Canadian rush), *Juncus effusus* (common rush), *Eleocharis erythropoda* (bald spikerush), *Osmunda regalis* (royal fern), *Osmunda cinnamomea* (cinnamon fern), *Thelypteris palustris* (eastern marsh fern), and *Triadenum virginicum* (Virginia marsh St. Johnswort). *Typha latifolia* (broadleaf cattail) may be present, but generally only occurs at low cover. A diverse range of other forbs may also be associated with this community. Shrubs may be present as sparsely distributed individuals, or more densely from the wetland edge. Typical shrubs include *Rosa rugosa* (rugosa rose), *Vaccinium corymbosum* (highbush blueberry), and *Morella pensylvanica* (northern bayberry).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Schoenoplectus pungens* var. *pungens* (common threesquare)

Characteristic Species: *Schoenoplectus pungens* var. *pungens* (common threesquare)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine

DISTRIBUTION
Range: This association is known from Massachusetts and New Jersey but is likely to occur in other coastal states of the Northeast.
States/Provinces: MA, NJ, NY
Federal Lands: NPS (Cape Cod)

CONSERVATION STATUS
Rank: GNR (8-Nov-2000)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2
Comments: New community described based on Gap Project sample sites ("FM1", "FM2", "FM4") at Island Beach State Park.
Similar Associations: Information not available.
Related Concepts:
- Fresh marsh (Martin 1959b) ?

SOURCES
Description Authors: L.A. Sneddon
References: Eastern Ecology Working Group n.d., Martin 1959b



Figure 59. Coastal Freshwater Marsh in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 399218, northing 4658967.



Figure 60. Coastal Freshwater Marsh in Cape Cod National Seashore (CACO.007). Summer 2003. NAD 1983 / UTM easting 400266, northing 4658409.

COMMON NAME (PARK-SPECIFIC): EASTERN CATTAIL MARSH

SYNONYMS

USNVC English Name: **(Narrowleaf Cattail, Broadleaf Cattail) - (Clubrush species) Eastern Herbaceous Vegetation**

USNVC Scientific Name: ***Typha* (*angustifolia, latifolia*) - (*Schoenoplectus* spp.) Eastern Herbaceous Vegetation**

USNVC Identifier: **CEGL006153**

LOCAL INFORMATION

Environmental Description: This association occurs along wide, freshwater sections of Coastal Plain streams and in embayment of large Coastal Plain ponds. Soils are made up of coarse organics from *Typha* (cattail) decomposition overlying fine, pasty organic deposits. Some occurrences are floating.

Vegetation Description: This association is dominated by either *Typha angustifolia* (narrowleaf cattail) or *Typha latifolia* (broadleaf cattail). In some cases both species occur as well as *Typha X glauca* (blue cattail). *Decodon verticillatus* (swamp loosestrife) is nearly always associated with the outer edge of this association when it occurs in a pond setting. Along streams the association is also bordered by *Decodon verticillatus* (swamp loosestrife) as well as *Chamaedaphne calyculata* (leatherleaf). Common associates include *Thelypteris palustris* (eastern marsh fern), *Galium aparine* (stickywilly), *Impatiens capensis* (jewelweed), *Polygonum arifolium* (halberdleaf tearthumb), and *Triadenum virginicum* (Virginia marsh St. Johnswort).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Polygonum arifolium* (halberdleaf tearthumb)
		Triadenum virginicum (Virginia marsh St. Johnswort)
Herb (field)	Graminoid	*Typha angustifolia* (narrowleaf cattail)
		Typha latifolia (broadleaf cattail)
Herb (field)	Fern or fern ally	*Thelypteris palustris* (eastern marsh fern)

Characteristic Species: *Thelypteris palustris* (eastern marsh fern), *Typha angustifolia* (narrowleaf cattail), *Typha latifolia* (broadleaf cattail)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNR	NA	NA	[not crosswalked]	Swain and Kearsley 2001

Local Range: This association occurs along the non-tidal portion of the Herring River in Wellfleet and around ponds in the Provincelands.

Classification Comments: There are probably additional occurrences of this association within the Bound Brook/Herring River complex in Wellfleet.

Other Comments: There is no clear crosswalk in the MA classification to this USNVC association.

Local Description Authors: R.E. Zaremba

Plots: CACO.008, CACO.041, CACO.055, CACO.095, CACO.107, and CACO.110.

AA (2004) Points: CACO.103, CACO.128, CACO.147, CACO.147, CACO.165, CACO.208, CACO.233, CACO.238, CACO.246, CACO.289, CACO.311, CACO.318, CACO.352, CACO.387, CACO.394, CACO.410, CACO.461, CACO.473.

Cape Cod National Seashore Inventory Notes: Mapped in the Cattail Marsh aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	Semipermanently flooded temperate or subpolar grassland (V.A.5.N.l.)
Alliance	*Typha (angustifolia, latifolia)* - *(Schoenoplectus* spp.) Semipermanently Flooded Herbaceous Alliance (A.1436)
Alliance (English name)	(Narrowleaf Cattail, Broadleaf Cattail) - (Clubrush species) Semipermanently Flooded Herbaceous Alliance
Association	*Typha (angustifolia, latifolia)* - *(Schoenoplectus* spp.) Eastern Herbaceous Vegetation
Association (English name)	(Narrowleaf Cattail, Broadleaf Cattail) - (Clubrush species) Eastern Herbaceous Vegetation
Ecological System(s):	Laurentian-Acadian Freshwater Marsh (CES201.594).

GLOBAL DESCRIPTION

Concept Summary: These tall emergent marshes are common throughout the northeastern United States and adjacent Canadian provinces. They occur in permanently flooded basins, often as part of a larger wetland mosaic and associated with lakes, ponds, or slow-moving streams. The substrate is muck over mineral soil. Lacustrine cattail marshes typically have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and a floating mat zone, where the roots grow suspended in a buoyant peaty mat. Tall graminoids dominate the vegetation; scattered shrubs are often present (usually totaling less than 25% cover) and are frequently shorter than the graminoids. Trees are absent. Bryophyte cover varies and is rarely extensive; bryophytes are mostly confined to the hummocks. *Typha angustifolia* (narrowleaf cattail), *Typha latifolia* (broadleaf cattail), or their hybrid *Typha X glauca* (blue cattail) dominate, either alone or in combination with other tall emergent marsh species. Associated species vary widely; sedges, such as *Carex aquatilis* (water sedge), *Carex lurida* (shallow sedge), *Carex rostrata* (beaked sedge), *Carex pellita* (woolly sedge), *Carex stricta* (upright sedge), *Scirpus cyperinus* (woolgrass), and bulrushes, such as *Schoenoplectus americanus* (chairmaker's bulrush) and *Schoenoplectus acutus* (hardstem bulrush), occur along with patchy grasses, such as *Calamagrostis canadensis* (bluejoint). Broad-leaved herbs include *Thelypteris palustris* (eastern marsh fern), *Asclepias incarnata* (swamp milkweed), *Onoclea sensibilis* (sensitive fern), *Symplocarpus foetidus* (skunk cabbage), *Calla palustris* (water arum), *Impatiens capensis* (jewelweed), *Sagittaria latifolia* (broadleaf arrowhead), *Scutellaria lateriflora* (blue skullcap), *Sparganium eurycarpum* (broadfruit bur-reed), and *Verbena hastata* (swamp verbena). Floating aquatics, such as *Lemna minor* (common duckweed), may be common in deeper zones. Shrub species vary across the geographic range of this type; in the northern part of its range, *Myrica gale* (sweetgale), *Ilex verticillata* (common winterberry), and *Spiraea alba* (white meadowsweet) are common. The invasive exotic plants *Lythrum salicaria* (purple loosestrife) and *Phragmites australis* (common reed) may be abundant in parts of some occurrences. This association is distinguished from other northeastern freshwater marshes by the strong dominance of *Typha* (cattail) spp.

Environmental Description: These tall emergent marshes are common throughout the northeastern United States and adjacent Canadian provinces. They occur in permanently flooded basins, often as part of a larger wetland mosaic and associated with lakes, ponds, or slow-moving streams. The substrate is muck over mineral soil. Lacustrine cattail marshes typically have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and a floating mat zone, where the roots grow suspended in a buoyant peaty mat. This association is often found in impounded waters.
Vegetation Description: Tall graminoids dominate the vegetation; scattered shrubs are often present (usually totaling less than 25% cover) and are frequently shorter than the graminoids. Trees are absent. Bryophyte cover varies and is rarely extensive; bryophytes are mostly confined to the hummocks. *Typha angustifolia* (narrowleaf cattail), *Typha latifolia* (broadleaf cattail), or their hybrid *Typha X glauca* (blue cattail) dominate, either alone or in combination with other tall emergent marsh species. Associated species vary widely; sedges, such as *Carex aquatilis* (water sedge), *Carex lurida* (shallow sedge), *Carex rostrata* (beaked sedge), *Carex pellita* (woolly sedge), *Carex stricta* (upright sedge), *Scirpus cyperinus* (woolgrass), and bulrushes, such as *Schoenoplectus americanus* (chairmaker's bulrush) and *Schoenoplectus acutus* (hardstem bulrush), occur along with patchy grasses, such as *Calamagrostis canadensis* (bluejoint). Broad-leaved herbs include *Thelypteris palustris* (eastern marsh fern), *Asclepias incarnata* (swamp milkweed), *Onoclea sensibilis* (sensitive fern), *Symplocarpus foetidus* (skunk cabbage), *Calla palustris* (water arum), *Impatiens capensis* (jewelweed), *Sagittaria latifolia* (broadleaf arrowhead), *Scutellaria lateriflora* (blue skullcap), *Sparganium eurycarpum* (broadfruit bur-reed), and *Verbena hastata* (swamp verbena). Floating aquatics, such as *Lemna minor* (common duckweed), may be common in deeper zones. Shrub species vary across the geographic range of this type; in the northern part of its range, *Myrica gale* (sweetgale), *Ilex verticillata* (common winterberry), and *Spiraea alba* (white meadowsweet) are common. The invasive exotic plants *Lythrum salicaria* (purple loosestrife) and *Phragmites australis* (common reed) may be abundant in parts of some occurrences.
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Typha angustifolia* (narrowleaf cattail)
		Typha latifolia (broadleaf cattail)
		Typha x *glauca* (blue cattail)

Characteristic Species: *Onoclea sensibilis* (sensitive fern), *Schoenoplectus acutus* (hardstem bulrush), *Schoenoplectus americanus* (chairmaker's bulrush), *Typha angustifolia* (narrowleaf cattail), *Typha latifolia* (broadleaf cattail)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine

DISTRIBUTION
Range: This association occurs throughout the northeastern U.S. from Maine to North Carolina.
States/Provinces: CT, DC?, DE, MA, MD, ME:S5, NC, NH:S4?, NJ:S5, NY, PA:S5, RI, VA, VT, WV
Federal Lands: NPS (Acadia, Blue Ridge Parkway?, Boston Harbor Islands, C&O Canal?, Cape Cod, Delaware Water Gap, Johnstown Flood, Minute Man, National Capital-East?, Saint-Gaudens, Saratoga, Upper Delaware); USFS (Nantahala?, Pisgah?); USFWS (Aroostook, Assabet River, Carlton Pond?, Erie, Great Meadows, Great Swamp, Moosehorn, Nomans Land Island, Nulhegan Basin, Oxbow, Pondicherry?, Prime Hook)

CONSERVATION STATUS
Rank: G5 (1-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: *Typha angustifolia* (narrowleaf cattail) can grow in deeper water compared to *Typha latifolia* (broadleaf cattail), although both species reach maximum growth at a water depth of 50 cm (Grace and Wetzel 1981). *Typha* (cattail) often occurs in pure stands and can colonize areas recently exposed by either natural or human causes.
Similar Associations:
- *Typha latifolia* Southern Herbaceous Vegetation (CEGL004150)
- *Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229)
- *Typha* spp. - *Schoenoplectus tabernaemontani* - Mixed Herbs Southern Great Lakes Shore Herbaceous Vegetation (CEGL005112)
- *Typha* spp. Midwest Herbaceous Vegetation (CEGL002233)

Related Concepts:
- Cattail Marsh (Thompson 1996) ?
- Cattail marsh (CAP pers. comm. 1998) ?
- Palustrine Narrow-leaved Persistent Emergent Wetland, Permanently Flooded (PEM5H) (Cowardin et al. 1979) ?
- Robust Emergent Marsh (Breden 1989) ?
- Southern New England nutrient-poor streamside/lakeside marsh (Rawinski 1984) ?
- Southern New England nutrient-rich streamside/lakeside marsh (Rawinski 1984) ?

SOURCES
Description Authors: S.C. Gawler
References: Breden 1989, Breden et al. 2001, CAP pers. comm. 1998, Clancy 1996, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fike 1999, Gawler 2002, Grace and Wetzel 1981, Harrison 2004, Metzler and Barrett 2001, NRCS 2004, Northern Appalachian Ecology Working Group 2000, Rawinski 1984, Sperduto and Nichols 2004, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000



Figure 61. Eastern Cattail Marsh in Cape Cod National Seashore (plot CACO.095). Summer 2003. NAD 1983 / UTM easting 401163, northing 4657733.

COMMON NAME (PARK-SPECIFIC): THREEWAY SEDGE ACIDIC FEN

SYNONYMS

USNVC English Name: **Threeway Sedge - Virginia Marsh St. John's-wort / Flat-top Bogmoss Herbaceous Vegetation**

USNVC Scientific Name: ***Dulichium arundinaceum* - *Triadenum virginicum* / *Sphagnum fallax* Herbaceous Vegetation**

USNVC Identifier: **CEGL006077**

LOCAL INFORMATION

Environmental Description: This vegetation type occurs on loose organic material that is nearly always saturated in isolated basins. It may also be found on floating mats during high water periods.

Vegetation Description: This association is dominated by *Dulichium arundinaceum* (threeway sedge) growing in *Sphagnum* (sphagnum). Common associated herbs include *Triadenum virginicum* (Virginia marsh St. Johnswort), *Nymphaea odorata* (American white waterlily), *Scirpus cyperinus* (woolgrass), *Hypericum canadense* (lesser Canadian St. Johnswort), and *Eleocharis robbinsii* (Robbins' spikerush). A few scattered shrubs may be present including *Vaccinium corymbosum* (highbush blueberry), *Clethra alnifolia* (coastal sweetpepperbush), and *Vaccinium macrocarpon* (cranberry).

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Clethra alnifolia* (coastal sweetpepperbush)
		Vaccinium corymbosum (highbush blueberry)
Herb (field)	Forb	*Triadenum virginicum* (Virginia marsh St. Johnswort)
Herb (field)	Graminoid	*Dulichium arundinaceum* (threeway sedge)
		Eleocharis robbinsii (Robbins' spikerush)
Floating aquatic	Aquatic herb (floating & submergent)	*Nymphaea odorata* (American white waterlily)

Characteristic Species: *Dulichium arundinaceum* (threeway sedge), *Triadenum virginicum* (Virginia marsh St. Johnswort)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNR	NA	NA	[not crosswalked]	Swain and Kearsley 2001

Local Range: This association is not well known in Cape Cod National Seashore. There is an occurrence in the Provincelands near the Beech Forest. There are likely more small occurrences in the Coastal Plain ponds throughout the Provincelands and in Truro, Wellfleet, and Eastham.

Classification Comments: One occurrence was described from the Provincelands. There are likely many more examples found in the many Coastal Plain ponds in Cape Cod National Seashore. Most of these examples are probably very small.

Other Comments: There is no clear crosswalk in the MA classification to this USNVC association.

Local Description Authors: R.E. Zaremba

Plots: CACO.093.

AA (2004) Points: CACO.451.

Cape Cod National Seashore Inventory Notes: Mapped as an inclusion within a Medium Fen (CEGL006302) polygon. Mapped in the Fen aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	Saturated temperate or subpolar grassland (V.A.5.N.m.)
Alliance	*Dulichium arundinaceum* Saturated Herbaceous Alliance (A.3023)
Alliance (English name)	Threeway Sedge Saturated Herbaceous Alliance
Association	*Dulichium arundinaceum - Triadenum virginicum / Sphagnum fallax* Herbaceous Vegetation
Association (English name)	Threeway Sedge - Virginia Marsh St. John's-wort / Flat-top Bogmoss Herbaceous Vegetation
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This saturated vegetation of New England and New Jersey occurs in saturated conditions of isolated basins. The vegetation is strongly dominated by *Dulichium arundinaceum* (threeway sedge) growing in a loosely consolidated aquatic suspension of *Sphagnum cuspidatum* (toothed sphagnum) and/or *Sphagnum fallax* (sphagnum). Associated species include *Triadenum virginicum* (Virginia marsh St. Johnswort), *Glyceria acutiflora* (creeping mannagrass), and *Glyceria obtusa* (Atlantic mannagrass). The vegetation is boggy in nature, forming a quaking mat in most cases. The dominance by *Dulichium arundinaceum* (threeway sedge) confers a lawn appearance. This association provides habitat for the rare dragonfly *Williamsonia lintneri* (ringed boghaunter).

Environmental Description: This vegetation type of New England and New Jersey occurs in saturated conditions of isolated basins.

Vegetation Description: The vegetation is strongly dominated by *Dulichium arundinaceum* (threeway sedge) growing in a loosely consolidated aquatic suspension of *Sphagnum cuspidatum* (toothed sphagnum) and/or *Sphagnum fallax* (sphagnum). Associated species include *Triadenum virginicum* (Virginia marsh St. Johnswort), *Glyceria acutiflora* (creeping mannagrass), and *Glyceria obtusa* (Atlantic mannagrass). The vegetation is boggy in nature, forming a quaking mat in most cases. The dominance by *Dulichium arundinaceum* (threeway sedge) confers a lawn appearance. This association provides habitat for the rare dragonfly *Williamsonia lintneri* (ringed boghaunter).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Dulichium arundinaceum* (threeway sedge)

Characteristic Species: *Dulichium arundinaceum* (threeway sedge)

Other Noteworthy Species:

Species	GRank	Type	Note
Williamsonia lintneri (ringed boghaunter)	G3	animal	

USFWS Wetland System: Palustrine

DISTRIBUTION

Range: Information not available.

States/Provinces: CT, MA, NH, NJ, RI

Federal Lands: NPS (Cape Cod); USFWS (Great Swamp, Pondicherry?)

CONSERVATION STATUS
Rank: GNR (1-Jun-2004)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: L.A. Sneddon, mod. R.E. Zaremba
References: Eastern Ecology Working Group n.d., Lundgren 1999b, Metzler and Barrett 2003, Sperduto 2000c



Figure 62. Threeway Sedge Acidic Fen in Cape Cod National Seashore (plot CACO.093). Summer 2003. NAD 1983 / UTM easting 400963, northing 4657781.

COMMON NAME (PARK-SPECIFIC): SPIKERUSH LAWN TIDAL MARSH

SYNONYMS

USNVC English Name: **Beaked Spikerush - Saltmeadow Cordgrass Herbaceous Vegetation**

USNVC Scientific Name: ***Eleocharis rostellata* - *Spartina patens* Herbaceous Vegetation**

USNVC Identifier: **CEGL006611**

LOCAL INFORMATION

Environmental Description: This association occurs at the upper edge of a broad salt marsh. The site is flooded during spring tides and storm surges. Freshwater seeps from the adjacent outwash deposit maintaining low soil salinity. The seepage extends across a section of bare sand where drift material accumulates and limits plant growth. There is a distinct orange discoloration of the sand extending into the high marsh, suggesting the presence of iron.

Vegetation Description: This high marsh association is dominated by *Schoenoplectus pungens* (common threesquare) with *Eleocharis rostellata* (beaked spikerush), *Solidago sempervirens* (seaside goldenrod), and *Glaux maritima* (sea milkwort). *Spartina patens* (saltmeadow cordgrass) is present, but at low cover. *Juncus gerardii* (saltmeadow rush), *Puccinellia maritima* (seaside alkaligrass), and *Distichlis spicata* (inland saltgrass) are also present. Other herbs include *Symphyotrichum tenuifolium* (perennial saltmarsh aster) and *Phragmites australis* (common reed).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Glaux maritima* (sea milkwort)
		Solidago sempervirens (seaside goldenrod)
Herb (field)	Graminoid	*Eleocharis rostellata* (beaked spikerush)
		Schoenoplectus pungens (common threesquare)

Characteristic Species: *Eleocharis rostellata* (beaked spikerush), *Glaux maritima* (sea milkwort)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNR	NA	NA	[not crosswalked]	Swain and Kearsley 2001

Local Range: This association is known only from the Nauset Marsh at Fort Hill.

Classification Comments: This community is defined by the presence of *Glaux maritima* (sea milkwort), which is rare on Cape Cod and appears to be limited to this association, at least within Cape Cod National Seashore. Freshwater seepage from the upland is likely key to the species assemblage which is one of the only areas along the high marsh edge not dominated by either *Spartina patens* (saltmeadow cordgrass) or *Phragmites* (reed). This community might have been more abundant in the past and is now displaced by *Phragmites* (reed). Near this occurrence there is an even clearer freshwater seepage marsh border that is also stained with iron and now dominated by *Phragmites* (reed). This occurrence is far less diverse than a sea-level fen which includes many non-halophytes. All of the species present in this community example are tolerant of some soil salinity.

Other Comments: There is no clear crosswalk in the MA classification to this USNVC association.
Local Description Authors: R.E. Zaremba
Plots: CACO.080.
AA (2004) Points: None.
Cape Cod National Seashore Inventory Notes: Mapped in the Salt Marsh aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	*Eleocharis fallax - Eleocharis rostellata* Tidal Herbaceous Alliance (A.1474)
Alliance (English name)	Creeping Spikerush - Beaked Spikerush Tidal Herbaceous Alliance
Association	*Eleocharis rostellata - Spartina patens* Herbaceous Vegetation
Association (English name)	Beaked Spikerush - Saltmeadow Cordgrass Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519).

GLOBAL DESCRIPTION

Concept Summary: This association is an irregularly flooded oligohaline marsh ranging discontinuously along the coast from Massachusetts to Virginia. It occurs as a narrow band in the transition zone between high salt marsh and salt shrub vegetation. Groundwater seepage dilutes tidal floodwaters. It occurs on peat or muck of variable depth over sand. It is heavily dominated by *Eleocharis rostellata* (beaked spikerush), growing in association with *Spartina patens* (saltmeadow cordgrass), *Schoenoplectus pungens* (common threesquare), *Typha angustifolia* (narrowleaf cattail), *Distichlis spicata* (inland saltgrass), *Juncus gerardii* (saltmeadow rush), *Cladium mariscoides* (smooth sawgrass), *Eleocharis fallax* (creeping spikerush), *Lythrum lineare* (wand lythrum), *Samolus valerandi ssp. parviflorus* (seaside brookweed), and *Galium tinctorium* (stiff marsh bedstraw), and *Centella erecta* (erect centella) and *Fimbristylis castanea* (marsh fimbry) in the southern extent of the range. *Glaux maritima* (sea milkwort) occurs in this association on Cape Cod, Massachusetts. *Baccharis halimifolia* (eastern baccharis) and *Iva frutescens* (Jesuit's bark) can occur sporadically. It is currently described from barrier islands along the Mid- and North Atlantic Coast.
Environmental Description: This association is an irregularly flooded high marsh. Substrate is peat or muck of variable depth over sand.
Vegetation Description: This type represents "spikerush lawn" dominated or codominated by *Eleocharis rostellata* (beaked spikerush), growing in association with *Spartina patens* (saltmeadow cordgrass), *Schoenoplectus pungens* (common threesquare), *Typha angustifolia* (narrowleaf cattail), *Distichlis spicata* (inland saltgrass), *Juncus gerardii* (saltmeadow rush), *Cladium mariscoides* (smooth sawgrass), *Eleocharis fallax* (creeping spikerush), *Lythrum lineare* (wand lythrum), *Samolus valerandi ssp. parviflorus* (seaside brookweed), and *Galium tinctorium* (stiff marsh bedstraw), and *Centella erecta* (erect centella) and *Fimbristylis castanea* (marsh fimbry) in the southern extent of the range. *Baccharis halimifolia* (eastern baccharis) and *Iva frutescens* (Jesuit's bark) can occur sporadically.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Eleocharis rostellata* (beaked spikerush)

Characteristic Species: *Eleocharis rostellata* (beaked spikerush)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

DISTRIBUTION
Range: This association occurs along the Atlantic Coast from Virginia and Maryland, and northward to New York and Massachusetts.
States/Provinces: DE:S1, MA, MD, NY, VA
Federal Lands: NPS (Assateague Island, Cape Cod, Fire Island); USFWS (Chincoteague)

CONSERVATION STATUS
Rank: GNR (17-Apr-2000)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: Information not available.
Similar Associations:
- *Baccharis halimifolia - Iva frutescens / Panicum virgatum* Shrubland (CEGL003921)
- *Iva frutescens / Spartina patens* Shrubland (CEGL006848)

Related Concepts:
- *Eleocharis rostellata - Spartina patens* Herbaceous Vegetation [Provisional] (VDNH 2003) =

SOURCES
Description Authors: S.L. Neid
References: Bowman 2000, Coulling 2002, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Harrison 2004, Sneddon and Lundgren 2001, VDNH 2003



Figure 63. Spikerush Lawn Tidal Marsh in Cape Cod National Seashore (plot CACO.080). Summer 2003. NAD 1983 / UTM easting 420179, northing 4629854.

COMMON NAME (PARK-SPECIFIC): BRACKISH MEADOW

SYNONYMS
USNVC English Name: **Switchgrass - Saltmeadow Cordgrass Herbaceous Vegetation**
USNVC Scientific Name: ***Panicum virgatum* - *Spartina patens* Herbaceous Vegetation**
USNVC Identifier: **CEGL006150**

LOCAL INFORMATION

Environmental Description: This association occurs at the upper edge of the salt marsh, generally in embayments where drift organic material accumulates. Usually the association occurs as a narrow band, but can be extensive in large embayments. Soils are sandy overlying the material of the adjacent upland which can range from coarse gravel on outwash deposits to sand on barrier beaches. In some cases there may be underlying deposits of peat from vegetation that was encroached upon during sea level rise. Soils are well-drained and droughty. Spring tides and storm tides flood this vegetation type which has a broad range of soil salinities over time. Some plants persist through these fluctuations; others die. Large blankets of organic drift material may smother some portions of this community from one year to another. Generally, the substrate is subject to extreme flooding and new drift deposits during the winter and early spring when plants are dormant.

Vegetation Description: This association is dominated by either tall grasses or *Solidago sempervirens* (seaside goldenrod). *Panicum virgatum* (switchgrass) and *Spartina patens* (saltmeadow cordgrass) are often the dominant species. *Solidago sempervirens* (seaside goldenrod) is always present and can on occasion be the dominant species. Other common native associates include *Teucrium canadense* (Canada germander), *Thinopyrum pycnanthum* (tick quackgrass), *Conyza canadensis* (Canadian horseweed), *Euthamia caroliniana* (=*Euthamia tenuifolia*, slender goldentop), *Cyperus filicinus* (fern flatsedge), and *Pseudognaphalium obtusifolium* (rabbittobacco). *Baccharis halimifolia* (eastern baccharis) and *Iva frutescens* (Jesuit's bark) may also be present and locally abundant, particularly as seedlings or small plants. Nonnative ruderal species are abundant, including *Raphanus raphanistrum* (wild radish), *Lepidium campestre* (field pepperweed), *Verbascum thapsus* (common mullein), *Hypericum perforatum* (common St. Johnswort), and *Rumex crispus* (curly dock). Invasive shrubs and vines may also be present, including *Celastrus orbiculatus* (Oriental bittersweet), *Lonicera morrowii* (Morrow's honeysuckle), and *Rosa rugosa* (rugosa rose). Some examples are very sparsely vegetated; others are very dense.

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved evergreen shrub	*Baccharis halimifolia* (eastern baccharis)
Herb (field)	Forb	*Conyza canadensis* (Canadian horseweed)
		Solidago sempervirens (seaside goldenrod)
Herb (field)	Graminoid	*Panicum virgatum* (switchgrass)
		Spartina patens (saltmeadow cordgrass)

Characteristic Species: *Panicum virgatum* (switchgrass), *Solidago sempervirens* (seaside goldenrod)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S1*	I	1	Brackish Tidal Marsh	Swain and Kearsley 2001
MA	S3*	I	1	Salt Marsh	Swain and Kearsley 2001

Local Range: This association occurs along the upper salt marsh border at Nauset Marsh, The Gut, Hatches Harbor, Herring Cove, and at the Massachusetts Audubon Sanctuary.
Classification Comments: Information not available.
Other Comments: The concept of this USNVC association intersects with the concepts of two communities described in Swain and Kearsley 2001.
Local Description Authors: R.E. Zaremba
Plots: CACO.076, CACO.081, CACO.101.
AA (2004) Points: None.
Cape Cod National Seashore Inventory Notes: This community is mapped as small inclusions within North Atlantic Low Salt Marsh polygons (CEGL004192). It is mapped in the Salt Marsh aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	*Panicum virgatum* Tidal Herbaceous Alliance (A.1476)
Alliance (English name)	Switchgrass Tidal Herbaceous Alliance
Association	*Panicum virgatum* - *Spartina patens* Herbaceous Vegetation
Association (English name)	Switchgrass - Saltmeadow Cordgrass Herbaceous Vegetation
Ecological System(s):	Atlantic Coastal Plain Northern Salt Pond Marsh (CES203.892). Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519).

GLOBAL DESCRIPTION

Concept Summary: This brackish meadow of the northern Atlantic Coast occurs at the upland border of high salt marshes. It occurs on freely drained, shallow, sandy peat that is moist from upland seepage and brackish from irregular tidal flooding. Vegetation is dominated by *Panicum virgatum* (switchgrass) and occasionally codominated by *Spartina patens* (saltmeadow cordgrass). Common associates can include *Schoenoplectus americanus* (chairmaker's bulrush), *Solidago sempervirens* (seaside goldenrod), *Teucrium canadense* (Canada germander), *Distichlis spicata* (inland saltgrass), *Carex silicea* (beach sedge), and *Juncus* (rush) spp. (*Juncus gerardii* (saltmeadow rush) in the north, *Juncus roemerianus* (needlegrass rush) in the south). Additional species can include *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Hibiscus moscheutos* (crimsoneyed rosemallow), *Amaranthus cannabinus* (tidalmarsh amaranth), and *Typha* (cattail) spp., especially in oligohaline situations. Shrubs may occur sporadically, especially *Baccharis halimifolia* (eastern baccharis), *Morella pensylvanica* (northern bayberry), *Prunus maritima* (beach plum), and *Iva frutescens* (Jesuit's bark). Vegetation can be quite diverse and is a mixture of freshwater and brackish species. This association is best developed in salt marshes with a gradual elevation gradient that lends itself to vegetation zonation. The diagnostic species of this association is *Panicum virgatum* (switchgrass) in brackish settings near upland-marsh borders.
Environmental Description: This association occurs at the upland border of salt marshes on moist, sandy, shallow peat over glacial till. This is the highest elevation within the salt marsh; it is irregularly flooded by tides, high spring tides and storm tides, but is freely drained. It is also subject to salt spray. Soil salinity is low (oligohaline to mesohaline, 0.5–18 ppt). Similar

vegetation can occur on anthropogenic dredge spoils where similar environmental conditions are created. Small patches of this association may also occur around coastal salt ponds.
Vegetation Description: This association is a tall grassland occupying brackish meadows at the upland border of high salt marshes. Vegetation is dominated by *Panicum virgatum* (switchgrass) and occasionally codominated by *Spartina patens* (saltmeadow cordgrass). Common associates include *Schoenoplectus americanus* (chairmaker's bulrush), *Solidago sempervirens* (seaside goldenrod), *Teucrium canadense* (Canada germander), *Distichlis spicata* (inland saltgrass), *Carex silicea* (beach sedge), and *Juncus* (rush) spp. (*Juncus gerardii* (saltmeadow rush) in the north, *Juncus roemerianus* (needlegrass rush) in the south). Shrubs may occur sporadically, especially *Baccharis halimifolia* (eastern baccharis), *Morella pensylvanica* (northern bayberry), *Prunus maritima* (beach plum), and *Iva frutescens* (Jesuit's bark). Vegetation can be quite diverse and is a mixture of freshwater and brackish species. In addition to the common associates, other graminoids can include *Setaria parviflora* (marsh bristlegrass), *Elymus virginicus* (Virginia wildrye), *Panicum amarum* (bitter panicgrass), *Cladium mariscoides* (smooth sawgrass), *Cyperus polystachyos* (manyspike flatsedge), *Cyperus dentatus* (toothed flatsedge), *Schoenoplectus pungens* (common threesquare), and *Fimbristylis castanea* (marsh fimbry), and other forbs can include *Polygala verticillata* (whorled milkwort), *Solidago sempervirens* (seaside goldenrod), *Euthamia caroliniana* (slender goldentop), *Agalinis maritima* (saltmarsh false foxglove), *Artemisia campestris ssp. caudata* (field sagewort), *Sabatia stellaris* (rose of Plymouth), *Sabatia dodecandra* (marsh rose gentian), and Asteraceae spp.
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Panicum virgatum* (switchgrass)
		Spartina patens (saltmeadow cordgrass)

Characteristic Species: *Panicum virgatum* (switchgrass), *Spartina patens* (saltmeadow cordgrass)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

DISTRIBUTION
Range: This association occurs from New Hampshire to Delaware.
States/Provinces: CT, DE:S3?, MA, MD:S4, ME?, NJ:S2S3, NY:S1S2, RI, VA
Federal Lands: NPS (Assateague Island, Cape Cod, Fire Island, Gateway, Muskeget Island?); USFWS (Parker River, Prime Hook)

CONSERVATION STATUS
Rank: GNR (1-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: This association is similar in species composition to the herbaceous component of *Baccharis halimifolia - Iva frutescens / Panicum virgatum* Shrubland (CEGL003921). This association is less developed in the northern edge of its range (New Hampshire).

Similar Associations:

- *(Morella cerifera) - Panicum virgatum - Spartina patens* Herbaceous Vegetation (CEGL004129)
- *Baccharis halimifolia - Iva frutescens / Panicum virgatum* Shrubland (CEGL003921)
- *Iva frutescens / Spartina patens* Shrubland (CEGL006848)
- *Schoenoplectus pungens - Eleocharis parvula* Herbaceous Vegetation (CEGL006398)
- *Spartina patens - Festuca rubra - (Spartina pectinata)* Herbaceous Vegetation (CEGL006368)

Related Concepts:

- *Panicum virgatum* Tidal Herbaceous Vegetation (Harrison 2001) =
- *Panicum virgatum* Wetland Association (Heckscher et al. 1995) B
- *Panicum virgatum* upland border (Nixon 1982) ?
- Brackish Tidal Marsh (Rawinski 1984) ?
- Fresh marsh (Hill 1986) B
- Freshwater marsh (Fender 1937) B
- Mesic shrub community (Higgins et al. 1971) B
- Salt Marsh (Rawinski 1984) ?
- Salt marsh complex, upland border (Breden 1989) ?

SOURCES

Description Authors: S.L. Neid after D. Hunt

References: Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1996, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fender 1937, Harrison 2001, Harrison 2004, Heckscher et al. 1995, Higgins et al. 1971, Hill 1986, Hunt 2000, Johnson 1985b, Lundgren et al. 2000, Metzler and Barrett 2001, NRCS 2001b, Nixon 1982, Rawinski 1984, Sperduto 2000b, Swain and Kearsley 2001



Figure 64. Brackish Meadow in Cape Cod National Seashore (plot CACO.081). Summer 2003. NAD 1983 / UTM easting 420295, northing 4629988.



Figure 65. Brackish Meadow in Cape Cod National Seashore (plot CACO.076). September 2007. NAD 1983 / UTM easting 419804, northing 4630607.

COMMON NAME (PARK-SPECIFIC): REED-GRASS TIDAL MARSH

SYNONYMS
USNVC English Name: **Common Reed Tidal Herbaceous Vegetation**
USNVC Scientific Name: ***Phragmites australis* Tidal Herbaceous Vegetation**
USNVC Identifier: **CEGL004187**

LOCAL INFORMATION

Environmental Description: This tall grassland community is associated with soil disturbance or high levels of nutrient input. It occurs in both freshwater and brackish tidal settings and at the upper edge of saline marshes where freshwater seeps to adjacent uplands. The substrate is generally peat but can also be sand, particularly in settings where *Phragmites* (reed) has expanded.
Vegetation Description: This community can be quite variable. In some cases, *Phragmites australis* (common reed) may be the only plant. In most settings, *Phragmites* (reed) has invaded an already existing community, and some components of that community persist under the shade of *Phragmites* (reed). Most often associated with *Phragmites* (reed) are *Solidago sempervirens* (seaside goldenrod), *Spartina patens* (saltmeadow cordgrass), *Teucrium canadense* (Canada germander), *Calystegia sepium* (hedge false bindweed), and *Rumex crispus* (curly dock). *Typha angustifolia* (narrowleaf cattail) and *Typha latifolia* (broadleaf cattail) may also persist in brackish settings along tidal streams. Some of these species function like spring ephemerals, taking advantage of the early season light that results from the late emergence of *Phragmites* (reed).
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Solidago sempervirens* (seaside goldenrod)
Herb (field)	Graminoid	*Phragmites australis* (common reed)

Characteristic Species: *Phragmites australis* (common reed), *Spartina patens* (saltmeadow cordgrass)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S1*	B	1	Brackish Tidal Marsh	Swain and Kearsley 2001

Local Range: This association occurs at Nauset Marsh, along the Herring River in Wellfleet, at the Massachusetts Audubon Sanctuary, and along the tidal portion of the Pamet River.
Classification Comments: The communities described in the MA vegetation classification and the USNVC are not equivalent in concept. The MA community type, Brackish Tidal Marsh, is broader in concept than the USNVC association Reed-grass Tidal Marsh. Under the MA classification, Brackish Tidal Marsh is ranked as a S1 type and it can include multiple USNVC associations that occur in the same environmental setting. Reed-grass Tidal Marsh, although invasive and not of conservation concern with a Grank of GNA (invasive) invades and persists in what is called Brackish Tidal Marsh in the MA classification; therefore, it is crosswalked to the MA classification unit, but with the broader relationship between the two clearly defined.
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: CACO.118.

AA (2004) Points: CACO.104, CACO.141, CACO.142, CACO.148, CACO.198, CACO.235, CACO.271, CACO.405, CACO.421.
Cape Cod National Seashore Inventory Notes: Mapped in the Phragmites aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Tidal temperate or subpolar grassland (V.A.5.N.n.)
Alliance	*Phragmites australis* Tidal Herbaceous Alliance (A.1477)
Alliance (English name)	Common Reed Tidal Herbaceous Alliance
Association	*Phragmites australis* Tidal Herbaceous Vegetation
Association (English name)	Common Reed Tidal Herbaceous Vegetation
Ecological System(s):	Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260). Central Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270). Atlantic Coastal Plain Embayed Region Tidal Freshwater Marsh (CES203.259). Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519).

GLOBAL DESCRIPTION

Concept Summary: This community is a dense tall grassland indicative of disturbance. It occurs in a range of tidal wetland habitats from fresh to brackish in salinity. It is characterized by dense stands of *Phragmites australis* (common reed), a species which tends to grow in colonies of tall, stout, leafy plants often to the exclusion of all other vascular plant species. Associated species are highly variable, depending on the community that has been invaded. Spreading in large colonies, *Phragmites* (reed) eventually dominates disturbed areas at coverage up to 100%. More typically, though, scattered individuals of other species may occur, such as sparse *Morella cerifera* (wax myrtle) shrubs, *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Calystegia sepium* (hedge false bindweed), *Boehmeria cylindrica* (smallspike false nettle), *Typha angustifolia* (narrowleaf cattail), *Apocynum cannabinum* (Indianhemp), *Rosa palustris* (swamp rose), *Polygonum* (knotweed) sp., and *Mikania scandens* (climbing hempvine). Vines of *Toxicodendron radicans* (eastern poison ivy) are also frequent, but typically occur at low cover. This community has a broad geographic range, including coastal areas of the eastern and southeastern United States and Canada.
Environmental Description: This community is a dense tall grassland indicative of disturbance. It occurs in a range of tidal wetland habitats from fresh to brackish in salinity.
Vegetation Description: This community is a broadly defined reed-grass marsh. It is characterized by dense stands of *Phragmites australis* (common reed), a species which tends to grow in colonies of tall, stout, leafy plants often to the exclusion of all other vascular plant species. Associated species are highly variable, depending on the community that has been invaded. Spreading in large colonies, *Phragmites* (reed) eventually dominates disturbed areas at coverage up to 100%. More typically, though, scattered individuals of other species may occur, such as sparse *Morella cerifera* (wax myrtle) shrubs, *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Calystegia sepium* (hedge false bindweed), *Boehmeria cylindrica* (smallspike false nettle), *Typha angustifolia* (narrowleaf cattail), *Apocynum cannabinum* (Indianhemp), *Rosa palustris* (swamp rose), *Polygonum* (knotweed) sp., and *Mikania scandens* (climbing hempvine).

Vines of *Toxicodendron radicans* (eastern poison ivy) are also frequent but typically occur at low cover.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Phragmites australis* (common reed)

Characteristic Species: *Phragmites australis* (common reed)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

DISTRIBUTION

Range: This community has a broad geographic range, including coastal areas of the eastern and southeastern United States and Canada.
States/Provinces: AL, CT, DC?, DE, FL, GA, LA, LB?, MA, MD, ME, MS, NC, NF?, NH, NJ, NS?, NY, PA, PE?, QC?, RI, SC, TX, VA
Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Cape Hatteras, Colonial, Fire Island, Gateway, George Washington Birthplace, National Capital-East?, Saugus Iron Works); USFWS (Back Bay, Bon Secour, Chesapeake Marshlands)

CONSERVATION STATUS

Rank: GNA (invasive) (22-Nov-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 1 - Strong
Comments: Although *Phragmites australis* (common reed) rhizomes have been noted in salt marsh sediments exceeding three thousand years in age (Niering and Warren 1977) and is thus a native component of salt marshes in some areas in North America, the growth of the species in its native condition was likely to have been significantly different than the dense monotypic stands that characterize this community in parts of its range today. The invasive, nonnative strain has been labeled haplotype M (Saltonstall 2002). The presence of the *Phragmites australis* (common reed) community in wetlands today generally indicates human-induced disturbance, either through direct habitat manipulation or through passive introduction of reproductive material to naturally disturbed substrates. Historically, without alteration, these sites would generally be more saline. In New England, *Phragmites* (reed) tends to invade behind artificial/man-made levees where regular salt input is blocked, making the sites more brackish and less saline than prior to levee construction and anthropogenic modification. In cases where *Phragmites australis* (common reed) is a significant component of the vegetation but the vegetation retains sufficient species composition to retain its identity, the site is considered an unhealthy or degraded example of that original community. Where *Phragmites australis* (common reed) cover is so high that native species have been excluded and the original community is no longer recognizable, the occurrence is then treated as an example of *Phragmites australis* (common reed) Tidal Herbaceous Vegetation (CEGL004187).
Similar Associations:

- *Phragmites australis - (Sagittaria platyphylla, Vigna luteola)* Tidal Herbaceous Vegetation (CEGL007891)
- *Phragmites australis* Eastern North America Temperate Semi-natural Herbaceous Vegetation (CEGL004141)

Related Concepts:

- *Phragmites australis* Association (Fleming 1998) ?
- *Phragmites australis* community (Metzler and Barrett 1992) ?
- *Phragmites australis* tidal marsh association (Clancy 1993b) ?
- Brackish Tidal Marsh (Rawinski 1984) ?
- Salt Marsh Complex (Breden 1989) B

SOURCES

Description Authors: R.E. Zaremba

References: Bell et al. 2002, Bowman 2000, Breden 1989, Clancy 1993b, Edinger et al. 2002, Fleming 1998, Harrison 2001, Metzler and Barrett 1992, Metzler and Barrett 1996, Metzler and Barrett 2001, NRCS 2001b, Nelson 1986, Niering and Warren 1977, Odum et al. 1984, Rawinski 1984, Saltonstall 2002, Schafale and Weakley 1990, Schotz pers. comm., Southeastern Ecology Working Group n.d., Swain and Kearsley 2001



Figure 66. Reed-grass Tidal Marsh in Cape Cod National Seashore (plot CACO.118). September 2004. NAD 1983 / UTM easting 420164, northing 4630360.

COMMON NAME (PARK-SPECIFIC): TRANSITIONAL TIDAL MARSH

SYNONYMS

USNVC English Name: **Chairmaker's Bulrush - Saltmeadow Cordgrass Herbaceous Vegetation**

USNVC Scientific Name: ***Schoenoplectus americanus* - *Spartina patens* Herbaceous Vegetation**

USNVC Identifier: **CEGL006612**

LOCAL INFORMATION

Environmental Description: This association occurs between high marsh and uplands along Blackfish Creek. A somewhat atypical example occurs at the upper edge of the high marsh at Nauset. It is influenced by irregular tidal flooding and may receive some groundwater seepage from adjacent uplands.

Vegetation Description: *Schoenoplectus americanus* (chairmaker's bulrush) is dominant or abundant. Scattered individuals of *Baccharis halimifolia* (eastern baccharis) occur at the upper edge. Other associates include *Thelypteris palustris* (eastern marsh fern), *Typha angustifolia* (narrowleaf cattail), *Spartina patens* (saltmeadow cordgrass), *Pluchea odorata* (sweetscent), and, at one site, *Eleocharis parvula* (dwarf spikerush).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Schoenoplectus americanus* (chairmaker's bulrush)
		Spartina patens (saltmeadow cordgrass)
		Typha angustifolia (narrowleaf cattail)

Characteristic Species: *Schoenoplectus americanus* (chairmaker's bulrush)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNR	NA	NA	[not crosswalked]	Swain and Kearsley 2001

Local Range: This association occurs between high marsh and uplands along Blackfish Creek.

Classification Comments: Information not available.

Other Comments: There is no clear crosswalk in the MA classification to this USNVC association.

Local Description Authors: L.A. Sneddon

Plots: CACO.064 (outside boundary), CACO.082 (mapped as an inclusion within a North Atlantic Low Salt Marsh polygon (CEGL004192).

AA (2004) Points: None.

Cape Cod National Seashore Inventory Notes: Mapped in the Salt Marsh aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	*Schoenoplectus americanus* Tidal Herbaceous Alliance (A.2007)
Alliance (English name)	Chairmaker's Bulrush Tidal Herbaceous Alliance
Association	*Schoenoplectus americanus* - *Spartina patens* Herbaceous Vegetation
Association (English name)	Chairmaker's Bulrush - Saltmeadow Cordgrass Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Brackish Tidal Marsh (CES203.894).

GLOBAL DESCRIPTION

Concept Summary: This brackish marsh occurs in wet depressions at the upper reaches of irregularly flooded tidal marshes of the mid-Atlantic coast. It occurs at the ecotone between low and high salt marsh zones. It is irregularly flooded, occurring just above the zone of regular tidal flooding, but is more frequently flooded than *Spartina patens* (saltmeadow cordgrass)-dominated high marsh. This community is dominated by colonies of *Schoenoplectus americanus* (chairmaker's bulrush), which often accounts for 40–75% of the total vegetation cover or codominant with *Spartina patens* (saltmeadow cordgrass) at some sites. Associated species can include *Pluchea odorata* (sweetscent), *Juncus roemerianus* (needlegrass rush), *Spartina alterniflora* (smooth cordgrass), *Spartina cynosuroides* (big cordgrass), *Distichlis spicata* (inland saltgrass), and *Limonium carolinianum* (Carolina sealavender) plus *Typha* (cattail) spp. and *Phragmites australis* (common reed). This community often grades into *Spartina patens* (saltmeadow cordgrass)- or *Juncus roemerianus* (needlegrass rush)-dominated high marsh landward or *Spartina alterniflora* (smooth cordgrass)- or *Spartina cynosuroides* (big cordgrass)-dominated low marsh seaward. This association is best developed where the elevation gradient across the marsh is more gradual, allowing for greater diversity of physical conditions of duration and frequency of flooding.

Environmental Description: This association occurs in wet depressions of high salt marshes and in the ecotone between low and high salt marsh zones. It is irregularly flooded, occurring just above the zone of regular tidal flooding, but is more frequently flooded than *Spartina patens* (saltmeadow cordgrass)-dominated high marsh. This association is best developed where the elevation gradient across the marsh is more gradual, allowing for greater diversity of physical conditions of duration and frequency of flooding.

Vegetation Description: This community is dominated by colonies of *Schoenoplectus americanus* (chairmaker's bulrush), which often accounts for 40–75% of the total vegetation cover or codominant with *Spartina patens* (saltmeadow cordgrass) at some sites. Associated species can include *Pluchea odorata* (sweetscent), *Juncus roemerianus* (needlegrass rush), *Hibiscus moscheutos* (crimsoneyed rosemallow), *Spartina alterniflora* (smooth cordgrass), *Spartina cynosuroides* (big cordgrass), *Distichlis spicata* (inland saltgrass), *Limonium carolinianum* (Carolina sealavender), and *Typha* (cattail) spp. *Phragmites australis* (common reed) also occurs in this vegetation. This community often grades into vegetation dominated by *Spartina patens* (saltmeadow cordgrass) or *Juncus roemerianus* (needlegrass rush) in high marsh landward and by vegetation dominated by *Spartina alterniflora* (smooth cordgrass) or *Spartina cynosuroides* (big cordgrass) in low marsh seaward. This vegetation does not typically occur along the edge of tidal channels.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Schoenoplectus americanus* (chairmaker's bulrush)

Characteristic Species: *Schoenoplectus americanus* (chairmaker's bulrush), *Spartina patens* (saltmeadow cordgrass)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

DISTRIBUTION

Range: This association is currently described from mid-Atlantic states of Delaware, Maryland and Virginia. It possibly extends south to Georgia.
States/Provinces: DE, GA?, MA, MD:S4, NC?, NJ, SC?, VA
Federal Lands: NPS (Cape Cod, Colonial); USFWS (Back Bay, Chesapeake Marshlands)

CONSERVATION STATUS

Rank: GNR (17-Apr-2000)
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 2 - Moderate
Comments: The halinity range of this vegetation is uncertain, but the relatively higher species diversity suggests lower halinity than that characteristic of *Spartina patens - Distichlis spicata - (Juncus gerardii)* Herbaceous Vegetation (CEGL006006). It is unclear whether stands attributed to this type at North Landing River and Back Bay National Wildlife Refuge represent the same vegetation. The prevailing tidal influence in these areas is generally wind-generated rather than strictly lunar (Coulling 2002).
Similar Associations:

- *Schoenoplectus americanus - (Spartina patens) - Typha* spp. Herbaceous Vegetation (CEGL008476)
- *Schoenoplectus pungens* Tidal Herbaceous Vegetation (CEGL004188)

Related Concepts:

- *Schoenoplectus americanus - Spartina patens* Tidal Herbaceous Vegetation (Bartgis 1986) =
- *Spartina patens - Schoenoplectus americanus* Tidal Herbaceous Vegetation (VDNH 2003) =

SOURCES

Description Authors: S.L. Neid, mod. L.A. Sneddon
References: Bartgis 1986, Bowman 2000, Coulling 2002, Eastern Ecology Working Group n.d., Fleming 2001a, Fleming et al. 2001, Harrison 2001, Harrison 2004, VDNH 2003



Figure 67. Transitional Tidal Marsh in Cape Cod National Seashore (plot CACO.082). Summer 2003. NAD 1983 / UTM easting 418188, northing 4640708.



Figure 68. Transitional Tidal Marsh in Cape Cod National Seashore (plot CACO.064 herbaceous foreground). Summer 2003. NAD 1983 / UTM easting 418188, northing 4640708.

COMMON NAME (PARK-SPECIFIC): COASTAL SALT POND MARSH

SYNONYMS

USNVC English Name: **Common Threesquare - Dwarf Spikerush Herbaceous Vegetation**

USNVC Scientific Name: ***Schoenoplectus pungens* - *Eleocharis parvula* Herbaceous Vegetation**

USNVC Identifier: **CEGL006398**

LOCAL INFORMATION

Environmental Description: This vegetation type is associated with coastal salt ponds that are irregularly flooded by tides and have broadly fluctuating soil salinity. Substrate can vary from sand to deep organics over sand. Water levels can also vary considerably over time. During very dry periods, organic soils can harden and crack. During wet periods, standing water can vary in depth up to 50 cm. Groundwater may also play a role in changes in salinity and nutrient flow. These communities are highly ephemeral and can move around year to year based on water depth and soil salinity. In some areas, *Phragmites* (reed) displaces this community entirely.

Vegetation Description: This vegetation type is highly variable both in terms of location and composition. The dominant plants are usually graminoids, including *Spartina patens* (saltmeadow cordgrass), *Schoenoplectus maritimus* (cosmopolitan bulrush), *Schoenoplectus pungens* (common threesquare), *Eleocharis parvula* (dwarf spikerush), *Juncus bufonius* (toad rush), and *Spartina alterniflora* (smooth cordgrass). *Pluchea odorata* (sweetscent) is nearly always present. Other common associates include *Symphyotrichum subulatum* (eastern annual saltmarsh aster), *Suaeda maritima* (herbaceous seepweed), *Atriplex patula* (spear saltbush), *Polygonum hydropiperoides* (swamp smartweed), *Ptilimnium capillaceum* (herbwilliam), and *Erechtites hieraciifolia* (American burnweed). Salt marsh and salt shrub species may be present but in low concentrations, including *Limonium carolinianum* (Carolina sealavender), *Distichlis spicata* (inland saltgrass), *Salicornia maritima* (slender grasswort), *Baccharis halimifolia* (eastern baccharis), *Iva frutescens* (Jesuit's bark), *Solidago sempervirens* (seaside goldenrod), and *Sonchus arvensis* (field sowthistle).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Eleocharis parvula* (dwarf spikerush)
		Schoenoplectus maritimus (cosmopolitan bulrush)
		Schoenoplectus pungens (common threesquare)
		Spartina patens (saltmeadow cordgrass)

Characteristic Species: *Pluchea odorata* (sweetscent), *Schoenoplectus maritimus* (cosmopolitan bulrush)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S2*	I	1	Coastal Salt Pond	Swain and Kearsley 2001
MA	S2*	I	1	Coastal Salt Pond Marsh	Swain and Kearsley 2001

Local Range: This association is currently known only from the area north of the Nauset Beach parking lot and from an embayment on Hatches Creek at the Massachusetts Audubon Sanctuary.

Classification Comments: This vegetation type is highly variable and not stable at a location over time. The general assemblage of species does recur at sites over many years and may rely on soil seed banks to persist for many years.
Other Comments: The concept of this USNVC association intersects with the concepts of two communities described in Swain and Kearsley 2001.
Local Description Authors: R.E. Zaremba
Plots: CACO.023, CACO.024, CACO.088, CACO.102.
AA (2004) Points: None.
Cape Cod National Seashore Inventory Notes: Mapped in the Salt Marsh aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	*Schoenoplectus pungens* Tidal Herbaceous Alliance (A.1478)
Alliance (English name)	Common Threesquare Tidal Herbaceous Alliance
Association	*Schoenoplectus pungens - Eleocharis parvula* Herbaceous Vegetation
Association (English name)	Common Threesquare - Dwarf Spikerush Herbaceous Vegetation
Ecological System(s):	Atlantic Coastal Plain Northern Salt Pond Marsh (CES203.892).

GLOBAL DESCRIPTION

Concept Summary: This association encompasses the brackish marshes of coastal salt ponds of the northeastern Atlantic coast. Coastal salt ponds are ponds separated from the ocean by a barrier beach. They generally form when a lagoon or bay is closed off from regular tidal flooding by a sand spit or other barrier. Salinity depends on the length of time since enclosure of the lake/pond; freshwater input from precipitation and overland flow dilutes the enclosed seawater resulting in meso- to oligohaline conditions. Depending on the distance from the ocean, saltwater input is infrequent and a result of tidal breaches or storm overwash, although there can be some saltwater seepage across the barrier beach. Shorelines usually have gentle slopes that magnify gradients of salinity and saturation. Depending on local water balance, ponds can draw down to a certain degree exposing mud or sand flats. Substrate ranges from sand to mud to peat. Vegetation of coastal salt ponds is highly variable both spatially and temporally given the variable nature of the habitat and processes affecting it. Although not constant, vegetation zonation often occurs along shores of coastal salt ponds along gradients of salinity and flooding or saturation. Dominant species can be variable depending on local conditions but are generally characterized by *Schoenoplectus pungens* (common threesquare), *Eleocharis parvula* (dwarf spikerush), and/or *Spartina patens* (saltmeadow cordgrass), *Spartina pectinata* (prairie cordgrass), or *Panicum virgatum* (switchgrass). Where salinity is less *Typha angustifolia* (narrowleaf cattail) can be common. Mud flat habitat can develop in lower areas that tend to be exposed later in the season with *Eleocharis parvula* (dwarf spikerush), *Eleocharis halophila* (saltmarsh spikerush), *Eleocharis flavescens* (yellow spikerush), *Schoenoplectus maritimus* (cosmopolitan bulrush), *Crassula aquatica* (water pygmyweed), *Spergularia salina* (salt sandspurry), *Cyperus filicinus* (fern flatsedge), or others. In higher zones, vegetation can be similar to high salt marsh habitat; *Panicum virgatum* (switchgrass), *Spartina patens* (saltmeadow cordgrass), or *Spartina pectinata*

(prairie cordgrass) can be characteristic, plus *Schoenoplectus smithii* (Smith's bulrush), *Echinochloa walteri* (coast cockspur grass), *Cladium mariscoides* (smooth sawgrass), *Distichlis spicata* (inland saltgrass), or *Chenopodium* (goosefoot) spp. Species found farther south include *Ptilimnium capillaceum* (herbwilliam), *Pluchea odorata* (sweetscent), *Schoenoplectus americanus* (chairmaker's bulrush), *Hibiscus moscheutos* (crimsoneyed rosemallow), plus scattered individuals of *Iva frutescens* (Jesuit's bark) or *Baccharis halimifolia* (eastern baccharis). Ponds often support aquatic plants that are tolerant of brackish/saline conditions, such as *Ruppia maritima* (widgeongrass), *Stuckenia pectinata* (sago pondweed), *Potamogeton perfoliatus* (claspingleaf pondweed), or *Zannichellia palustris* (horned pondweed), plus some marine algal species. Several associations may be warranted in these highly variable systems; collection of further data will likely support the division of more associations.

Environmental Description: Coastal salt ponds are ponds separated from the ocean by a barrier beach. They generally form when a lagoon or bay is closed off from regular tidal flooding by a sand spit or other barrier. However, some ponds have a permanent, often artificially maintained, inlet/outlet and thus have regular saltwater exchange. Salinity depends on the length of time since enclosure of the lake/pond; freshwater input from precipitation and overland flow dilutes the enclosed seawater resulting in meso- to oligohaline conditions. Depending on the distance from the ocean, saltwater input is infrequent and a result of tidal breaches or storm overwash, although there can be some saltwater seepage across the barrier beach. Shorelines usually have gentle slopes that magnify gradients of salinity and saturation. Depending on local water balance, ponds can draw down to a certain degree exposing mud or sand flats. Substrate ranges from sand to mud to peat. These ponds occur in glaciated areas in moraine or outwash deposits.

Vegetation Description: Vegetation of coastal salt ponds is highly variable both spatially and temporally given the variable nature of the habitat and processes affecting it. Although not constant, vegetation zonation often occurs along shores of coastal salt ponds along gradients of salinity and flooding or saturation. Dominant species can be variable depending on local conditions but are generally characterized by *Schoenoplectus pungens* (common threesquare), *Eleocharis parvula* (dwarf spikerush), and/or *Spartina patens* (saltmeadow cordgrass), *Spartina pectinata* (prairie cordgrass), or *Panicum virgatum* (switchgrass). Where salinity is less *Typha angustifolia* (narrowleaf cattail) can be common. Mud flat habitat can develop in lower areas that tend to be exposed later in the season with *Eleocharis parvula* (dwarf spikerush), *Eleocharis halophila* (saltmarsh spikerush), *Eleocharis flavescens* (yellow spikerush), *Schoenoplectus maritimus* (cosmopolitan bulrush), *Crassula aquatica* (water pygmyweed), *Spergularia salina* (salt sandspurry), or others. In higher zones, vegetation can be similar to high salt marsh habitat; *Panicum virgatum* (switchgrass), *Spartina patens* (saltmeadow cordgrass), or *Spartina pectinata* (prairie cordgrass) can be characteristic, plus *Schoenoplectus smithii* (Smith's bulrush), *Echinochloa walteri* (coast cockspur grass), *Cladium mariscoides* (smooth sawgrass), *Distichlis spicata* (inland saltgrass), and *Chenopodium* (goosefoot) spp. Species found farther south include *Ptilimnium capillaceum* (herbwilliam), *Pluchea odorata* (sweetscent), *Schoenoplectus americanus* (chairmaker's bulrush), *Hibiscus moscheutos* (crimsoneyed rosemallow), plus scattered individuals of *Iva frutescens* (Jesuit's bark) or *Baccharis halimifolia* (eastern baccharis). Ponds often support aquatic plants that are tolerant of brackish/saline conditions, such as *Ruppia maritima* (widgeongrass), *Stuckenia pectinata* (sago pondweed), *Potamogeton perfoliatus* (claspingleaf pondweed), or *Zannichellia palustris* (horned pondweed), plus some marine algal species.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Eleocharis parvula* (dwarf spikerush)
		Schoenoplectus pungens (common threesquare)
		Spartina patens (saltmeadow cordgrass)

Characteristic Species: *Eleocharis parvula* (dwarf spikerush), *Schoenoplectus pungens* (common threesquare)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

DISTRIBUTION
Range: Coastal salt ponds occur in a limited geomorphological setting in New Hampshire, Massachusetts, Rhode Island, and Long Island, New York.
States/Provinces: MA, ME, NH:S1, NY:S1S2, RI
Federal Lands: NPS (Boston Harbor Islands, Cape Cod, Gateway)

CONSERVATION STATUS
Rank: GNR (1-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: This association encompasses a highly variable and shifting vegetation mosaic in a variable and dynamic habitat. Several associations may be warranted; collection of further data will likely support the division of this type into more associations.
Similar Associations:
- *Panicum virgatum - Spartina patens* Herbaceous Vegetation (CEGL006150)
- *Ruppia maritima* Acadian/Virginian Zone Temperate Herbaceous Vegetation (CEGL006167)
- *Schoenoplectus pungens* Tidal Herbaceous Vegetation (CEGL004188)
- *Spartina patens - Eleocharis parvula* Herbaceous Vegetation (CEGL006342)

Related Concepts:
- Coastal Salt Pond (Rawinski 1984) ?
- Coastal Salt Pond Marsh (Rawinski 1984) ?

SOURCES
Description Authors: S.L. Neid
References: Eastern Ecology Working Group n.d., Edinger et al. 2002, Elliman 2003, Gawler 2002, Island Alliance 2001, Karanaukas 2001, Lundgren 1998, Lundgren 2000, NRCS 2001b, Rawinski 1984, Reschke 1990, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2000, Swain and Kearsley 2001, Thorne-Miller et al. 1983, Zaremba 1999



Figure 69. Coastal Salt Pond Marsh at Fort Hill in Cape Cod National Seashore (no specific plot). September 2004. UTM coordinates not available.

COMMON NAME (PARK-SPECIFIC): ALKALI BULRUSH BRACKISH MARSH

SYNONYMS
USNVC English Name: **Alkali Bulrush - Saltmarsh Cordgrass Herbaceous Vegetation**
USNVC Scientific Name: ***Schoenoplectus robustus* - *Spartina alterniflora* Herbaceous Vegetation**
USNVC Identifier: **CEGL006416**

LOCAL INFORMATION

Environmental Description: This vegetation occurs along the Pamet River and at the upper edge of a salt marsh where groundwater may emerge.
Vegetation Description: *Schoenoplectus robustus* (sturdy bulrush) and *Spartina alterniflora* (smooth cordgrass) are constant species. The vegetation is depauperate, with only *Spartina patens* (saltmeadow cordgrass), *Typha angustifolia* (narrowleaf cattail), and *Distichlis spicata* (inland saltgrass) occurring as associates.
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Schoenoplectus robustus* (sturdy bulrush)

Characteristic Species: *Schoenoplectus robustus* (sturdy bulrush)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNR	NA	NA	[not crosswalked]	Swain and Kearsley 2001

Local Range: This vegetation occurs along the Pamet River.
Classification Comments: There is no clear crosswalk in the MA classification to this USNVC association.
Other Comments: Information not available.
Local Description Authors: L.A. Sneddon
Plots: CACO.070 (Wellfleet Mass Audubon property), CACO.079 (interdigitated with a Phragmites (CEGL004187) polygon, CACO.120 (outside CACO boundary).
AA (2004) Points: None.
Cape Cod National Seashore Inventory Notes: Photograph not available. Small patch community treated as inclusion in Salt Marsh when mapped.

GLOBAL INFORMATION

USNVC 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	*Schoenoplectus robustus* - *Spartina alterniflora* Herbaceous Vegetation
Association (English name)	Alkali Bulrush - Saltmarsh Cordgrass Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Brackish Tidal Marsh (CES203.894).

GLOBAL DESCRIPTION

Concept Summary: This brackish marsh occurs as small patches on low sites in the interior of marshes on tidal rivers of Virginia and possibly elsewhere. Dominant species are *Schoenoplectus robustus* (sturdy bulrush) and *Spartina alterniflora*. *Spartina cynosuroides* (big cordgrass) is a nearly constant associate and frequently attains high cover. Other associates may include *Borrichia frutescens* (bushy seaside tansy), *Symphyotrichum tenuifolium* (perennial saltmarsh aster), *Distichlis spicata* (inland saltgrass), *Symphyotrichum novi-belgii var. novi-belgii* (New York aster), *Typha angustifolia* (narrowleaf cattail), *Rumex verticillatus* (swamp dock), *Pontederia cordata* (pickerelweed), *Echinochloa walteri* (coast cockspur grass), *Peltandra virginica* (green arrow arum), *Amaranthus cannabinus* (tidalmarsh amaranth), *Polygonum punctatum* (dotted smartweed), and *Leersia oryzoides* (rice cutgrass). In general, this association is depauperate with few other associated species.

Environmental Description: This marsh occurs along brackish sections of tidal rivers in Virginia.

Vegetation Description: This brackish marsh is dominated by *Schoenoplectus robustus* (sturdy bulrush) and *Spartina alterniflora* (smooth cordgrass). Other associates may include *Spartina cynosuroides* (big cordgrass), *Borrichia frutescens* (bushy seaside tansy), *Symphyotrichum tenuifolium* (perennial saltmarsh aster), *Symphyotrichum novi-belgii* (New York aster), *Typha angustifolia* (narrowleaf cattail), *Rumex verticillatus* (swamp dock), *Pontederia cordata* (pickerelweed), *Echinochloa walteri* (coast cockspur grass), *Peltandra virginica* (green arrow arum), *Amaranthus cannabinus* (tidalmarsh amaranth), *Polygonum punctatum* (dotted smartweed), and *Leersia oryzoides* (rice cutgrass). In general, this association is depauperate with few other associated species.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Distichlis spicata* (inland saltgrass)
		Schoenoplectus robustus (sturdy bulrush)
		Spartina alterniflora (smooth cordgrass)
		Spartina cynosuroides (big cordgrass)

Characteristic Species: *Schoenoplectus robustus* (sturdy bulrush)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Estuarine

DISTRIBUTION

Range: This association is currently described only from Virginia (Mattaponi, Pamunkey, and York rivers) and Massachusetts (Pamet River); it is also reported from New Jersey and Delaware and may occur in Maryland.

States/Provinces: DE, MA, MD?, NJ, VA:S2S4

Federal Lands: NPS (Cape Cod); USFWS (Prime Hook)

CONSERVATION STATUS

Rank: GNR (15-Nov-2000)

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: This association differs from *Spartina alterniflora - Lilaeopsis chinensis* Herbaceous Vegetation (CEGL004193) and *Spartina alterniflora - Amaranthus cannabinus*

Herbaceous Vegetation (CEGL006417) in that it is distinctly brackish with *Schoenoplectus robustus* (sturdy bulrush) as the primary dominant species. *Spartina alterniflora - Lilaeopsis chinensis* Herbaceous Vegetation (CEGL004193) tends to occur on larger tidal rivers (i.e., Connecticut River, Delaware River). *Spartina alterniflora - Amaranthus cannabinus* Herbaceous Vegetation (CEGL006417) occurs in oligohaline habitat.

Similar Associations:

- *Spartina alterniflora - Lilaeopsis chinensis* Herbaceous Vegetation (CEGL004193)

Related Concepts:

- *Schoenoplectus robustus - Spartina alterniflora* Tidal Herbaceous Vegetation (VDNH 2003) =

SOURCES

Description Authors: Chesapeake Bay Ecology Group, mod. S.L. Neid and L.A. Sneddon

References: Coulling pers. comm., Eastern Ecology Working Group n.d., Fleming 2001a, Fleming et al. 2001, VDNH 2003



Figure 70. Alkali Bulrush Brackish Marsh near Cape Cod National Seashore (plot CACO.120). Summer 2004. NAD 1983 / UTM easting 412908, northing 4649620.

COMMON NAME (PARK-SPECIFIC): BRACKISH TIDAL LOW MARSH

SYNONYMS

USNVC English Name: **Saltmarsh Cordgrass - Marsh Grasswort Herbaceous Vegetation**

USNVC Scientific Name: ***Spartina alterniflora* - *Lilaeopsis chinensis* Herbaceous Vegetation**

USNVC Identifier: **CEGL004193**

LOCAL INFORMATION

Environmental Description: This low marsh community occurs along the banks of the upper end of a tidal river where there is a constant flow of freshwater. The substrate is fine, loose organics. This portion of the riverbank is scoured by ice in the winter and can be the site of large organic deposits of drift material that move around at the upper edges of the marsh.

Vegetation Description: This association is dominated by *Spartina alterniflora* (smooth cordgrass) or *Schoenoplectus robustus* (sturdy bulrush) with *Lilaeopsis chinensis* (eastern grasswort) covering much of the surface. In some small areas, particularly along the main channel of a creek, *Lilaeopsis chinensis* (eastern grasswort) is the only plant. Other common associates include *Pluchea odorata* (sweetscent), *Eleocharis parvula* (dwarf spikerush), *Distichlis spicata* (inland saltgrass), and *Atriplex patula* (spear saltbush). Some areas have been invaded by *Phragmites australis* (common reed).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Lilaeopsis chinensis* (eastern grasswort)
Herb (field)	Graminoid	*Spartina alterniflora* (smooth cordgrass)

Characteristic Species: *Lilaeopsis chinensis* (eastern grasswort)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S1*	B	1	Brackish Tidal Marsh	Swain and Kearsley 2001

Local Range: This association is known only from the tidal section of the Pamet River in Truro.

Classification Comments: This community has been seen only along the Pamet River. It may have been more common on Cape Cod before most tidal rivers were impounded.

Other Comments: The communities described in the MA vegetation classification and the USNVC are not equivalent in concept. The MA community type, Brackish Tidal Marsh, is broader in concept than the USNVC association Brackish Tidal Low Marsh. Under the MA classification, Brackish Tidal Marsh is ranked as a S1 type and it can include multiple USNVC associations that occur in the same environmental setting. Brackish Tidal Low Marsh, although has a Grank and is considered a compenent association of the broader conceptual unit called Brackish Tidal Marsh in the MA classification; therefore, Brackish Tidal Low Marsh is crosswalked to the MA classification unit.

Local Description Authors: R.E. Zaremba

Plots: CACO.119 (outside boundary).

AA (2004) Points: None.

Cape Cod National Seashore Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC 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 - Lilaeopsis chinensis* Herbaceous Vegetation
Association (English name)	Saltmarsh Cordgrass - Marsh Grasswort Herbaceous Vegetation
Ecological System(s):	Atlantic Coastal Plain Embayed Region Tidal Freshwater Marsh (CES203.259). Northern Atlantic Coastal Plain Brackish Tidal Marsh (CES203.894).

GLOBAL DESCRIPTION

Concept Summary: This association is a brackish, mid-tidal low marsh of larger tidal rivers along the mid- and north Atlantic coast. *Spartina alterniflora* (smooth cordgrass) is dominant, but occurs with various mixtures of species such as *Schoenoplectus robustus* (sturdy bulrush), *Schoenoplectus pungens* (common threesquare), and *Spartina cynosuroides* (big cordgrass), which may be locally prominent, especially as salinity decreases. Characteristic species in addition to *Spartina alterniflora* (smooth cordgrass) include *Lilaeopsis chinensis* (eastern grasswort), *Schoenoplectus robustus* (sturdy bulrush), *Polygonum punctatum* (dotted smartweed), and *Eleocharis parvula* (dwarf spikerush). Associated species that occur in low abundance can include *Amaranthus cannabinus* (tidalmarsh amaranth), *Atriplex prostrata* (triangle orache), *Typha angustifolia* (narrowleaf cattail), *Schoenoplectus maritimus* (cosmopolitan bulrush), *Eleocharis halophila* (saltmarsh spikerush), *Samolus valerandi ssp. parviflorus* (seaside brookweed), *Sagittaria calycina* (hooded arrowhead), and *Crassula aquatica* (water pygmyweed). Freshwater species increase as salinity decreases, such as *Peltandra virginica* (green arrow arum), *Schoenoplectus fluviatilis* (river bulrush), *Sagittaria latifolia* (broadleaf arrowhead), *Leersia oryzoides* (rice cutgrass), and *Pontederia cordata* (pickerelweed). Substrate is mud or muddy, fibrous peat.

Environmental Description: This low brackish marsh occurs in the lower reaches of tidal rivers adjacent to the river channel subject to river flooding and annual ice-scour. It receives constant freshwater input from the upstream watershed. This association is regularly flooded by diurnal tides. Substrate is coarse, fibrous peat or mud.

Vegetation Description: This association is dominated *Spartina alterniflora* (smooth cordgrass). *Schoenoplectus robustus* (sturdy bulrush), *Schoenoplectus pungens* (common threesquare), and *Spartina cynosuroides* (big cordgrass) may be locally prominent, especially as salinity decreases. Characteristic species in addition to *Spartina alterniflora* (smooth cordgrass) include *Schoenoplectus robustus* (sturdy bulrush), *Lilaeopsis chinensis* (eastern grasswort), and *Eleocharis parvula* (dwarf spikerush). Associated species that occur in low abundance can include *Amaranthus cannabinus* (tidalmarsh amaranth), *Atriplex prostrata* (triangle orache), *Typha angustifolia* (narrowleaf cattail), *Schoenoplectus maritimus* (cosmopolitan bulrush), *Eleocharis halophila* (saltmarsh spikerush), *Samolus valerandi ssp. parviflorus* (seaside brookweed), *Sagittaria calycina* (hooded arrowhead), and *Crassula aquatica* (water pygmyweed). Freshwater species increase as salinity decreases, such as *Peltandra virginica* (green arrow arum), *Schoenoplectus fluviatilis* (river bulrush), *Sagittaria latifolia* (broadleaf arrowhead), *Leersia oryzoides* (rice cutgrass), and *Pontederia cordata* (pickerelweed).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Schoenoplectus pungens* (common threesquare)
		Schoenoplectus robustus (sturdy bulrush)
		Spartina alterniflora (smooth cordgrass)

Characteristic Species: *Eleocharis parvula* (dwarf spikerush), *Lilaeopsis chinensis* (eastern grasswort), *Schoenoplectus robustus* (sturdy bulrush), *Spartina alterniflora* (smooth cordgrass)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

DISTRIBUTION

Range: This association occurs along the north and mid-Atlantic coast from New Hampshire to South Carolina.
States/Provinces: CT, DE, MA, NC, NH, NJ:S3, RI, SC
Federal Lands: NPS (Cape Cod)

CONSERVATION STATUS

Rank: G3G4 (19-Jan-2006)
Reasons: This vegetation occurs in small patches and is restricted to the tidal portions of large navigable rivers in the northeastern states. It is threatened by pollution, particularly oil spills.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 2 - Moderate
Comments: Floristically, this community differs from the other communities of this alliance in that it is brackish rather than saline, indicated by the presence of brackish indicators such as *Lilaeopsis chinensis* (eastern grasswort), *Eleocharis parvula* (dwarf spikerush), and *Limosella australis* (Welsh mudwort). It occurs on large tidal rivers (i.e., Connecticut River, Delaware River).
Similar Associations:

- *Schoenoplectus robustus - Spartina alterniflora* Herbaceous Vegetation (CEGL006416)
- *Spartina alterniflora - Polygonum punctatum - Amaranthus cannabinus* Herbaceous Vegetation (CEGL006418)
- *Spartina alterniflora / (Ascophyllum nodosum)* Acadian/Virginian Zone Herbaceous Vegetation (CEGL004192)

Related Concepts:

- *Spartina alterniflora* cover type (Ferren et al. 1981) ?
- *Spartina alterniflora* cover type (Caldwell 1990) ?
- Brackish Marsh (Smooth Cordgrass Subtype) (Schafale 2000) ?
- Brackish Tidal Marsh (Rawinski 1984) ?
- Brackish tidal marsh complex (Breden 1989) ?

SOURCES

Description Authors: S.L. Neid and L.A. Sneddon
References: Bowman 2000, Breden 1989, Breden et al. 2001, Caldwell 1990, Eastern Ecology Working Group n.d., Enser 1999, Ferren et al. 1981, Lundgren 1998, Metzler and Barrett 2001, Nelson 1986, Rawinski 1984, Reschke 1990, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2001



Figure 71. Brackish Tidal Low Marsh near Cape Cod National Seashore (plot CACO.119). Summer 2003. NAD 1983 / UTM easting 412968, northing 4649628.

COMMON NAME (PARK-SPECIFIC): NORTH ATLANTIC LOW SALT MARSH

SYNONYMS

USNVC English Name: **Saltmarsh Cordgrass / (Yellow Tang) Acadian/Virginian Zone Herbaceous Vegetation**

USNVC Scientific Name: ***Spartina alterniflora* / (*Ascophyllum nodosum*) *Acadian*/*Virginian* Zone Herbaceous Vegetation**

USNVC Identifier: **CEGL004192**

LOCAL INFORMATION

Environmental Description: This low marsh community occurs in portions of the intertidal zone that are both flooded and exposed during each tidal cycle. The substrate is initially sand in newly developing examples and peat in older examples. Peat deposits may be up to a meter in depth. Because the sites are flooded twice a day with full strength saltwater, soil salinity is between 18 and 30 ppt. Highest productivity examples occur along creeks that are flooded for the longest periods of time. Lower productivity examples are found in sites that flood twice a day, but drainage is impeded by topography. These sites may be sparsely vegetated and support very stunted plants.

Vegetation Description: This community is characterized as being dominated by *Spartina alterniflora* (smooth cordgrass), which in many cases forms a monoculture. Highest productivity examples of this community occur along the outer edges of the community bordering creeks and open water. These areas are flooded for long periods of time relative to other parts of the community and are often on sandy substrate. In these areas, *Spartina alterniflora* (smooth cordgrass) often occurs as a monoculture of very tall plants up to 2.5 m or with *Ascophyllum nodosum* (yellow tang). At the other extreme expression of this association, areas that are flooded during each tidal cycle but for much shorter periods of time have much lower productivity but higher species diversity. *Spartina alterniflora* (smooth cordgrass) is dominant in these areas as well, but grows as a much shorter plant. In extreme conditions where water is impounded and drains poorly, plants may be only 10–15 cm tall and co-occur with *Spergularia salina* (salt sandspurry), *Suaeda maritima* (herbaceous seepweed), *Salicornia bigelovii* (dwarf saltwort), *Salicornia maritima* (slender grasswort) and/or *Salicornia virginica* (Virginia glasswort), and *Puccinellia maritima* (seaside alkaligrass).

Most Abundant Species:

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

Characteristic Species: *Spartina alterniflora* (smooth cordgrass)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S3*	B	1	Salt Marsh	Swain and Kearsley 2001

Local Range: This association occurs at scattered intertidal sites throughout the seashore. Extensive examples of this community occur in Pleasant Bay, Nauset Marsh, Hatches Harbor, Long Point, Wellfleet Harbor, and around the Massachusetts Audubon Sanctuary at Wellfleet Bay where the some of the highest productivity marshes occur on Cape Cod.

Classification Comments: The Salt Marsh community described in Swain and Kearsley 2001 is broader in concept than the USNVC association North Atlantic Low Salt Marsh.

Other Comments: Information not available.

Local Description Authors: R.E. Zaremba
Plots: CACO.084, CACO.091, CACO.105.
AA (2004) Points: CACO.1010, CACO.1011, CACO.121, CACO.154, CACO.155, CACO.186, CACO.197, CACO.211, CACO.219, CACO.224, CACO.236, CACO.250, CACO.257, CACO.276, CACO.301, CACO.308, CACO.326, CACO.342, CACO.364, CACO.404, CACO.407, CACO.441, CACO.457, CACO.468, CACO.481, CACO.490, CACO.505, CACO.507, CACO.517, CACO.527, CACO.537, CACO.546, CACO.570, CACO.584
Cape Cod National Seashore Inventory Notes: Mapped in the Salt Marsh aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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 / (Ascophyllum nodosum)* Acadian/Virginian Zone Herbaceous Vegetation
Association (English name)	Saltmarsh Cordgrass / (Yellow Tang) Acadian/Virginian Zone Herbaceous Vegetation
Ecological System(s):	Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260). Acadian Coastal Salt Marsh (CES201.578). Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519).

GLOBAL DESCRIPTION

Concept Summary: This tall grassland dominated by *Spartina alterniflora* (smooth cordgrass) forms the low salt marsh of the north and mid-Atlantic coast. It is diurnally flooded by tides, occurring in the intertidal zone between mean high tide and mean sea level in protected inlets behind barrier beaches or in the seaward reaches of drowned river valleys. It forms a coarse peat over sandy substrate. The low salt marsh occurs elevationally between high marsh that occurs landward and subtidal communities that occur seaward. *Spartina alterniflora* (smooth cordgrass) is limited to the low marsh zone by interspecific competition and by moderate salinity; it can withstand longer submergence than other salt marsh grasses but still requires periodic exposure of the substrate. *Spartina alterniflora* (smooth cordgrass) forms nearly monotypic stands with little variation across the geographic range of the community. Tall form *Spartina alterniflora* (smooth cordgrass) occurs adjacent to salt water and colonizes unvegetated flats. This association also grades into short form *Spartina alterniflora* (smooth cordgrass) landward. Associated species occur in low abundance and commonly include *Limonium carolinianum* (Carolina sealavender), *Salicornia virginica* (Virginia glasswort), *Salicornia bigelovii* (dwarf saltwort), *Spergularia maritima* (media sandspurry), *Spergularia canadensis* (Canadian sandspurry), and *Suaeda maritima* (herbaceous seepweed). Macroalgae can form extensive mats at the bases of the grass culms, especially *Ascophyllum nodosum*, *Fucus vesiculosus*, *Enteromorpha* spp., and *Ulva* (sea-lettuce) spp. Macroalgae associates may be sparse or absent at the southern edge of the range. This community occurs from Nova Scotia to Cape Hatteras, North Carolina. Low marshes at the northern edge of the geographic range are far less extensive

in size than those farther south due to differences in geomorphology and time since last glaciation.

Environmental Description: This low salt marsh community occurs in the regularly flooded intertidal zone, approximately from mean high tide to mean sea level; it is diurnally flooded by tides and classified as polyhaline (18–30 ppt). This low marsh occurs in areas sheltered from direct wave action, such as behind barrier beaches, as pocket marshes at the heads of bays, or in the outer reaches of estuaries. Low salt marshes occur landward of intertidal flats and subtidal communities and seaward of high salt marsh communities. Low salt marshes dominated by *Spartina alterniflora* (smooth cordgrass) generally occur on mucky silt to silty coarse fibrous peat, often with high organic matter content. However, peat in the low marsh is generally less dense than farther landward (Bertness 1988). Peat depth ranges from a few feet, if the community formed over a mudflat, to 80 feet in drowned river valleys at the mouths of estuaries.

Vegetation Description: This community is a tall grassland dominated by *Spartina alterniflora* (smooth cordgrass) occurring in regularly flooded intertidal zones. *Spartina alterniflora* (smooth cordgrass) dominates this physically stressful zone due to limited competition and its ability to tolerate salinity and flooding. It also requires moderately high levels of iron (7–15 ppm) (Adams 1963). *Spartina alterniflora* (smooth cordgrass) is strongly dominant, forming a nearly monotypic tallgrass layer. There is little variation in vascular plant composition across the range. Tall-form *Spartina alterniflora* (smooth cordgrass) occurs adjacent to saltwater and colonizes unvegetated flats. This association also grades into short-form *Spartina alterniflora* (smooth cordgrass) landward where tidal range is more restricted. Common associates, occurring in low abundance, include *Limonium carolinianum* (Carolina sealavender), *Salicornia virginica* (Virginia glasswort), *Salicornia bigelovii* (dwarf saltwort), *Spergularia maritima* (media sandspurry), *Spergularia canadensis* (Canadian sandspurry), and *Suaeda maritima* (herbaceous seepweed). *Distichlis spicata* (inland saltgrass), *Agalinis maritima* (saltmarsh false foxglove), *Symphyotrichum tenuifolium* (perennial saltmarsh aster), and *Spartina patens* (saltmeadow cordgrass) can also sporadically occur, but are more common in the high salt marsh. Macroalgae can form extensive mats at the bases of the grass culms, especially *Ascophyllum nodosum*, *Fucus vesiculosus*, and *Ulva* (sea-lettuce) spp. *Enteromorpha* spp. can occur early in the growing season. Macroalgae associates may be sparse or absent at the southern edge of the range. Microscopic algae, especially diatoms, can be abundant on the marsh surface (Teal 1986).

Most Abundant Species:

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

Characteristic Species: *Spartina alterniflora* (smooth cordgrass)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Estuarine

DISTRIBUTION

Range: This association occurs along the Atlantic coastline from Nova Scotia and New Brunswick south to Cape Hatteras, North Carolina.

States/Provinces: CT, DE:S5, MA, MD:S5, ME, NB, NC, NH, NJ:S5, NS, NY:S3S4, RI, VA

Federal Lands: NPS (Acadia, Assateague Island, Boston Harbor Islands, Cape Cod, Fire Island, Gateway, Muskeget Island, Sagamore Hill); USFWS (Back Bay?, Chesapeake Marshlands, Monomoy, Moosehorn?, Parker River, Prime Hook)

CONSERVATION STATUS
Rank: G5 (1-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 1 - Strong
Comments: The northern limit of this type occurs where there is a slower accumulation of silt and corresponding absence of algal species (Chapman 1937). The southern 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 (Gosner 1979, Cowardin 1979). Southern occurrences, where *Ascophyllum nodosum* (yellow tang) may be sparse or absent, are placed within this type because of the associated characteristic faunal assemblage, including *Uca pugnax* (Atlantic marsh fiddler), *Littorina saxatilis* (rough periwinkle), *Littorina obtusata* (smooth periwinkle), and *Brachidontes demissus* (ribbed mussel). Analogous low salt marsh associations in other geographic areas include *Spartina alterniflora* (smooth cordgrass) Carolinian Zone Herbaceous Vegetation (CEGL004191) and *Spartina alterniflora - Juncus roemerianus - Distichlis spicata* Louisianian Zone Salt Tidal Herbaceous Vegetation (CEGL004190) for the Atlantic Coast of the southeastern U.S. (Cape Hatteras, North Carolina, to Florida) and the Gulf Coast (Florida to Texas), respectively [see Cowardin (1979) for regional boundaries]. *Spartina alterniflora - Lilaeopsis chinensis* Herbaceous Vegetation (CEGL004193) is a *Spartina alterniflora* (smooth cordgrass)-dominated association occurring in the mid-tidal range of tidal rivers that have a minimum tidal range of one meter.
Similar Associations:
- *Spartina alterniflora - Juncus roemerianus - Distichlis spicata* Louisianian Zone Salt Tidal Herbaceous Vegetation (CEGL004190)
- *Spartina alterniflora - Lilaeopsis chinensis* Herbaceous Vegetation (CEGL004193)
- *Spartina alterniflora* Carolinian Zone Herbaceous Vegetation (CEGL004191)

Related Concepts:
- *Spartina alterniflora* Tidal Herbaceous Vegetation (Harrison 2001) =
- *Spartina alterniflora* community (Metzler and Barrett 1992) ?
- *Spartina alterniflora* salt marsh (Clancy 1993b) ?
- Cordgrass saltmarsh community (MENHP 1991) ?
- Low salt marsh (Reschke 1990) ?
- Low salt marsh (Enser 1993) ?
- Low salt marsh community (Sperduto 1994) ?
- Salt Marsh (Rawinski 1984) ?
- Salt Marsh (Virginian Subtype) (Schafale 2000) ?
- Salt marsh (Higgins et al. 1971) B
- Salt marsh community (Hill 1986) B
- Salt marsh complex, low marsh (Breden 1989) ?

SOURCES
Description Authors: S.L. Neid
References: Adams 1963, Bell et al. 2002, Bertness 1988, Bowman 2000, Breden 1989, Breden et al. 2001, Chapman 1937, Clancy 1993b, Clancy 1996, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1993, Enser 1999, Fleming et al. 2001, Gawler 2001, Gawler 2002, Gosner 1979, Harrison 2001, Harrison 2004, Higgins et al. 1971, Hill 1986, MENHP 1991, Metzler and Barrett 1992, Metzler and Barrett 2001, Moul 1973, NRCS 2001b, Rawinski 1984, Reschke 1990, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Soil

Conservation Service 1987, Sperduto 1994, Sperduto 2000a, Sperduto 2000b, Stalter 1979, Swain and Kearsley 2001, Teal 1986



Figure 72. North Atlantic Low Salt Marsh in Cape Cod National Seashore (plot CACO.105). Summer 2003. NAD 1983 / UTM easting 411207, northing 4642075.



Figure 73. North Atlantic Low Salt Marsh in Cape Cod National Seashore (plot CACO.091). September 2004. NAD 1983 / UTM easting 416880, northing 4636691.

COMMON NAME (PARK-SPECIFIC): ATLANTIC GIANT CORDGRASS MARSH

SYNONYMS
USNVC English Name: **Giant Cordgrass Herbaceous Vegetation**
USNVC Scientific Name: ***Spartina cynosuroides* Herbaceous Vegetation**
USNVC Identifier: **CEGL004195**

LOCAL INFORMATION

Environmental Description: This association occurs along a tidal creek within a large salt marsh complex. There is a low level flow of freshwater in the creek from the upland which mixes variably with saltwater. The general soil salinity is brackish, but can periodically be nearly full strength seawater (28–32 ppt). The substrate is very loose mucky organics. This community occurs along the immediate borders of creeks where tidal flow drains well with each tide. There is an irregular topography created by many small tidal creeks.
Vegetation Description: The dominant plant in this community is *Spartina cynosuroides* (big cordgrass) which can grow to 2.5 m. The primary associates include *Spartina patens* (saltmeadow cordgrass) and *Spartina alterniflora* (smooth cordgrass) with *Schoenoplectus robustus* (sturdy bulrush) and *Eleocharis parvula* (dwarf spikerush). There are scattered herbaceous plants at low density including *Suaeda linearis* (annual seepweed), *Pluchea odorata* (sweetscent), *Atriplex patula* (spear saltbush), *Salicornia maritima* (slender grasswort), *Symphyotrichum novi-belgii* (New York aster), and *Symphyotrichum tenuifolium* (perennial saltmarsh aster).
Most Abundant Species:

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

Characteristic Species: *Spartina cynosuroides* (big cordgrass)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	SNR	NA	NA	[not crosswalked]	Swain and Kearsley 2001

Local Range: There is only one site known for this association in the vicinity of the Cape Cod National Seashore, at Wellfleet Bay Audubon Sanctuary along Hatches Creek.
Classification Comments: This community is limited to one area along Hatches Creek between Wellfleet and Eastham. There are numerous dead culms of both *Spartina cynosuroides* (big cordgrass) and *Schoenoplectus robustus* (sturdy bulrush) in the area, suggesting that this community and a *Scirpus* (bulrush)-dominated community nearby move around over time based on tidal flow and soil salinity.
Other Comments: There is no clear crosswalk in the MA classification to this USNVC association.
Local Description Authors: R.E. Zaremba
Plots: CACO.074 (outside boundary).
AA (2004) Points: None.
Cape Cod National Seashore Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC 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
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).

GLOBAL DESCRIPTION

Concept 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: 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: *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* (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, *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:

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

Characteristic Species: *Spartina cynosuroides* (big cordgrass)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

DISTRIBUTION

Range: This association occurs along the Atlantic coast from New Jersey to Georgia.
States/Provinces: DE:S3?, GA, MA, MD:S4?, NC, NJ:S3, SC, VA
Federal Lands: NPS (Assateague Island, Cape Cod, Colonial, Fort Pulaski, George Washington Birthplace); USFWS (Back Bay, Chesapeake Marshlands)

CONSERVATION STATUS

Rank: G4 (13-Aug-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 2 - Moderate
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* (big cordgrass) is a component of brackish high marsh associations, but does not tend to dominate.

Similar Associations:

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

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) ?

SOURCES

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, 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.



Figure 74. Atlantic Giant Cordgrass Marsh in Hatches Creek near Cape Cod National Seashore (plot CACO.074). Summer 2003. NAD 1983 / UTM easting 417277, northing 4636625.

COMMON NAME (PARK-SPECIFIC): NORTH ATLANTIC HIGH SALT MARSH

SYNONYMS

USNVC English Name: **Saltmeadow Cordgrass - Saltgrass - (Black-grass) Herbaceous Vegetation**

USNVC Scientific Name: ***Spartina patens* - *Distichlis spicata* - (*Juncus gerardii*) Herbaceous Vegetation**

USNVC Identifier: **CEGL006006**

LOCAL INFORMATION

Environmental Description: This association is the most common high marsh community type on Cape Cod. It forms at the upper edge of marshes between the low salt marsh and salt hay dunes. It is flooded by saltwater twice daily during spring tides. Some portions of the community can have periodic very high soil salinity and be only sparsely vegetated. Drift material is often deposited in portions of this community and may remain in place during much of the growing season killing plants. On barrier beaches, where overwash occurs, this association can form quickly on new substrate at the elevation between the lowest high tides during neap tides and the highest tides during spring tides. Dominant species in this community can grow through shallow deposits of sand during overwash events if the new surface of the sand remains within the influence of tides.

Vegetation Description: This community type is always dominated by *Spartina patens* (saltmeadow cordgrass) and may be codominated by *Distichlis spicata* (inland saltgrass) or *Juncus gerardii* (saltmeadow rush). Other common associates include *Puccinellia maritima* (seaside alkaligrass) and *Puccinellia fasciculata* (saltmarsh alkaligrass), *Symphyotrichum tenuifolium* (perennial saltmarsh aster), *Limonium carolinianum* (Carolina sealavender), and *Spergularia salina* (salt sandspurry).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Salicornia maritima* (slender grasswort)
		Salicornia virginica (Virginia glasswort)
Herb (field)	Graminoid	*Distichlis spicata* (inland saltgrass)
		Puccinellia maritima (seaside alkaligrass)
		Spartina patens (saltmeadow cordgrass)

Characteristic Species: *Distichlis spicata* (inland saltgrass)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S3*	B	1	Salt Marsh	Swain and Kearsley 2001

Local Range: This association is found in all of the well-developed salt marshes in the seashore.

Classification Comments: This community is found throughout the seashore wherever there are well-developed salt marshes. Good examples are present in Pleasant Bay in Orleans and Chatham, at Nauset Marsh, at the Wellfleet Bay Audubon Sanctuary, at Wellfleet Harbor, at Hatches Harbor, and at Long Point. None of these examples is very diverse compared to similar high marsh communities farther south in New York.

Other Comments: The Salt Marsh community described in Swain and Kearsley 2001 is broader in concept than the USNVC association North Atlantic High Salt Marsh and it includes multiple

USNVC associations including North Atlantic High Salt Marsh, North Atlantic Low Salt Marsh, and Salt Panne.
Local Description Authors: R.E. Zaremba
Plots: CACO.003, CACO.049, CACO.100.
AA (2004) Points: CACO.132, CACO.163, CACO.241 , CACO.314, CACO.383, CACO.433
Cape Cod National Seashore Inventory Notes: Mapped in the Salt Shrub aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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 gerardii)* Herbaceous Vegetation
Association (English name)	Saltmeadow Cordgrass - Saltgrass - (Black-grass) Herbaceous Vegetation
Ecological System(s):	Atlantic Coastal Plain Northern Salt Pond Marsh (CES203.892). Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519). Acadian Coastal Salt Marsh (CES201.578).

GLOBAL DESCRIPTION

Concept Summary: This high salt marsh vegetation dominated by *Spartina patens* (saltmeadow cordgrass) or codominated by *Distichlis spicata* (inland saltgrass) forms distinct "cowlicked" meadows above low salt marsh communities. This high marsh association generally occurs behind barrier beaches along the north Atlantic coast from the Canadian maritime provinces south to New Jersey. It occupies the irregularly flooded zone extending from mean high tide landward to the limit of spring tides. The substrate is peat overlying sand, silt, or bedrock. Vegetation of this marsh community occurs in mosaics of patches generally dominated by a single graminoid species, *Spartina patens* (saltmeadow cordgrass), *Distichlis spicata* (inland saltgrass), or *Juncus gerardii* (saltmeadow rush). Other characteristic associates that occur in low abundance include *Symphyotrichum tenuifolium* (perennial saltmarsh aster), *Limonium carolinianum* (Carolina sealavender), *Solidago sempervirens* (seaside goldenrod), *Symphyotrichum subulatum* (eastern annual saltmarsh aster), *Polygonum ramosissimum* (bushy knotweed), *Argentina anserina* (silverweed cinquefoil), *Atriplex patula* (spear saltbush), *Lythrum lineare* (wand lythrum), and *Panicum virgatum* (switchgrass). Salt pannes are often a prominent feature within this association.
Environmental Description: 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 spring tides. They are often adjacent to low salt marshes dominated by *Spartina alterniflora* (smooth cordgrass) (tall form), which are regularly flooded by diurnal tides. *Spartina patens* (saltmeadow cordgrass)-dominated high marshes form very dense peat with high organic matter content. Peat forms over sand, silt or bedrock.
Vegetation Description: Vegetation of this marsh community occurs in mosaics of patches generally dominated by a single graminoid species, *Spartina patens* (saltmeadow cordgrass),

Distichlis spicata (inland saltgrass), or *Juncus gerardii* (saltmeadow rush). Other characteristic associates that occur in low abundance include *Symphyotrichum tenuifolium* (perennial saltmarsh aster), *Limonium carolinianum* (Carolina sealavender), *Solidago sempervirens* (seaside goldenrod), *Symphyotrichum subulatum* (eastern annual saltmarsh aster), *Polygonum ramosissimum* (bushy knotweed), *Argentina anserina* (silverweed cinquefoil), *Atriplex patula* (spear saltbush), *Lythrum lineare* (wand lythrum), and *Panicum virgatum* (switchgrass).

Most Abundant Species:

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

Characteristic Species: *Distichlis spicata* (inland saltgrass), *Juncus gerardii* (saltmeadow rush), *Spartina patens* (saltmeadow cordgrass)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

DISTRIBUTION

Range: This high salt marsh association occurs from the Canadian maritime provinces south to Delaware.
States/Provinces: CT, DE, MA, MD, ME, NH, NJ:S5, NY:S3S4, RI
Federal Lands: NPS (Acadia, Boston Harbor Islands, Cape Cod, Fire Island, Gateway, Muskeget Island?, Sagamore Hill); USFWS (Moosehorn, Parker River?, Prime Hook)

CONSERVATION STATUS

Rank: G5 (1-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 2 - Moderate
Comments: This community is differentiated from *Spartina patens - Distichlis spicata - (Juncus roemerianus)* Herbaceous Vegetation (CEGL004197) to the south by the importance of *Juncus gerardii* (saltmeadow rush), *Plantago maritima* (goose tongue), and *Triglochin maritima* (seaside arrowgrass) and absence or relatively infrequent occurrence of species of southern distribution such as *Borrichia frutescens* (bushy seaside tansy), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Fimbristylis castanea* (marsh fimbry), and *Lythrum lineare* (wand lythrum).
Similar Associations:

- *Spartina patens - Agrostis stolonifera* Herbaceous Vegetation (CEGL006365)
- *Spartina patens - Distichlis spicata - (Juncus roemerianus)* Herbaceous Vegetation (CEGL004197)

Related Concepts:

- *Spartina patens - Distichlis spicata* Herbaceous Vegetation (Harrison 2001) I
- Salt Marsh (Rawinski 1984) ?
- Salt marsh complex, high marsh (Breden 1989) ?

SOURCES

Description Authors: S.L. Neid
References: Bell et al. 2002, Bertness et al. 1992, Breden 1989, Breden et al. 2001, Coulling pers. comm., Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming 2001a, Gawler 2001, Gawler 2002, Harrison 2001, Hill 1923,

Metzler and Barrett 2001, Nixon 1982, Rawinski 1984, Reschke 1990, Soil Conservation Service 1987, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2001



Figure 75. North Atlantic High Salt Marsh in Cape Cod National Seashore (plot CACO.049). September 2004. NAD 1983 / UTM easting 398339, northing 4657311.



Figure 76. North Atlantic High Salt Marsh in Cape Cod National Seashore (plot CACO.003). September 2004. NAD 1983 / UTM easting 411117, northing 4642216.

COMMON NAME (PARK-SPECIFIC): NORTHERN BRACKISH MEADOW

SYNONYMS

USNVC English Name: **Saltmeadow Cordgrass - Red Fescue - (Prairie Cordgrass) Herbaceous Vegetation**

USNVC Scientific Name: ***Spartina patens* - *Festuca rubra* - (*Spartina pectinata*) Herbaceous Vegetation**

USNVC Identifier: **CEGL006368**

LOCAL INFORMATION

Environmental Description: This upper high marsh is located at the intersection of salt marsh and upland communities on outwash deposits. The community is subject to tidal flooding only during extreme storm events during the growing season. Growth of most upland woody species is limited by periodic saltwater flooding. This community also supports some annuals that are killed by spring tide flooding some years but not in others. The substrate is variable but generally windblown sand over glacial outwash sands and gravels. Upland topography bordering these sites is very low and not likely to contribute substantial freshwater seepage to the community.

Vegetation Description: This grassland community is dominated by *Spartina pectinata* (prairie cordgrass) and *Spartina patens* (saltmeadow cordgrass) with *Festuca filiformis* (fineleaf sheep fescue). *Distichlis spicata* (inland saltgrass), *Thinopyrum pycnanthum* (tick quackgrass), and *Panicum virgatum* (switchgrass) are frequent associates. *Teucrium canadense* (Canada germander) and *Solidago sempervirens* (seaside goldenrod) are usually present. Shrub cover is very low and includes *Rosa carolina* (Carolina rose) and *Morella pensylvanica* (northern bayberry). *Smilax glauca* (cat greenbrier) and *Rubus flagellaris* (northern dewberry) are also often present. Other common species include *Pseudognaphalium obtusifolium* (rabbittobacco), *Lepidium campestre* (field pepperweed), *Sonchus arvensis* (field sowthistle), and *Rumex crispus* (curly dock).

Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Rosa carolina* (Carolina rose)
Herb (field)	Forb	*Teucrium canadense* (Canada germander)
Herb (field)	Graminoid	*Festuca filiformis* (fineleaf sheep fescue)
		Spartina patens (saltmeadow cordgrass)
		Spartina pectinata (prairie cordgrass)

Characteristic Species: *Festuca filiformis* (fineleaf sheep fescue), *Teucrium canadense* (Canada germander)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S1*	B	1	Brackish Tidal Marsh	Swain and Kearsley 2001

Local Range: This association is currently known from the Ballston Beach area of Truro and the Wellfleet Bay Audubon Sanctuary and in the vicinity of the seashore.

Classification Comments: The communities described in the MA vegetation classification and the USNVC are not equivalent in concept. The MA community type, Brackish Tidal Marsh, is broader in concept than the USNVC association Northern Brackish Meadow. Multiple USNVC associations can occur within one Brackish Tidal Marsh community as classified by MA.

Other Comments: Information not available.

Local Description Authors: R.E. Zaremba
Plots: CACO.075 (outside boundary), CACO.125 (outside boundary), and CACO.058.
AA (2004) Points: None.
Cape Cod National Seashore Inventory Notes: Mapped in the Coastal Marsh aggregated map class in the vegetation map. Photograph not available.

GLOBAL INFORMATION

USNVC 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 - Festuca rubra - (Spartina pectinata)* Herbaceous Vegetation
Association (English name)	Saltmeadow Cordgrass - Red Fescue - (Prairie Cordgrass) Herbaceous Vegetation
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This oligohaline to mesohaline marsh occurs as a narrow band at the border between high salt marsh and the adjacent uplands in northern New England. Salinity input is a result of irregular flooding by spring tides and storm surges with freshwater input from runoff or groundwater discharge. Substrate is peat that is drier than that of high salt marsh vegetation. Small pannes tend to form in this marsh; they can be rather temporary. Local dominants include *Agrostis stolonifera* (creeping bentgrass), *Juncus gerardii* (saltmeadow rush), and *Spartina patens* (saltmeadow cordgrass). Associated species include *Symphyotrichum novi-belgii* (New York aster), *Solidago sempervirens* (seaside goldenrod), *Festuca rubra* (red fescue), *Spartina pectinata* (prairie cordgrass), and *Schoenoplectus robustus* (sturdy bulrush). In wetter areas, *Carex paleacea* (chaffy sedge) can be strongly dominant. In ponded, but less frequently flooded areas, *Schoenoplectus tabernaemontani* (softstem bulrush) and/or *Juncus balticus var. littoralis* (Baltic rush) can be locally dominant. Species occurring less frequently can include *Schoenoplectus pungens* (common threesquare), *Distichlis spicata* (inland saltgrass), *Triglochin maritima* (seaside arrowgrass), *Argentina anserina* (silverweed cinquefoil), *Carex hormathodes* (marsh straw sedge), *Ranunculus sceleratus* (cursed buttercup), *Panicum virgatum* (switchgrass), *Amaranthus cannabinus* (tidalmarsh amaranth), *Hierochloe odorata* (vanilla grass), *Elymus virginicus* (Virginia wildrye), *Teucrium canadense* (Canada germander), *Iris versicolor* (harlequin blueflag), *Cuscuta gronovii* (scaldweed), *Impatiens capensis* (jewelweed), *Acorus calamus* (calamus), *Calystegia sepium* (hedge false bindweed), *Typha angustifolia* (narrowleaf cattail), *Sanguisorba canadensis* (Canadian burnet), and *Phragmites australis* (common reed). Local pannes can form within this marsh community with distinctly different species composition.
Environmental Description: This oligohaline to mesohaline marsh occurs as a narrow band at the border between high salt marsh and the adjacent uplands. Salinity input is from irregular flooding by spring tides and storm surges with freshwater input from runoff or groundwater discharge. Substrate is peat that is drier than that of high salt marsh vegetation. Small pannes tend to form in this marsh; they can be rather temporary.

Vegetation Description: This marsh is dominated by graminoids and has several variants. Local dominants include *Agrostis stolonifera* (creeping bentgrass), *Juncus gerardii* (saltmeadow rush), and *Spartina patens* (saltmeadow cordgrass). Associated species include *Symphyotrichum novi-belgii* (New York aster), *Solidago sempervirens* (seaside goldenrod), *Festuca rubra* (red fescue), *Spartina pectinata* (prairie cordgrass), and *Schoenoplectus robustus* (sturdy bulrush). In wetter areas, *Carex paleacea* (chaffy sedge) can be strongly dominant. In ponded, but less frequently flooded areas, *Schoenoplectus tabernaemontani* (softstem bulrush) and/or *Juncus balticus var. littoralis* (Baltic rush) can be locally dominant. Species occurring less frequently can include *Schoenoplectus pungens* (common threesquare), *Distichlis spicata* (inland saltgrass), *Triglochin maritima* (seaside arrowgrass), *Argentina anserina* (silverweed cinquefoil), *Carex hormathodes* (marsh straw sedge), *Ranunculus sceleratus* (cursed buttercup), *Panicum virgatum* (switchgrass), *Amaranthus cannabinus* (tidalmarsh amaranth), *Hierochloe odorata* (vanilla grass), *Elymus virginicus* (Virginia wildrye), *Teucrium canadense* (Canada germander), *Iris versicolor* (harlequin blueflag), *Cuscuta gronovii* (scaldweed), *Impatiens capensis* (jewelweed), *Acorus calamus* (calamus), *Calystegia sepium* (hedge false bindweed), *Typha angustifolia* (narrowleaf cattail), *Sanguisorba canadensis* (Canadian burnet), and *Phragmites australis* (common reed). Local pannes can form within this marsh community with distinctly different species composition.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Agrostis stolonifera* (creeping bentgrass)
		Juncus gerardii (saltmeadow rush)
		Spartina patens (saltmeadow cordgrass)

Characteristic Species: *Festuca rubra* (red fescue), *Spartina patens* (saltmeadow cordgrass), *Spartina pectinata* (prairie cordgrass)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Estuarine

DISTRIBUTION

Range: This association is currently described from New Hampshire and Massachusetts.

States/Provinces: MA, ME?, NH

Federal Lands: NPS (Cape Cod)

CONSERVATION STATUS

Rank: GNR (14-Apr-1998)

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: This association is the northern analog of *Panicum virgatum - Spartina patens* Herbaceous Vegetation (CEGL006150). *Panicum virgatum* (switchgrass) is a component of this association, but is not dominant.

Similar Associations:

- *Panicum virgatum - Spartina patens* Herbaceous Vegetation (CEGL006150)

Related Concepts:

- Brackish Tidal Marsh (Rawinski 1984) ?

SOURCES

Description Authors: S.L. Neid

References: Eastern Ecology Working Group n.d., Nichols pers. comm., Rawinski 1984, Sperduto 2000b, Swain and Kearsley 2001

COMMON NAME (PARK-SPECIFIC): CATTAIL BRACKISH TIDAL MARSH

SYNONYMS

USNVC English Name: **Narrowleaf Cattail - Eastern Rosemallow Herbaceous Vegetation**

USNVC Scientific Name: ***Typha angustifolia* - *Hibiscus moscheutos* Herbaceous Vegetation**

USNVC Identifier: **CEGL004201**

LOCAL INFORMATION

Environmental Description: This association occurs in the oligohaline to mesohaline areas of tidal marshes (0.5–18 ppt). The community is flooded twice a day by brackish water or is freshwater tidal periodically influenced by brackish tides. It occurs in two settings in Cape Cod National Seashore. One is along large tidal streams, the other is at the upper edges of tidal marshes not associated with streams, but where freshwater seeps from steep uplands bordering the marsh. The substrate is composed of coarse organics derived from *Typha* (cattail) litter. The community may also have scattered deep layers of salt marsh drift material or tidal debris such as boards and plastic.

Vegetation Description: This association is dominated by either *Typha angustifolia* (narrowleaf cattail) or *Typha latifolia* (broadleaf cattail). There are two physical settings for this association. The occurrences along moderate-sized tidal streams support *Hibiscus moscheutos* (crimsoneyed rosemallow), *Polygonum hydropiperoides* (swamp smartweed) and *Polygonum arifolium* (halberdleaf tearthumb), *Bidens cernua* (nodding beggartick), and *Symphyotrichum puniceum* (purplestem aster). Occurrences bordering upland seeps also include *Polygonum ramosissimum* (bushy knotweed), *Pluchea odorata* (sweetscent), *Thelypteris palustris* (eastern marsh fern), and *Spartina patens* (saltmeadow cordgrass). Other common associates include *Calystegia sepium* (hedge false bindweed), *Onoclea sensibilis* (sensitive fern), *Solidago canadensis* (Canada goldenrod) and *Solidago sempervirens* (seaside goldenrod), *Symphyotrichum novi-belgii* (New York aster), and *Teucrium canadense* (Canada germander).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Hibiscus moscheutos* (crimsoneyed rosemallow)
		Polygonum hydropiperoides (swamp smartweed)
Herb (field)	Graminoid	*Typha angustifolia* (narrowleaf cattail)
		Typha latifolia (broadleaf cattail)
Herb (field)	Fern or fern ally	*Thelypteris palustris* (eastern marsh fern)

Characteristic Species: *Hibiscus moscheutos* (crimsoneyed rosemallow), *Polygonum arifolium* (halberdleaf tearthumb), *Typha angustifolia* (narrowleaf cattail), *Typha latifolia* (broadleaf cattail)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S1*	B	1	Brackish Tidal Marsh	Swain and Kearsley 2001

Local Range: This association occurs in Pilgrim Lake and along the tidal section of the Herring River in Wellfleet, and along Hatches Creek at the Wellfleet Bay Massachusetts Audubon Sanctuary.

Classification Comments: The communities described in the MA vegetation classification and the USNVC are not equivalent in concept. The MA community type, Brackish Tidal Marsh, is broader in concept than the USNVC association. Multiple USNVC associations can occur within one Brackish Tidal Marsh community as classified by MA. The concept of the Cattail Brackish Marsh in the USNVC is finer in scale than the unit classified in the MA vegetation classification and has a Grank of G4G5.
Other Comments: Information not available.
Local Description Authors: R.E. Zaremba
Plots: CACO.072 and CACO.073.
AA (2004) Points: None.
Cape Cod National Seashore Inventory Notes: Mapped in the Cattail Marsh aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	*Typha (angustifolia, domingensis)* Tidal Herbaceous Alliance (A.1472)
Alliance (English name)	(Narrowleaf Cattail, Southern Cattail) Tidal Herbaceous Alliance
Association	*Typha angustifolia - Hibiscus moscheutos* Herbaceous Vegetation
Association (English name)	Narrowleaf Cattail - Eastern Rosemallow Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Brackish Tidal Marsh (CES203.894). Atlantic Coastal Plain Northern Salt Pond Marsh (CES203.892). Atlantic Coastal Plain Embayed Region Tidal Freshwater Marsh (CES203.259). Acadian Estuary Marsh (CES201.579). Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519).

GLOBAL DESCRIPTION

Concept Summary: This community is a brackish tidal marsh of the northern to central Atlantic coast, occurring along the margin of tidal rivers and at the upper margins of some high salt marshes and coastal salt ponds where water salinity ranges from 0.5–18.0 ppt. Brackish marshes are most extensive on large tidal rivers, but smaller marshes of this alliance also occur at the upper limits of larger tidal creeks. The vegetation of this tall grassland is a mixture of freshwater and saltmarsh species dominated by *Typha angustifolia* (narrowleaf cattail). *Phragmites australis* (common reed) and/or *Typha latifolia* (broadleaf cattail) can be codominant. The *Phragmites australis* (common reed) component is the native strain. Common associates include *Hibiscus moscheutos* (crimsoneyed rosemallow), *Schoenoplectus pungens* (common threesquare), *Impatiens capensis* (jewelweed), *Amaranthus cannabinus* (tidalmarsh amaranth), *Peltandra virginica* (green arrow arum), *Pontederia cordata* (pickerelweed), and *Bidens* (beggarticks) spp., plus *Spartina cynosuroides* (big cordgrass) in the south. Other infrequent associates include *Mikania scandens* (climbing hempvine), *Polygonum punctatum* (dotted smartweed), *Pluchea odorata* (sweetscent), *Eleocharis* (spikerush) spp., and *Schoenoplectus robustus* (sturdy bulrush), plus *Schoenoplectus americanus* (chairmaker's bulrush) farther south. Species from adjacent high salt marsh may also be present. Substrate is muck or peat, and there is often an accumulation of *Typha* (cattail) litter.

Environmental Description: This association occurs in oligohaline to mesohaline areas of tidal marshes (0.5–18 ppt). In estuarine systems, it can occur in the uppermost zone of brackish marshes where there is freshwater influence; it receives diurnal tidal flooding of brackish water. In salt marshes behind barrier beaches it can occur in the upper reaches of larger tidal creeks within brackish areas and also at the upland border where there is significant freshwater input from the adjacent upland; here it receives irregular tidal flooding only during high spring tides. Substrate is muck or peat, and there is often an accumulation of *Typha* (cattail) litter.
Vegetation Description: The vegetation of this tall grassland is a mixture of freshwater and saltmarsh species dominated by *Typha angustifolia* (narrowleaf cattail). *Phragmites australis* (common reed), *Typha latifolia* (broadleaf cattail), *Spartina cynosuroides* (big cordgrass), or *Schoenoplectus pungens* (common threesquare) can codominate. The *Phragmites australis* (common reed) component is the native strain (Saltonstall 2002). Common associates include *Hibiscus moscheutos* (crimsoneyed rosemallow), *Schoenoplectus pungens* (common threesquare), *Impatiens capensis* (jewelweed), *Amaranthus cannabinus* (tidalmarsh amaranth), *Peltandra virginica* (green arrow arum), *Pontederia cordata* (pickerelweed), and *Bidens* (beggarticks) spp., plus *Spartina cynosuroides* (big cordgrass) in the south. Other infrequent associates include *Mikania scandens* (climbing hempvine), *Pluchea odorata* (sweetscent), *Polygonum punctatum* (dotted smartweed), *Eleocharis* (spikerush) spp., and *Schoenoplectus robustus* (sturdy bulrush), plus *Schoenoplectus americanus* (chairmaker's bulrush) farther south. Species from adjacent high salt marsh may also be present.
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Semi-shrub	*Hibiscus moscheutos* (crimsoneyed rosemallow)
Herb (field)	Graminoid	*Schoenoplectus pungens* (common threesquare)
		Typha angustifolia (narrowleaf cattail)
Floating aquatic	Aquatic herb (floating & submergent)	*Pontederia cordata* (pickerelweed)

Characteristic Species: *Hibiscus moscheutos* (crimsoneyed rosemallow), *Typha angustifolia* (narrowleaf cattail)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

DISTRIBUTION
Range: This association occurs along the Atlantic coast from Maine to Virginia and possibly to South Carolina.
States/Provinces: CT, DE:S4, MA, MD:S4, ME, NC?, NH, NJ:S4, NY, RI, SC?, VA
Federal Lands: NPS (Acadia, Assateague Island, Boston Harbor Islands, Cape Cod, Fire Island, Saugus Iron Works); USFWS (Back Bay?, Chesapeake Marshlands, Chincoteague, Monomoy?, Parker River?, Prime Hook)

CONSERVATION STATUS
Rank: G4G5 (19-Jan-2006)
Reasons: This common small-patch community occurs in the estuarine areas of up to 13 northeastern states, several of which rank this vegetation as S4. It is threatened by pollution and by encroachment of *Phragmites australis* (common reed).

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: A non-tidal barrier wetland documented at the Cove Point Wetland, Calvert County, Maryland (Steury 1999), appears to fit this concept.

Similar Associations:

- *Typha domingensis* Tidal Herbaceous Vegetation (CEGL008456)

Related Concepts:

- *Hibiscus* marsh (Cahoon and Stevenson 1986) ?
- *Typha (angustifolia, latifolia) - Hibiscus moscheutos* Herbaceous Vegetation (Harrison 2001) =
- *Typha angustifolia - Hibiscus palustris* community (Metzler and Barrett 1992) ?
- *Typha angustifolia* community (Good and Good 1975b) ?
- *Typha angustifolia* type (Ferren et al. 1981) ?
- *Typha* association (Shreve et al. 1910) =
- Brackish Tidal Marsh (Rawinski 1984) ?
- Brackish marsh (Sperduto 1994) ?
- Brackish tidal marsh (Reschke 1990) ?
- Brackish tidal marsh community (MENHP 1991) ?
- Brackish tidal marsh complex (Breden 1989) ?
- Cattail Community Type (Odum et al. 1984) ?
- Fresh-brackish marsh (Klotz 1986) ?
- Narrowleaf cattail type (McCormick and Ashbaugh 1972) ?
- Tidal Freshwater Marsh (Narrowleaf Cattail Subtype) (Schafale 2000) ?
- Transitional fresh marsh (Hill 1986) B

SOURCES

Description Authors: S.L. Neid

References: Bowman 2000, Breden 1989, Breden et al. 2001, Cahoon and Stevenson 1986, Coulling 2002, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Ferren et al. 1981, Fleming 2001a, Fleming and Moorhead 1998, Fleming et al. 2001, Gawler 2002, Good and Good 1975b, Harrison 2001, Harrison 2004, Hill 1986, Klotz 1986, MENHP 1991, McCormick and Ashbaugh 1972, Metzler and Barrett 1992, Metzler and Barrett 2001, Odum et al. 1984, Rawinski 1984, Reschke 1990, Saltonstall 2002, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Shreve et al. 1910, Sperduto 1994, Sperduto 1997a, Sperduto 2000b, Steury 1999, Swain and Kearsley 2001



Figure 77. Cattail Brackish Tidal Marsh in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 405453, northing 4657297.

COMMON NAME (PARK-SPECIFIC): ATLANTIC COAST WILD RICE TIDAL MARSH

SYNONYMS
USNVC English Name: **Indian Wild Rice Tidal Herbaceous Vegetation**
USNVC Scientific Name: ***Zizania aquatica* Tidal Herbaceous Vegetation**
USNVC Identifier: **CEGL004202**

LOCAL INFORMATION

Environmental Description: This association occurs in areas with permanent shallow water in the freshwater section of a tidal river. The substrate is mucky organics over sand. Water flow is very slow. There are likely periodic influxes of saltwater associated with storm events, particularly during the winter.
Vegetation Description: This freshwater tidal community is dominated by *Zizania aquatica* (annual wildrice) which can form large stands. Growing with the *Zizania* (wildrice) at much lower cover are *Sparganium* (bur-reed) sp., *Leersia oryzoides* (rice cutgrass), and *Lemna minor* (common duckweed). Other associates growing in shallow water include *Spiraea tomentosa* (steeplebush), *Decodon verticillatus* (swamp loosestrife), *Ilex verticillata* (common winterberry), *Clethra alnifolia* (coastal sweetpepperbush), and *Calamagrostis canadensis* (bluejoint).
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Lemna minor* (common duckweed)
Herb (field)	Graminoid	*Leersia oryzoides* (rice cutgrass)
		Zizania aquatica (annual wildrice)

Characteristic Species: *Zizania aquatica* (annual wildrice)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S1*	B	1	Freshwater Tidal Marsh	Swain and Kearsley 2001

Local Range: This association is currently known only from the Herring River in Wellfleet.
Classification Comments: This association is known only from one small section of the Herring River. There could be more of this community in other sections of the Herring River/Bound Brook complex that were not explored during this study.
Other Comments: The communities described in the MA vegetation classification and the USNVC are not equivalent in concept. The MA community type, Freshwater Tidal Marsh, is broader in concept than the USNVC association Atlantic Coast Wild Rice Tidal Marsh. Multiple USNVC associations can occur within one Freshwater Tidal Marsh community as classified by MA.
Local Description Authors: R.E. Zaremba
Plots: CACO.108.
AA (2004) Points: None.
Cape Cod National Seashore Inventory Notes: Mapped in the Freshwater Marsh aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC 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	*Zizania aquatica* Tidal Herbaceous Alliance (A.1484)
Alliance (English name)	Indian Wild Rice Tidal Herbaceous Alliance
Association	*Zizania aquatica* Tidal Herbaceous Vegetation
Association (English name)	Indian Wild Rice Tidal Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.516). Atlantic Coastal Plain Embayed Region Tidal Freshwater Marsh (CES203.259). Acadian Estuary Marsh (CES201.579). Central Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.376).

GLOBAL DESCRIPTION

Concept Summary: This is a freshwater tidal marsh characterized by *Zizania aquatica* (annual wildrice) that occurs in oligohaline zones of tidal rivers along the north and mid-Atlantic coast of North America. These marshes occur in the lower reaches of freshwater tidal systems, in fresh to slightly brackish areas along flats that are infrequently exposed at very low tides. Soils are highly variable and are composed of varying amounts of silts, silty mucks, fine peat, to very coarse sands. *Zizania aquatica* (annual wildrice) is dominant, although only conspicuously so in mid to late summer, when it overtops early season vegetation. This community can be codominated by species such as *Pontederia cordata* (pickerelweed), *Peltandra virginica* (green arrow arum), *Polygonum arifolium* (halberdleaf tearthumb), *Polygonum punctatum* (dotted smartweed), and/or *Bidens* (beggarticks) spp. Common associates are generally a mixture of freshwater and brackish species and can include *Sagittaria latifolia* (broadleaf arrowhead), *Ludwigia palustris* (marsh seedbox), *Impatiens capensis* (jewelweed), *Leersia oryzoides* (rice cutgrass), *Amaranthus cannabinus* (tidalmarsh amaranth), *Hibiscus moscheutos* (crimsoneyed rosemallow), *Sium suave* (hemlock waterparsnip), *Acorus americanus* (sweetflag), and *Schoenoplectus fluviatilis* (river bulrush). This vegetation provides an important food source for migratory birds.

Environmental Description: This association occurs in the lower reaches of freshwater tidal marshes, in fresh to slightly brackish areas that are low within the marsh and are infrequently exposed at lowest tides. It occurs on alluvial soils that are commonly silts or silty clays, although occasionally have a greater sand component. *Zizania* (wildrice) flats are best developed in quiet waters conducive to sedimentation (Barrett 1989).

Vegetation Description: This freshwater tidal marsh community can be highly variable in species composition, but characterized by *Zizania aquatica* (annual wildrice), which is dominant and monotypic in some examples, often forming a "canopy" over such species as *Pontederia cordata* (pickerelweed), *Peltandra virginica* (green arrow arum), *Polygonum arifolium* (halberdleaf tearthumb), *Polygonum punctatum* (dotted smartweed), and/or *Bidens* (beggarticks) spp., among others. Common associates are generally a mixture of freshwater and brackish species and can include *Sagittaria latifolia* (broadleaf arrowhead), *Ludwigia palustris* (marsh seedbox), *Impatiens capensis* (jewelweed), *Leersia oryzoides* (rice cutgrass), *Amaranthus cannabinus* (tidalmarsh amaranth), *Hibiscus moscheutos* (crimsoneyed rosemallow), *Sium suave* (hemlock waterparsnip), *Acorus americanus* (sweetflag), and *Schoenoplectus fluviatilis* (river bulrush). *Nuphar lutea ssp. advena* (yellow pond-lily) is a common associate in the southern

portion of the range. This plant association shows extreme seasonal variability with *Zizania aquatica* (annual wildrice) becoming a conspicuous component only in mid to late summer and generally senescing by mid to late autumn. The exotic species *Murdannia keisak* (wartremoving herb) can be a major component in many stands in Virginia. This vegetation provides an important food source for migratory birds.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Zizania aquatica* (annual wildrice)

Characteristic Species: *Zizania aquatica* (annual wildrice)

Other Noteworthy Species:

Species	GRank	Type	Note
Aeschynomene virginica (Virginia jointvetch)	G2	plant	Federally listed threatened; globally imperiled

USFWS Wetland System: Estuarine

DISTRIBUTION

Range: This association occurs along the Atlantic Coastal Plain from Maine and Massachusetts south to South Carolina, possibly extending into Georgia.

States/Provinces: CT, DE:S3, FL?, GA?, MA, MD:S3, ME, MS, NC, NJ:S2S3, NY, RI, SC, VA:S4?

Federal Lands: NPS (Cape Cod); USFS (Croatan, Francis Marion); USFWS (Back Bay?, Chesapeake Marshlands, Presquile, Prime Hook)

CONSERVATION STATUS

Rank: G4? (13-Aug-1997)

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: Because of high seasonal variability, stands sampled in the early spring that may appear to be *Peltandra virginica - Pontederia cordata* Tidal Herbaceous Vegetation (CEGL004706) may be more appropriately classified as *Zizania aquatica* (annual wildrice) Tidal Herbaceous Vegetation (CEGL004202). This vegetation is best sampled later in the season.

Similar Associations:

- *Zizania (aquatica, palustris)* Herbaceous Vegetation (CEGL002382)
- *Zizania aquatica* Gulf Coast Herbaceous Vegetation (CEGL003887)

Related Concepts:

- *Zizania aquatica - Polygonum punctatum* Tidal Herbaceous Vegetation (Coulling 2002) ?
- *Zizania aquatica - Pontederia cordata - Peltandra virginica - Polygonum punctatum* Tidal Herbaceous Vegetation (VDNH 2003) =
- *Zizania aquatica* marsh community (Barrett 1989) ?
- FW Tidal Marsh (Rawinski 1984) ?
- Freshwater Tidal Marsh: Wild Rice - Smartweed Type (McCoy and Fleming 2000) ?
- Freshwater tidal marsh complex, midtidal zone (Breden 1989) ?
- Tidal Freshwater Marsh (Wild Rice Subtype) (Schafale 2000) ?
- Wild Rice Community Type (Odum et al. 1984) ?

SOURCES

Description Authors: S.L. Neid

References: Barrett 1989, Barrett 1994, Bowman 2000, Breden 1989, Breden et al. 2001, Coulling 2002, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Ferren

and Good 1977, Fleming et al. 2001, Gawler 2001, Gawler 2002, Glitzenstein and Streng 2004, Good and Good 1975b, Harrison 2001, Harrison 2004, McCormick and Ashbaugh 1972, McCormick et al. 1970, McCoy and Fleming 2000, Metzler and Barrett 2001, Metzler and Rosza 1982, Odum et al. 1984, Rawinski 1984, Reschke 1990, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Swain and Kearsley 2001, VDNH 2003, Wharton 1978



Figure 78. Atlantic Coast Wild Rice Tidal Marsh in Cape Cod National Seashore (plot CACO.108). Summer 2003. NAD 1983 / UTM easting 412181, northing 4644533.

COMMON NAME (PARK-SPECIFIC): SANDPLAIN GRASSLAND

SYNONYMS

USNVC English Name: **Northern Bayberry / Seaside Bluestem - Poverty Oatgrass Shrub Herbaceous Vegetation**

USNVC Scientific Name: ***Morella pensylvanica* / *Schizachyrium littorale* - *Danthonia spicata* Shrub Herbaceous Vegetation**

USNVC Identifier: **CEGL006067**

LOCAL INFORMATION

Environmental Description: This grassland occurs on sands and gravels of glacial outwash deposits. Soils are acidic and droughty. Some occurrences are maintained by active management, including prescribed fire and mowing.

Vegetation Description: This grassland community is characterized by native species dominated by *Schizachyrium scoparium* (little bluestem), *Danthonia spicata* (poverty oatgrass), *Helianthemum dumosum* (bushy frostweed) and *Helianthemum canadense* (longbranch frostweed), *Symphyotrichum dumosum* (rice button aster), *Ionactis linariifolius* (flaxleaf whitetop aster), *Sericocarpus asteroides* (toothed whitetop aster), *Symphyotrichum patens* (late purple aster), and *Baptisia tinctoria* (horseflyweed). Also present in low concentration are ericaceous shrubs, including *Arctostaphylos uva-ursi* (kinnikinnick), *Hudsonia ericoides* (pinebarren goldenheather), and *Vaccinium angustifolium* (lowbush blueberry).

Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Quercus ilicifolia* (bear oak)
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Morella pensylvanica* (northern bayberry)
Herb (field)	Forb	*Lechea maritima* (beach pinweed)
Herb (field)	Graminoid	*Danthonia spicata* (poverty oatgrass)
		Schizachyrium scoparium (little bluestem)

Characteristic Species: *Schizachyrium scoparium* (little bluestem)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S1*	B	1	Sandplain Grassland	Swain and Kearsley 2001

Local Range: This association is known from the Wellfleet Bay Audubon Sanctuary and is found in scattered small patches in Eastham and Wellfleet.

Classification Comments: The communities described in the MA vegetation classification and the USNVC are not equivalent in concept. The MA community type, Sandplain Grassland, is broader in concept than the USNVC association.

Other Comments: Information not available.

Local Description Authors: R.E. Zaremba

Plots: None.

CACO AA (2004) points: CACO.173.

Cape Cod National Seashore Inventory Notes: Mapped in the Heathland Grassland aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland with a sparse shrub layer (V.A.7.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland with a sparse shrub layer (V.A.7.N.)
Formation	Medium-tall temperate or subpolar grassland with a sparse cold-deciduous shrub layer (V.A.7.N.g.)
Alliance	*Schizachyrium littorale* Shrub Herbaceous Alliance (A.1533)
Alliance (English name)	Seaside Bluestem Shrub Herbaceous Alliance
Association	*Morella pensylvanica / Schizachyrium littorale - Danthonia spicata* Shrub Herbaceous Vegetation
Association (English name)	Northern Bayberry / Seaside Bluestem - Poverty Oatgrass Shrub Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264). Northern Atlantic Coastal Plain Pitch Pine Barrens (CES203.269). Northern Atlantic Coastal Plain Heathland and Grassland (CES203.895).

GLOBAL DESCRIPTION

Concept Summary: This association comprises sandplain grasslands of the northeastern Atlantic coast. They occur on dry, nutrient-poor, sandy/gravelly soils of outwash plains influenced by offshore winds and salt spray. They are often associated with frost pockets on the landscape. The herbaceous layer is very diverse; graminoids are dominant and tend to form a dense turf. Dominant species include *Schizachyrium littorale* (shore little bluestem), *Danthonia spicata* (poverty oatgrass), *Deschampsia flexuosa* (wavy hairgrass), *Carex pensylvanica* (Pennsylvania sedge), and occasionally *Andropogon gerardii* (big bluestem). Other typical species include *Ionactis linariifolius* (flaxleaf whitetop aster), *Solidago puberula* (downy goldenrod), *Lechea maritima* (beach pinweed), *Antennaria plantaginifolia* (woman's tobacco), *Polygala polygama* (racemed milkwort), *Sericocarpus asteroides* (toothed whitetop aster), *Symphyotrichum dumosum* (rice button aster), *Helianthemum dumosum* (bushy frostweed), *Juncus greenei* (Greene's rush), *Pityopsis falcata* (sickleleaf silkgrass), *Euthamia graminifolia* (flat-top goldentop), *Euthamia caroliniana* (slender goldentop), *Solidago nemoralis* (gray goldenrod), *Tephrosia virginiana* (Virginia tephrosia), *Dichanthelium scoparium* (velvet panicum), *Liatris scariosa var. novae-angliae* (New England blazing star), *Chrysopsis mariana* (Maryland goldenaster), *Aristida purpurascens*, *Asclepias tuberosa* (butterfly milkweed), *Baptisia tinctoria* (horseflyweed), *Viola pedata* (birdfoot violet), *Symphyotrichum concolor* (eastern silver aster), *Linum intercursum* (sandplain flax), and others. Lichens are generally present, characteristically including *Cladina rangiferina* (greygreen reindeer lichen). Low shrubs can occur with variable cover (up to 50%). Species can include *Gaylussacia baccata* (black huckleberry), *Vaccinium angustifolium* (lowbush blueberry), *Arctostaphylos uva-ursi* (kinnikinnick), *Morella pensylvanica* (northern bayberry), *Comptonia peregrina* (sweet fern), *Quercus ilicifolia* (bear oak), *Rhus copallinum* (flameleaf sumac), and *Rubus flagellaris* (northern dewberry).

Environmental Description: This association occurs on dry, nutrient-poor, sandy/gravelly soils of outwash plains influenced by offshore winds and salt spray. They are often associated with frost pockets on the landscape.

Vegetation Description: The herbaceous layer is very diverse; graminoids are dominant and tend to form a dense turf. Dominant species include *Schizachyrium littorale* (shore little

bluestem), *Danthonia spicata* (poverty oatgrass), *Deschampsia flexuosa* (wavy hairgrass), *Carex pensylvanica* (Pennsylvania sedge), and occasionally *Andropogon gerardii* (big bluestem). Other typical species include *Ionactis linariifolius* (flaxleaf whitetop aster), *Solidago puberula* (downy goldenrod), *Lechea maritima* (beach pinweed), *Antennaria plantaginifolia* (woman's tobacco), *Polygala polygama* (racemed milkwort), *Sericocarpus asteroides* (toothed whitetop aster), *Symphyotrichum dumosum* (rice button aster), *Helianthemum dumosum* (bushy frostweed), *Juncus greenei* (Greene's rush), *Pityopsis falcata* (sickleleaf silkgrass), *Euthamia graminifolia* (flat-top goldentop), *Euthamia caroliniana* (slender goldentop), *Solidago nemoralis* (gray goldenrod), *Tephrosia virginiana* (Virginia tephrosia), *Dichanthelium scoparium* (velvet panicum), *Liatris scariosa var. novae-angliae* (New England blazing star), *Chrysopsis mariana* (Maryland goldenaster), *Aristida purpurascens*, *Asclepias tuberosa* (butterfly milkweed), *Baptisia tinctoria* (horseflyweed), *Viola pedata* (birdfoot violet), *Symphyotrichum concolor* (eastern silver aster), *Linum intercursum* (sandplain flax), and others. Lichens are generally present, characteristically including *Cladina rangiferina* (greygreen reindeer lichen). Low shrubs can occur with variable cover (up to 50%). Species can include *Gaylussacia baccata* (black huckleberry), *Vaccinium angustifolium* (lowbush blueberry), *Arctostaphylos uva-ursi* (kinnikinnick), *Morella pensylvanica* (northern bayberry), *Comptonia peregrina* (sweet fern), *Quercus ilicifolia* (bear oak), *Rhus copallinum* (flameleaf sumac), and *Rubus flagellaris* (northern dewberry).

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
Short shrub/sapling	Broad-leaved evergreen shrub	*Arctostaphylos uva-ursi* (kinnikinnick)
		Morella pensylvanica (northern bayberry)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)
		Schizachyrium scoparium (little bluestem)

Characteristic Species: *Andropogon gerardii* (big bluestem), *Arctostaphylos uva-ursi* (kinnikinnick), *Carex pensylvanica* (Pennsylvania sedge), *Danthonia spicata* (poverty oatgrass), *Deschampsia caespitosa* (tufted hairgrass), *Gaylussacia baccata* (black huckleberry), *Morella pensylvanica* (northern bayberry), *Schizachyrium scoparium* (little bluestem), *Solidago nemoralis* (gray goldenrod), *Vaccinium angustifolium* (lowbush blueberry)

Other Noteworthy Species:

Species	GRank	Type	Note
Helianthemum dumosum (bushy frostweed)	G3	plant	
Liatris scariosa var. *novae-angliae* (New England blazing star)	G5?T3	plant	
Linum intercursum (sandplain flax)	-	plant	state-vulnerable

USFWS Wetland System: Not applicable

DISTRIBUTION

Range: This association occurs in patches along the northeastern seacoast and on offshore islands of Massachusetts, Rhode Island, and New York.

States/Provinces: MA, NY:S1, RI

Federal Lands: NPS (Cape Cod, Fire Island); USFWS (Nomans Land Island)

CONSERVATION STATUS

Rank: G2 (2-Dec-1999)

Reasons: This sandplain grassland community is of naturally limited extent, confined to coastal sandplains well beyond primary dune systems. An estimated 60 to 80 occurrences exist rangewide. The size range of individual occurrences is generally fewer than 5 to several hundred

acres, and geographic range is confined to coastal Massachusetts and Long Island, New York. Human development pressure (residential and commercial building, airport and road expansion) and, in some cases, agriculture pose the greatest threat to this community.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: Sandplain grasslands are similar in species composition and environmental setting to sandplain heathlands. They differ in being more species-rich, having slightly higher soil fertility, and having less shrub cover.

Dunwiddie et al. (1993) have subdivided this community into two variants based on differences in the relative abundances and dominance patterns of the component species. They refer to these as (1) Little bluestem grassland, dominated by *Schizachyrium scoparium* (little bluestem) and containing many rare species, and (2) Hairgrass grassland, dominated by *Danthonia spicata* (poverty oatgrass) and generally less species-rich than the little bluestem sites. Because the whole complex is rare and because some of these divisions are somewhat finer than those recognized by other states, we are categorizing the entire complex as a single element. However, the finer subdivisions are useful for site management, and further research may justify the acknowledgement of the subdivisions at the element level.

Similar Associations:

- *Gaylussacia baccata - Vaccinium angustifolium - Arctostaphylos uva-ursi / Schizachyrium littorale* Dwarf-shrubland (CEGL006066)
- *Morella (pensylvanica, cerifera) / Schizachyrium littorale - Eupatorium hyssopifolium* Shrub Herbaceous Vegetation (CEGL004240)
- *Vaccinium angustifolium / Schizachyrium scoparium - Carex lucorum* Shrub Herbaceous Vegetation (CEGL006393)

Related Concepts:

- Heathy grassland (Dunwiddie et al. 1996) F
- High-diversity native grassland (Dunwiddie et al. 1996) F
- Moorland (Lundgren 2000) ?
- Pennsylvania sedge grassland (Dunwiddie et al. 1996) F
- Sandplain Grassland (Rawinski 1984) ?

SOURCES

Description Authors: S.L. Neid and L.A. Sneddon

References: Askings 1997, Dowhan and Rozsa 1989, Dunwiddie and Caljouw 1990, Dunwiddie et al. 1993, Dunwiddie et al. 1996, Dunwiddie et al. 1997, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Goldstein 1997, Lundgren 1998, Lundgren 2000, Rawinski 1984, Reschke 1990, Sneddon and Lundgren 2001, Swain and Kearsley 2001, Taylor 1923



Figure 79. Sandplain Grassland in Cape Cod National Seashore (no specific plot). September 2007. UTM coordinates not available.

COMMON NAME (PARK-SPECIFIC): MEDIUM FEN

SYNONYMS

USNVC English Name: **Sweet Gale - Leatherleaf / (Wiregrass Sedge, Northwest Territory Sedge) - Bladderwort species Shrub Herbaceous Vegetation**

USNVC Scientific Name: ***Myrica gale* - *Chamaedaphne calyculata* / *Carex* (*lasiocarpa, utriculata*) - *Utricularia* spp. Shrub Herbaceous Vegetation**

USNVC Identifier: **CEGL006302**

LOCAL INFORMATION

Environmental Description: This association is found in Coastal Plain ponds in old interdunal depressions. The substrate is peat and is generally floating during high water periods and underlain by sand during low water periods. The substrate is nearly always saturated. There is minor nutrient input from groundwater flow from surrounding high dunes.

Vegetation Description: This association is dominated by *Carex lasiocarpa* (woollyfruit sedge) growing in a mat of *Sphagnum* (sphagnum) and other mosses. The most common associates are *Triadenum virginicum* (Virginia marsh St. Johnswort), *Drosera intermedia* (spoonleaf sundew) and *Drosera rotundifolia* (roundleaf sundew), and *Calamagrostis canadensis* (bluejoint). Shrubs and stunted trees occur at low cover and include *Vaccinium corymbosum* (highbush blueberry), *Clethra alnifolia* (coastal sweetpepperbush), *Acer rubrum* (red maple), and *Rhododendron viscosum* (swamp azalea).

Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Acer rubrum* (red maple)
		Clethra alnifolia (coastal sweetpepperbush)
		Vaccinium corymbosum (highbush blueberry)
Herb (field)	Forb	*Triadenum virginicum* (Virginia marsh St. Johnswort)
Herb (field)	Graminoid	*Calamagrostis canadensis* (bluejoint)
		Carex lasiocarpa (woollyfruit sedge)

Characteristic Species: Information not available.

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S3*	I	1	Acidic Graminoid Fen	Swain and Kearsley 2001

Local Range: This association is currently known only from the ponds in the Provincelands.

Classification Comments: This association is known from an unnamed pond between the Beech Forest Parking Lot and Great Pond and from the large fen at Clapps Pond. The Clapps Pond occurrence was not sampled because it was first located late in the growing season. It is very diverse and intergrades with the dwarf-shrub bog and other sedge-dominated communities.

Other Comments: The concept of the Acidic Graminoid Fen described in Swain and Kearlsey 2001 intersects with the concept of the Medium Fen in the USNVC, but they are not equivalent.

Local Description Authors: R.E. Zaremba

Plots: CACO.092.

AA (2004) Points: CACO.138

Cape Cod National Seashore Inventory Notes: Mapped in the Fen aggregated map class in the vegetation map. Photograph not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland with a sparse shrub layer (V.A.7.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland with a sparse shrub layer (V.A.7.N.)
Formation	Saturated temperate or subpolar grassland with a sparse broad-leaved evergreen shrub layer (V.A.7.N.o.)
Alliance	*Chamaedaphne calyculata / Carex lasiocarpa* Saturated Shrub Herbaceous Alliance (A.1557)
Alliance (English name)	Leatherleaf / Wiregrass Sedge Saturated Shrub Herbaceous Alliance
Association	*Myrica gale - Chamaedaphne calyculata / Carex (lasiocarpa, utriculata) - Utricularia* spp. Shrub Herbaceous Vegetation
Association (English name)	Sweet Gale - Leatherleaf / (Wiregrass Sedge, Northwest Territory Sedge) - Bladderwort species Shrub Herbaceous Vegetation
Ecological System(s):	Boreal-Laurentian-Acadian Acidic Basin Fen (CES201.583). North-Central Interior and Appalachian Acidic Peatland (CES202.606).

GLOBAL DESCRIPTION

Concept Summary: This fen vegetation is found in peatlands and peaty lakesides of the northeastern United States. It occurs in acidic waters receiving weakly minerotrophic input from surface water inflow or seepage from surrounding uplands. The substrate may be flooded at high water, and remains saturated through the growing season. pH is acidic to circumneutral, 4.8–6.8. Tall, rhizomatous sedges dominate the vegetation, with shrubs often shorter than the graminoids. Bryophyte cover is variable. Scattered shrubs of *Alnus incana* (gray alder) and *Spiraea alba* (white meadowsweet) may protrude above the graminoid cover; shorter shrubs such as *Myrica gale* (sweetgale), *Andromeda polifolia var. glaucophylla* (bog rosemary), *Vaccinium macrocarpon* (cranberry), and *Chamaedaphne calyculata* (leatherleaf) grow among the sedges. The dominant sedges are usually *Carex lasiocarpa* (woollyfruit sedge) or *Carex utriculata* (Northwest Territory sedge); associates include *Carex oligosperma* (fewseed sedge), *Carex exilis* (coastal sedge), *Carex vesicaria* (blister sedge), *Carex limosa* (mud sedge), *Carex canescens* (silvery sedge), *Carex lacustris* (hairy sedge), *Carex stricta* (upright sedge) (non-tussock form), *Carex oligosperma* (fewseed sedge), *Rhynchospora alba* (white beaksedge), *Calamagrostis canadensis* (bluejoint), *Cladium mariscoides* (smooth sawgrass), *Eriophorum angustifolium* (tall cottongrass), *Eriophorum virginicum* (tawny cottongrass), and *Dulichium arundinaceum* (threeway sedge). Forbs include *Lysimachia terrestris* (earth loosestrife), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Osmunda regalis* (royal fern), *Comarum palustre* (purple marshlocks), *Drosera intermedia* (spoonleaf sundew), *Utricularia intermedia* (flatleaf bladderwort), and *Pogonia ophioglossoides* (snakemouth orchid). The bryophyte layer is dominated by species of *Sphagnum* (sphagnum), including *Sphagnum fallax* (sphagnum), *Sphagnum papillosum* (papillose sphagnum), *Sphagnum cuspidatum* (toothed sphagnum), *Sphagnum fimbriatum* (sphagnum), *Sphagnum centrale* (sphagnum), *Sphagnum lescurii* (Lescur's sphagnum), and others. This fen vegetation is distinguished by the dominance of *Carex lasiocarpa* (woollyfruit sedge) and the absence of any richness indicators such as *Dasiphora fruticosa ssp. floribunda* (shrubby cinquefoil).

Environmental Description: This fen vegetation is found in peatlands and peaty lakesides of the northeastern United States. It occurs in acidic waters receiving weakly minerotrophic input from surface water inflow or seepage from surrounding uplands. The substrate may be flooded at

high water, and remains saturated through the growing season. pH is acidic to circumneutral, 4.8–6.8. Peat tends to be shallow.

Vegetation Description: Tall, rhizomatous sedges dominate the vegetation, with shrubs often shorter than the graminoids. Bryophyte cover is variable. Scattered shrubs of *Alnus incana* (gray alder) and *Spiraea alba* (white meadowsweet) may protrude above the graminoid cover; shorter shrubs such as *Myrica gale* (sweetgale), *Andromeda polifolia var. glaucophylla* (bog rosemary), *Vaccinium macrocarpon* (cranberry), and *Chamaedaphne calyculata* (leatherleaf) grow among the sedges. The dominant sedges are usually *Carex lasiocarpa* (woollyfruit sedge) or *Carex utriculata* (Northwest Territory sedge); associates include *Carex oligosperma* (fewseed sedge), *Carex exilis* (coastal sedge), *Carex vesicaria* (blister sedge), *Carex limosa* (mud sedge), *Carex canescens* (silvery sedge), *Carex lacustris* (hairy sedge), *Carex stricta* (upright sedge) (non-tussock form), *Rhynchospora alba* (white beaksedge), *Calamagrostis canadensis* (bluejoint), *Cladium mariscoides* (smooth sawgrass), *Eriophorum angustifolium* (tall cottongrass), *Eriophorum virginicum* (tawny cottongrass), and *Dulichium arundinaceum* (threeway sedge). Forbs include *Lysimachia terrestris* (earth loosestrife), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Osmunda regalis* (royal fern), *Comarum palustre* (purple marshlocks), *Drosera intermedia* (spoonleaf sundew), *Utricularia intermedia* (flatleaf bladderwort), and *Pogonia ophioglossoides* (snakemouth orchid). The bryophyte layer is dominated by species of *Sphagnum* (sphagnum), including *Sphagnum fallax* (sphagnum), *Sphagnum papillosum* (papillose sphagnum), *Sphagnum cuspidatum* (toothed sphagnum), *Sphagnum fimbriatum* (sphagnum), *Sphagnum centrale* (sphagnum), *Sphagnum lescurii* (Lescur's sphagnum), and others.

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved evergreen shrub	*Chamaedaphne calyculata* (leatherleaf)
		Myrica gale (sweetgale)
Herb (field)	Graminoid	*Carex lasiocarpa* (woollyfruit sedge)
		Carex utriculata (Northwest Territory sedge)

Characteristic Species: *Carex lasiocarpa* (woollyfruit sedge), *Carex utriculata* (Northwest Territory sedge), *Chamaedaphne calyculata* (leatherleaf), *Myrica gale* (sweetgale)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine

DISTRIBUTION

Range: Information not available.

States/Provinces: CT, MA, ME, NH, NY, PA, RI, VT

Federal Lands: NPS (Acadia, Cape Cod); USFWS (Pondicherry?)

CONSERVATION STATUS

Rank: G4G5 (31-Dec-1997)

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: Information not available.

Similar Associations:

- *Carex (rostrata, utriculata) - Carex lacustris - (Carex vesicaria)* Herbaceous Vegetation (CEGL002257)
- *Myrica gale - Chamaedaphne calyculata / Carex exilis* Shrub Herbaceous Vegetation (CEGL006392)
- *Myrica gale - Dasiphora fruticosa* ssp. *floribunda / Carex lasiocarpa - Cladium mariscoides* Shrub Herbaceous Vegetation (CEGL006068)

Related Concepts:

- *Carex rostrata* fen (Damman and French 1987) ?
- *Carex* spp. sedge fen (Anderson and Davis 1997) ?
- Palustrine Scrub-Shrub and Emergent Broad-leaved Evergreen Saturated Wetland (PSS3/EMB) (Cowardin et al. 1979) ?
- Poor Fen (Thompson 1996) ?
- SNE acidic basin fen (Rawinski 1984) ?

SOURCES

Description Authors: S.C. Gawler

References: Anderson and Davis 1997, Cowardin et al. 1979, Damman and French 1987, Eastern Ecology Working Group n.d., Fike 1999, Gawler 2002, Metzler and Barrett 2001, Olivero 2001, Rawinski 1984, Sperduto et al. 2000a, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000

COMMON NAME (PARK-SPECIFIC): NORTHEASTERN LEAFY FORB MARSH

SYNONYMS

USNVC English Name: **Pickerelweed - Green Arrow-arum - Broadleaf Arrowhead Herbaceous Vegetation**

USNVC Scientific Name: ***Pontederia cordata - Peltandra virginica - Sagittaria latifolia* Herbaceous Vegetation**

USNVC Identifier: **CEGL006191**

LOCAL INFORMATION

Environmental Description: This association occurs along the borders of a Coastal Plain stream. The stream is not tidal, but may rarely be flooded by brackish water during storm events mostly during the dormant season. The substrate is peat mixed with loose organics. During all but the driest periods, the community is floating.

Vegetation Description: This very diverse community is dominated by *Peltandra virginica* (green arrow arum) with *Spiraea tomentosa* (steeplebush) and *Decodon verticillatus* (swamp loosestrife). *Calamagrostis canadensis* (bluejoint) and *Thelypteris palustris* (eastern marsh fern) are also common. Other associates include *Scirpus cyperinus* (woolgrass), *Typha latifolia* (broadleaf cattail), *Impatiens capensis* (jewelweed), *Bidens discoidea* (small beggarticks), *Polygonum hydropiperoides* (swamp smartweed) and *Polygonum arifolium* (halberdleaf tearthumb), and scattered *Carex* (sedge) spp.

Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Acer rubrum* (red maple)
		Decodon verticillatus (swamp loosestrife)
		Spiraea tomentosa (steeplebush)
Herb (field)	Forb	*Peltandra virginica* (green arrow arum)
Herb (field)	Graminoid	*Calamagrostis canadensis* (bluejoint)
Herb (field)	Fern or fern ally	*Thelypteris palustris* (eastern marsh fern)

Characteristic Species: Information not available.

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S4*	B	1	Deep Emergent Marsh	Swain and Kearsley 2001

Local Range: This association is known form the Herring River in Wellfleet.

Classification Comments: The sampled occurrence is in the Herring River on the east side of Route 6. There are likely additional occurrences of this association elsewhere in the Herring River/Bound Brook region.

Other Comments: The communities described in the MA vegetation classification and the USNVC are not equivalent in concept. The MA community type, Deep Emergent Marsh, is broader in concept than the USNVC association, Northeastern Leafy Forb Marsh.

Local Description Authors: R.E. Zaremba

Plots: CACO.013.

AA (2004) Points: CACO.190

Cape Cod National Seashore Inventory Notes: Mapped in the Freshwater Marsh aggregated map class in the vegetation map. Photograph not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial forb vegetation (V.B.)
Physiognomic Group	Temperate or subpolar perennial forb vegetation (V.B.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar perennial forb vegetation (V.B.2.N.)
Formation	Semipermanently flooded temperate perennial forb vegetation (V.B.2.N.e.)
Alliance	*Pontederia cordata - Peltandra virginica* Semipermanently Flooded Herbaceous Alliance (A.1669)
Alliance (English name)	Pickerelweed - Green Arrow-arum Semipermanently Flooded Herbaceous Alliance
Association	*Pontederia cordata - Peltandra virginica - Sagittaria latifolia* Herbaceous Vegetation
Association (English name)	Pickerelweed - Green Arrow-arum - Broadleaf Arrowhead Herbaceous Vegetation
Ecological System(s):	Laurentian-Acadian Freshwater Marsh (CES201.594).

GLOBAL DESCRIPTION

Concept Summary: Emergent marsh dominated by broad-leaved, aerenchymatous plants along pondshores, lakeshores, impoundments, and quiet riverbanks in the northeastern United States and elsewhere. This marsh occurs in shallow to deep standing water usually on muck soils. Common species include *Pontederia cordata* (pickerelweed), *Sagittaria latifolia* (broadleaf arrowhead), *Peltandra virginica* (green arrow arum), and *Sparganium* (bur-reed) spp. Additional emergent species include *Eleocharis palustris* (common spikerush), *Schoenoplectus tabernaemontani* (softstem bulrush), *Acorus calamus* (calamus), *Nuphar lutea ssp. variegata* (variegated yellow pond-lily), *Nymphaea odorata* (American white waterlily), *Sium suave* (hemlock waterparsnip), and submerged species including *Ceratophyllum demersum* (coon's tail) and *Utricularia macrorhiza* (common bladderwort).

Environmental Description: This association occurs along pondshores, lakeshores, impoundments, and quiet riverbanks in shallow to deep standing water usually on muck soils.

Vegetation Description: Common species include *Pontederia cordata* (pickerelweed), *Sagittaria latifolia* (broadleaf arrowhead), *Peltandra virginica* (green arrow arum), and *Sparganium* (bur-reed) spp. Additional emergent species include *Eleocharis palustris* (common spikerush), *Schoenoplectus tabernaemontani* (softstem bulrush), *Acorus calamus* (calamus), *Nuphar lutea ssp. variegata* (variegated yellow pond-lily), *Nymphaea odorata* (American white waterlily), *Sium suave* (hemlock waterparsnip), and submerged species including *Ceratophyllum demersum* (coon's tail) and *Utricularia macrorhiza* (common bladderwort).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Peltandra virginica* (green arrow arum)
		Pontederia cordata (pickerelweed)
		Sagittaria latifolia (broadleaf arrowhead)

Characteristic Species: *Peltandra virginica* (green arrow arum), *Pontederia cordata* (pickerelweed), *Sagittaria latifolia* (broadleaf arrowhead)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine

DISTRIBUTION

Range: This association occurs in the northeastern United States.

States/Provinces: CT, MA, ME, NH, NJ, NY, PA, RI, VT

Federal Lands: NPS (Cape Cod, Saratoga); USFWS (Great Meadows, Great Swamp?)

CONSERVATION STATUS
Rank: G5 (19-Jan-2006)
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: Information not available.
Similar Associations:
- *Peltandra virginica - Pontederia cordata* Tidal Herbaceous Vegetation (CEGL004706)

Related Concepts:
- Deep Rush Marsh (Thompson 1996) B
- Palustrine Broad-leaved Nonpersistent Emergent Wetland, Permanently Flooded (PEM4H) (Cowardin et al. 1979) ?
- Southern New England nutrient-poor streamside/lakeside marsh (Rawinski 1984) ?
- Southern New England nutrient-rich streamside/lakeside marsh (Rawinski 1984) ?

SOURCES
Description Authors: S.L. Neid
References: Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fike 1999, Gawler 2002, Metzler and Barrett 2001, NRCS 2004, Rawinski 1984, Sperduto 2000a, Swain and Kearsley 2000, Thompson 1996, Thompson and Sorenson 2000

COMMON NAME (PARK-SPECIFIC): NORTH ATLANTIC COASTAL PLAIN RIVER BRACKISH INTERTIDAL MUDFLAT

SYNONYMS
USNVC English Name: **Awl-leaf Arrowhead - Awlwort Tidal Herbaceous Vegetation**
USNVC Scientific Name: ***Sagittaria subulata* - *Limosella australis* Tidal Herbaceous Vegetation**
USNVC Identifier: **CEGL004473**

LOCAL INFORMATION

Environmental Description: This community occurs along the upper tidal border of a Coastal Plain river where freshwater seepage from the outwash-deposit uplands mixes with brackish water. The substrate is light organics over gravel. There may be periodic erosion of sites during severe weather events, but most of the time wave conditions are calm allowing siltation and the persistence of shallow-rooted plants. The community is very narrow, generally less than 1 m and occurs in small patches along the tidal river. The community probably moves around within a fairly narrow section of the river over time.
Vegetation Description: This low graminoid community is dominated by *Limosella australis* (Welsh mudwort) which can locally form a "lawn," occurring in small linear patches. Common graminoid associates include *Juncus effusus* (common rush), *Juncus canadensis* (Canadian rush), *Juncus articulatus* (jointleaf rush), *Festuca filiformis* (fineleaf sheep fescue), *Carex pseudocyperus* (cypresslike sedge), and *Anthoxanthum odoratum* (sweet vernalgrass). Other frequent associates include *Polygonum arifolium* (halberdleaf tearthumb) and *Polygonum hydropiperoides* (swamp smartweed), *Thelypteris palustris* (eastern marsh fern), *Symphyotrichum novi-belgii* (New York aster), *Iris versicolor* (harlequin blueflag), *Epilobium* (willowherb) sp., and *Ptilimnium capillaceum* (herbwilliam). There are scattered concentrations of mosses in this community.
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Limosella australis* (Welsh mudwort)
Herb (field)	Graminoid	*Festuca filiformis* (fineleaf sheep fescue)
		Juncus effusus (common rush)

Characteristic Species: *Limosella australis* (Welsh mudwort)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S3*	B	1	Estuarine Intertidal: Saline / Brackish Flats	Swain & Kearsley 2001

Local Range: This association is known only from the Monomoy River between Chatham and Harwich.
Classification Comments: Only one occurrence of this community was seen during this study. There may be other occurrences in very small patches or in compromised situations, such as under *Phragmites* (reed). Areas to search in particular might include the Herring River, Pamet River, and Hatches Creek.
Other Comments: North Atlantic Coastal Plain River Brackish Intertidal Mudflat differs from North Atlantic Coast Intertidal Mudflat in the fact that salinity levels range from 0.5–18.0 ppt; it lacks the macroalgae component of North Atlantic Coast Intertidal Mudflat; and occurs along tidal coastal plain rivers rather than along the coastal shoreline.

Local Description Authors: R.E. Zaremba
Plots: CACO.128.
AA (2004) Points: None.
Cape Cod National Seashore Inventory Notes: Plot CACO.128 occurs along the Monomoy River between Chatham and Harwich and is located outside of the CACO boundary.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial forb vegetation (V.B.)
Physiognomic Group	Temperate or subpolar perennial forb vegetation (V.B.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar perennial forb vegetation (V.B.2.N.)
Formation	Tidal temperate perennial forb vegetation (V.B.2.N.g.)
Alliance	*Sagittaria subulata - Limosella australis* Tidal Herbaceous Alliance (A.1710)
Alliance (English name)	Awl-leaf Arrowhead - Awlwort Tidal Herbaceous Alliance
Association	*Sagittaria subulata - Limosella australis* Tidal Herbaceous Vegetation
Association (English name)	Awl-leaf Arrowhead - Awlwort Tidal Herbaceous Vegetation
Ecological System(s):	Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260). Northern Atlantic Coastal Plain Brackish Tidal Marsh (CES203.894). Atlantic Coastal Plain Embayed Region Tidal Freshwater Marsh (CES203.259).

GLOBAL DESCRIPTION

Concept Summary: This brackish (salinity levels range from 0.5–18.0 ppt) tidal flat community occurs along the northeastern Atlantic Coast on muddy to sandy substrates of broad, flat tidal rivershores. The flats are exposed at low tide and submerged at high tide. Vegetation is of variable cover and may be quite sparse. Characteristic plants are low-growing rosette species such as *Sagittaria subulata* (awl-leaf arrowhead), *Sagittaria calycina var. spongiosa* (hooded arrowhead), *Limosella australis* (Welsh mudwort), *Lilaeopsis chinensis* (eastern grasswort), *Festuca filiformis* (fineleaf sheep fescue), *Polygonum arifolium* (halberdleaf tearthumb), *Polygonum hydropiperoides* (swamp smartweed), *Ptilimnium capillaceum* (herbwilliam), *Zannichellia palustris* (horned pondweed), and *Eleocharis parvula* (dwarf spikerush).
Environmental Description: These communities occur on gently sloping intertidal mud flats and occasionally in tidal creek channels exposed at low tide. The flats are fresh to brackish and are diurnally flooded by tides. These are best developed along broad, flat areas protected from direct wave action, occurring behind barrier beaches or along tidal rivers. Substrate is generally silty mud with high organic matter content and can have greater sand component in settings with relatively more water energy.
Vegetation Description: These brackish intertidal mud flats are sparsely vegetated with low-growing, rosette-forming herbs. Characteristic plants are low-growing rosette species and others such as *Sagittaria subulata* (awl-leaf arrowhead), *Sagittaria calycina var. spongiosa* (hooded arrowhead), *Limosella australis* (Welsh mudwort), *Lilaeopsis chinensis* (eastern grasswort), *Festuca filiformis* (fineleaf sheep fescue), *Polygonum arifolium* (halberdleaf tearthumb), *Polygonum hydropiperoides* (swamp smartweed), *Ptilimnium capillaceum* (herbwilliam), *Zannichellia palustris* (horned pondweed), and *Eleocharis parvula* (dwarf spikerush).
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Limosella australis* (Welsh mudwort)
		Sagittaria subulata (awl-leaf arrowhead)

Characteristic Species: *Limosella australis* (Welsh mudwort), *Sagittaria calycina* var. *spongiosa* (hooded arrowhead), *Sagittaria subulata* (awl-leaf arrowhead)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

DISTRIBUTION
Range: This association occurs along the Atlantic coast from Maine to Virginia. It may also occur in Canada.
States/Provinces: CT, DE, LB?, MA, MD, ME, NB?, NF?, NH, NJ:S1S3, NS?, NY, PE?, QC?, RI, VA?
Federal Lands: NPS (Cape Cod); USFWS (Chincoteague)

CONSERVATION STATUS
Rank: G2G4 (19-Jan-2006)
Reasons: This vegetation occurs in the Chesapeake and Delaware Bay estuaries, ranging north to northern New England; presence in Canada is not confirmed and requires review. More information on classification and distribution is required to determine the global rank with more precision.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: Classification of this vegetation on Cape Cod is problematic, where it occurs in very small patches. Classification of this type on Cape Cod must be considered provisional until further rangewide data are collected.
Similar Associations:
- *Eriocaulon parkeri - Polygonum punctatum* Herbaceous Vegetation (CEGL006352)--occurs on sandy substrates, not mud flats.
- Intertidal Mudflats Sparse Vegetation (CEGL006614)--occurs on saline intertidal mudflats; salinity levels are greater than 18.0 ppt; *Ulva lactuca* may be present but typically these mudflats lack vegetation.
- *Isoetes riparia* Tidal Herbaceous Vegetation (CEGL006058)--occurs in freshwater tidal conditions.

Related Concepts:
- Southern New England/Gulf of Maine Fresh/ Brackish Subtidal Estuarine Community (Rawinski 1984) ?
- Southern New England/Gulf of Maine Saline/ Brackish Intertidal Flat (Rawinski 1984) ?

SOURCES
Description Authors: S.L. Neid and L.A. Sneddon
References: Bowman 2000, Breden et al. 2001, Coulling 2002, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Gawler 2002, Harrison 2004, Harrison and Stango 2003, Metzler and Barrett 2001, Rawinski 1984, Reschke 1990, Sperduto 2000b, Sperduto and Nichols 2004, Swain and Kearsley 2001, Whitlatch 1982



Figure 80. North Atlantic Coastal Plain River Brackish Intertidal Mudflat in Cape Cod National Seashore (plot CACO.128). Summer 2003. NAD 1983 / UTM easting 416615, northing 4617741.

COMMON NAME (PARK-SPECIFIC): SALT PANNE (SALICORNIA TYPE)

SYNONYMS

USNVC English Name: **(Virginia Glasswort, Dwarf Glasswort, Sea Saltwort) - Saltmarsh Cordgrass Herbaceous Vegetation**

USNVC Scientific Name: ***Salicornia* (*virginica, bigelovii, maritima*) - *Spartina alterniflora* Herbaceous Vegetation**

USNVC Identifier: **CEGL004308**

LOCAL INFORMATION

Environmental Description: This association occurs at the upper edges of salt marshes where the substrate is flat and drainage is poor. The substrate is sand mixed with fine organics and may include blue-green algae in mats which can further reduce drainage. Drift material may accumulate periodically in the location of this community and smother plants. High water from subsequent storms or very high spring tides may move drift accumulations exposing new unvegetated substrate which is colonized by plants that form this association. One unusual variant of this community occurs in a brackish tidal marsh where poor drainage results in impounded brackish water which evaporates and concentrates salts. Species composition may vary from year to year at a site, based on drainage patterns and seed availability.

Vegetation Description: This association is dominated by annuals and perennials that establish quickly and are ephemeral. Dominant species can vary but most often include *Salicornia maritima* (slender grasswort), *Suaeda maritima* (herbaceous seepweed), and *Atriplex patula* (spear saltbush). Also frequently present, but in lower cover, are *Spartina alterniflora* (smooth cordgrass), *Spartina patens* (saltmeadow cordgrass), *Distichlis spicata* (inland saltgrass), *Juncus gerardii* (saltmeadow rush), and *Puccinellia maritima* (seaside alkaligrass). In one unusual variant along a tidal creek in an embayment, *Pluchea odorata* (sweetscent) and *Eleocharis parvula* (dwarf spikerush) are dominants. Other common associates include *Limonium carolinianum* (Carolina sealavender) and *Symphyotrichum tenuifolium* (perennial saltmarsh aster). Fiddler crabs, blue-ribbed mussels, and snails are frequently abundant in this community.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Atriplex patula* (spear saltbush)
		Salicornia maritima (slender grasswort)
		Suaeda maritima (herbaceous seepweed)

Characteristic Species: *Salicornia maritima* (slender grasswort), *Suaeda maritima* (herbaceous seepweed)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S3*	B	1	Salt Marsh	Swain and Kearsley 2001

Local Range: This association occurs throughout the seashore within salt marshes.

Classification Comments: The Salt Marsh community described in Swain and Kearsley 2001 is broader in concept than the USNVC association Salt Panne and it includes multiple USNVC associations including North Atlantic High Salt Marsh, North Atlantic Low Salt Marsh, and Salt Panne.

Other Comments: Information not available.

Local Description Authors: R.E. Zaremba

Plots: CACO.001, CACO.021, CACO.053 (should be CACO.051-small inclusion mapped as North Atlantic Upper Ocean Beach (CEGL004400), CACO.077 (small inclusion mapped as North Atlantic Low Salt Marsh (CEGL004192), and CACO.089 (outside boundary).
AA (2004) Points: CACO.119, CACO.170, CACO.294, CACO.346, CACO.549
Cape Cod National Seashore Inventory Notes: This small patch association was mapped in the Salt Marsh aggregated map class in the vegetation map. It was typically mapped as an inclusion within the North Atlantic Low Salt Marsh association polygons.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial forb vegetation (V.B.)
Physiognomic Group	Temperate or subpolar perennial forb vegetation (V.B.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar perennial forb vegetation (V.B.2.N.)
Formation	Tidal temperate perennial forb vegetation (V.B.2.N.g.)
Alliance	*Sarcocornia perennis - (Distichlis spicata, Salicornia* spp.) Tidal Herbaceous Alliance (A.1704)
Alliance (English name)	Woody Glasswort - (Saltgrass, Saltwort species) Tidal Herbaceous Alliance
Association	*Salicornia (virginica, bigelovii, maritima) - Spartina alterniflora* Herbaceous Vegetation
Association (English name)	(Virginia Glasswort, Dwarf Glasswort, Sea Saltwort) - Saltmarsh Cordgrass Herbaceous Vegetation
Ecological System(s):	Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260). Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519). Central Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270). Acadian Coastal Salt Marsh (CES201.578).

GLOBAL DESCRIPTION

Concept Summary: This association represents tidally flooded hypersaline flats or very shallow depressions (pannes) dominated by halophytic herbs, including *Salicornia virginica* (Virginia glasswort), *Salicornia bigelovii* (dwarf saltwort), *Salicornia maritima* (slender grasswort), and stunted *Spartina alterniflora* (smooth cordgrass), that occur in salt marshes of the Atlantic Coast. Vegetation of this association tends to develop in shallow depressions within high or salt marshes where drainage is poor. The depressions are regularly to irregularly flooded by high tides, but as the water evaporates during low tide, the salinity concentration increases forming "salt pannes." Formation of the pannes may result from ice-scouring, rafting flotsam, peat compaction, mosquito ditch levees, or erosion of tidal creek banks, which create small, sparsely vegetated to unvegetated impoundments. Bare peat and/or mucky soils are prevalent (up to 85% bare soils). Total vegetative cover is variable in pannes, from near total absence of vascular plants to a dense cover of *Salicornia virginica* (Virginia glasswort), *Salicornia bigelovii* (dwarf saltwort), *Salicornia maritima* (slender grasswort), *Sarcocornia perennis* (chickenclaws), or *Spartina alterniflora* (smooth cordgrass) (short form). Common associates include *Limonium carolinianum* (Carolina sealavender), *Plantago maritima var. juncoides* (goose tongue), *Triglochin maritima* (seaside arrowgrass), *Spartina patens* (saltmeadow cordgrass), *Suaeda maritima* (herbaceous seepweed), and *Atriplex* (saltbush) spp. Algal mats are characteristically present, visible even in densely vegetated pannes. Blue-green algae are an important component of these mats, in some cases contributing significantly more biomass to the community than do

vascular species. Diagnostic species include *Salicornia bigelovii* (dwarf saltwort) and *Salicornia virginica* (Virginia glasswort).

Environmental Description: Vegetation of this association tends to develop in shallow depressions in salt marshes where drainage is poor. They tend to occur more frequently on the high marsh but occur within low marsh as well. Pannes form in depressions that range from 2–30 cm lower than the elevation of the marsh. The depressions are regularly to irregularly flooded by tides, and as the water evaporates during low tide, the salinity concentration increases forming "salt pannes." Substrate is soft, silty muck or peat of variable density.

Vegetation Description: This association includes tidally flooded hypersaline flats or very shallow depressions (pannes) dominated by halophytic herbs. Total vegetative cover is quite variable in pannes, from near total absence of vascular plants to a dense cover of *Salicornia virginica* (Virginia glasswort), *Salicornia bigelovii* (dwarf saltwort), *Salicornia maritima* (slender grasswort), *Sarcocornia perennis* (chickenclaws), or *Spartina alterniflora* (smooth cordgrass) (short form). Common associates include *Limonium carolinianum* (Carolina sealavender), *Plantago maritima var. juncoides* (goose tongue), *Triglochin maritima* (seaside arrowgrass), *Spartina patens* (saltmeadow cordgrass), *Suaeda maritima* (herbaceous seepweed), and *Atriplex* (saltbush) spp. Algal mats are characteristically present, visible even in densely vegetated pannes. Blue-green algae are an important component of these mats, in some cases contributing significantly more biomass to the community than do vascular species. The following algae were noted to occur in association with *Spartina alterniflora* (smooth cordgrass) in the littoral zone of a Massachusetts salt marsh: *Oscillatoria subuliformis, Oscillatoria amphibia, Lyngbea* spp., *Microcoleus chthonoplastes, Nodularia harveyana, Hydrocoleum lyngbyaceum,* and *Symploca* spp. (Webber 1967).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Semi-shrub	*Salicornia virginica* (Virginia glasswort)
		Sarcocornia perennis (chickenclaws)
Herb (field)	Forb	*Salicornia bigelovii* (dwarf saltwort)
Herb (field)	Graminoid	*Spartina alterniflora* (smooth cordgrass)

Characteristic Species: *Salicornia bigelovii* (dwarf saltwort), *Salicornia virginica* (Virginia glasswort), *Sarcocornia perennis* (chickenclaws)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Estuarine

DISTRIBUTION

Range: This association occurs along the Mid- and North Atlantic Coast from the Canadian maritime provinces south to North Carolina.

States/Provinces: CT, DE:S3, MA, MD, ME, NB, NC, NH, NJ:S3S4, NS, NY, RI, SC?, VA

Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Cape Lookout, Fire Island, Gateway); USFWS (Parker River, Prime Hook)

CONSERVATION STATUS

Rank: G5 (1-Dec-1997)

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: This community occurs in coastal salt marshes from Nova Scotia to the Carolinas, north of the range of *Batis maritima* (turtleweed). Salt pannes can potentially be classified based on morphology, salinity gradients, or substrate (Godfrey et al. 1978), which may elucidate further variation.

Similar Associations:
- *Batis maritima - Sarcocornia perennis* Dwarf-shrubland (CEGL003956)
- *Sarcocornia perennis - (Batis maritima, Distichlis spicata)* Dwarf-shrubland (CEGL002278)
- *Spartina alterniflora - Distichlis spicata* Tidal Herbaceous Vegetation [Provisional] (CEGL006586)

Related Concepts:
- *Salicornia - Bassia* salt flat (Harvill 1965) =
- *Salicornia europaea - Spartina alterniflora* community (Metzler and Barrett 1992) =
- *Salicornia virginica* Tidal Dwarf Shrubland (VDNH 2003) =
- *Salicornia* tidal flat (Clovis 1968) =
- *Salicornietum ambiguae* (Conard 1935) =
- *Sarcocornia perennis - (Distichlis spicata, Spartina alterniflora)* Dwarf-shrubland (Bartgis 1986) =
- *Spartina alterniflora / Salicornia europaea* community (Clancy 1993b) =
- Pan (Nichols 1920) =
- Panne (Good 1965) =
- Panne marsh (Baumann 1978b) =
- Pans (Higgins et al. 1971) =
- Pans (Hill 1986) =
- Salt Flat (Schafale 2000) =
- Salt Marsh (Rawinski 1984) ?
- Salt marsh complex, pannes (Breden 1989) =
- Salt pan (Klotz 1986) =
- Salt panne (Miller and Egler 1950) =
- Salt panne (Clancy 1993b) =
- Salt panne (Reschke 1990) =
- Stunted *Spartina alterniflora* community (Miller and Egler 1950) =

SOURCES

Description Authors: S.L. Neid

References: Bartgis 1986, Baumann 1978b, Bell et al. 2002, Berdine 1998, Bertness et al. 1992, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1993b, Clancy 1996, Clovis 1968, Conard 1935, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming 2001a, Fleming et al. 2001, Gawler 2001, Gawler 2002, Godfrey et al. 1978, Good 1965, Harrison 2004, Harvill 1965, Higgins et al. 1971, Hill 1986, Klotz 1986, Metzler and Barrett 1992, Metzler and Barrett 2001, Miller and Egler 1950, NRCS 2001b, Nichols 1920, Niering and Warren 1980, Peet et al. unpubl. data 2002, Rawinski 1984, Redfield 1972, Reschke 1990, Schafale 2000, Schafale and Weakley 1990, Sperduto 2000b, Swain and Kearsley 2001, VDNH 2003, Webber 1967



Figure 81. Salt Panne (Salicornia Type) in Cape Cod National Seahshore (plot CACO.001). Summer 2003. NAD 1983 / UTM easting 411265, northing 4642648.



Figure 82. Salt Panne (Salicornia Type) in Cape Cod National Seahshore (AA point CACO.170). September 2004. NAD 1983 / UTM easting 421378, northing 4629889.

COMMON NAME (PARK-SPECIFIC): COASTAL PLAIN POND

SYNONYMS
USNVC English Name: **White Water-lily - Robbins' Spikerush Herbaceous Vegetation**
USNVC Scientific Name: ***Nymphaea odorata* - *Eleocharis robbinsii* Herbaceous Vegetation**
USNVC Identifier: **CEGL006086**

LOCAL INFORMATION

Environmental Description: This vegetation community occurs on sand or mucky sand within Coastal Plain ponds. Floating aquatic vegetation covers 40–90% of the pond. Open water is typical. In one pond near Herring Cove, a relatively thick organic mat covers the unvegetated surface. In Clapps Pond in Provincetown, shrub-dominated islands are present.
Vegetation Description: *Nymphaea odorata* (American white waterlily) is the dominant floating aquatic forb. *Eleocharis robbinsii* (Robbins' spikerush) is also associated with the Coastal Plain pond community. Additional species may be present at low cover and can include *Juncus militaris* (bayonet rush), *Dulichium arundinaceum* (threeway sedge), *Phragmites australis* (common reed), *Decodon verticillatus* (swamp loosestrife), *Schoenoplectus americanus* (chairmaker's bulrush), *Xyris* (yelloweyed grass) sp., *Typha angustifolia* (narrowleaf cattail), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Eleocharis olivacea* (bright green spikerush), *Utricularia* (bladderwort) sp., and *Eriocaulon aquaticum* (sevenangle pipewort).
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Eleocharis robbinsii* (Robbins' spikerush)
Floating aquatic	Aquatic herb (floating & submergent)	*Nymphaea odorata* (American white waterlily)

Characteristic Species: *Eleocharis robbinsii* (Robbins' spikerush), *Nymphaea odorata* (American white waterlily)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S2*	B	1	Coastal Plain Pondshore	Swain and Kearsley 2001

Local Range: This community occurs near the Nauset Coast Guard area in Eastham, off of Cahoon Hollow Road in Wellfleet, Great Pond in Truro, and Clapps Pond, Herring Pond, and Beech Forest in Provincetown.
Classification Comments: None.
Other Comments: None.
Local Description Authors: E. Largay
Plots: None.
CACO AA (2004) points: CACO.169, CACO.514, CACO.428, CACO.467, CACO.140, CACO.194, CACO.145, CACO.144, CACO.143, CACO.350, CACO.253, CACO.255, CACO.285, CACO.307, CACO.478, CACO.515, CACO.544.
Cape Cod National Seashore Inventory Notes: Mapped in the Coastal Plain Pondshore aggregated map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Hydromorphic-rooted vegetation (V.C.)
Physiognomic Group	Temperate or subpolar hydromorphic-rooted vegetation (V.C.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar hydromorphic-rooted vegetation (V.C.2.N.)
Formation	Permanently flooded temperate or subpolar hydromorphic-rooted vegetation (V.C.2.N.a.)
Alliance	*Nymphaea odorata - Nuphar* spp. Permanently Flooded Temperate Herbaceous Alliance (A.1984)
Alliance (English name)	White Water-lily - Yellow Pond-lily species Permanently Flooded Temperate Herbaceous Alliance
Association	*Nymphaea odorata - Eleocharis robbinsii* Herbaceous Vegetation
Association (English name)	White Water-lily - Robbins' Spikerush Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Pondshore (CES203.518).

GLOBAL DESCRIPTION

Concept Summary: This hydromorphic Coastal Plain pond community ranges from southern New England to Maryland. It occurs in standing water in all but exceptionally dry years. The substrate is most often deep muck, but in oligotrophic ponds an organic layer may be absent or much reduced and the vegetation occurs on sand or mucky sand. Characteristic species include *Nymphaea odorata* (American white waterlily), *Nymphoides cordata* (little floatingheart), and *Eleocharis robbinsii* (Robbins' spikerush), with frequent associates including *Scleria reticularis* (netted nutrush), *Gratiola aurea* (golden hedgehyssop), *Proserpinaca pectinata* (combleaf mermaidweed), *Utricularia juncea* (southern bladderwort), *Brasenia schreberi* (watershield), *Pontederia cordata* (pickerelweed), *Ludwigia* (primrose-willow) spp., *Utricularia* (bladderwort) spp., and *Eriocaulon aquaticum* (sevenangle pipewort).

Environmental Description: This hydromorphic Coastal Plain pond community ranges from southern New England to Maryland. It occurs in standing water in all but exceptionally dry years. The substrate is most often deep muck, but in oligotrophic ponds, an organic layer may be absent or much reduced, and the vegetation occurs on sand or mucky sand.

Vegetation Description: Characteristic species include *Nymphaea odorata* (American white waterlily), *Nymphoides cordata* (little floatingheart), and *Eleocharis robbinsii* (Robbins' spikerush), with frequent associates including *Scleria reticularis* (netted nutrush), *Gratiola aurea* (golden hedgehyssop), *Proserpinaca pectinata* (combleaf mermaidweed), *Utricularia juncea* (southern bladderwort), *Brasenia schreberi* (watershield), *Pontederia cordata* (pickerelweed), *Ludwigia* (primrose-willow) spp., *Utricularia* (bladderwort) spp., and *Eriocaulon aquaticum* (sevenangle pipewort).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Eleocharis robbinsii* (Robbins' spikerush)
Floating aquatic	Aquatic herb (floating & submergent)	*Nymphaea odorata* (American white waterlily)
		Nymphoides cordata (little floatingheart)

Characteristic Species: Information not available.

Other Noteworthy Species: Information not available.

USFWS Wetland System: Lacustrine

DISTRIBUTION

Range: This association is limited to the Atlantic and Coastal plains from southern New England to Maryland.

States/Provinces: DE, MA, MD, NH, NJ:S1S2, NY, RI

Federal Lands: NPS (Cape Cod)

CONSERVATION STATUS

Rank: G2 (7-Dec-1998)

Reasons: This Coastal Plain pond association has an estimated 100–150 occurrences rangewide, but it is a small-patch community that totals fewer than 1000 acres. Coastal Plain ponds in general are threatened by hydrologic alteration (groundwater depletion), agricultural runoff, and recreation activities.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 1 - Strong

Comments: Information not available.

Similar Associations: Information not available.

Related Concepts:

- Coastal Plain Intermittent Pond (Breden 1989) B
- New England coastal plain pondshore (Rawinski 1984) ?

SOURCES

Description Authors: L.A. Sneddon

References: Breden 1989, Breden et al. 2001, Eastern Ecology Working Group n.d., Harrison 2004, Rawinski 1984, Sneddon 1994, Swain and Kearsley 2001



Figure 83. Coastal Plain Pond in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 416165, northing 4646701 (photo and GPS reading taken from shore at distance of approximately 20 m).

COMMON NAME (PARK-SPECIFIC): NORTHERN ATLANTIC COAST BEAKED DITCH-GRASS BED

SYNONYMS

USNVC English Name: **Beaked Ditch-grass Acadian/Virginian Zone Temperate Herbaceous Vegetation**

USNVC Scientific Name: ***Ruppia maritima Acadian*/*Virginian* Zone Temperate Herbaceous Vegetation**

USNVC Identifier: **CEGL006167**

LOCAL INFORMATION

Environmental Description: This community occurs in subtidal situations, deepwater pools and pannes, tidal creeks, and flats within salt marshes, or along tidal rivers. It also occurs in coastal salt ponds with polyhaline to mesohaline salinity levels.

Vegetation Description: *Ruppia maritima* (widgeongrass) is the dominant vegetation in this community.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Ruppia maritima* (widgeongrass)

Characteristic Species: *Ruppia maritima* (widgeongrass)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S4*	B	1	Estuarine Subtidal: Saline / Brackish Flats	Swain and Kearsley 2001

Local Range: Information not available.

Classification Comments: Information not available.

Other Comments: This vegetation was not sampled at Cape Cod National Seashore.

Local Description Authors: E. Largay

Plots: None.

AA (2004) Points: None.

Cape Cod National Seashore Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Hydromorphic-rooted vegetation (V.C.)
Physiognomic Group	Temperate or subpolar hydromorphic-rooted vegetation (V.C.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar hydromorphic-rooted vegetation (V.C.2.N.)
Formation	Permanently flooded - tidal temperate or subpolar hydromorphic-rooted vegetation (V.C.2.N.b.)
Alliance	*Ruppia maritima* Permanently Flooded - Tidal Temperate Herbaceous Alliance (A.1769)
Alliance (English name)	Beaked Ditch-grass Permanently Flooded - Tidal Temperate Herbaceous Alliance
Association	*Ruppia maritima* Acadian/Virginian Zone Temperate Herbaceous Vegetation
Association (English name)	Beaked Ditch-grass Acadian/Virginian Zone Temperate Herbaceous Vegetation
Ecological System(s):	Atlantic Coastal Plain Northern Salt Pond Marsh (CES203.892). Northern Atlantic Coastal Plain Seagrass Bed (CES203.246). Acadian Coastal Salt Marsh (CES201.578).

GLOBAL DESCRIPTION

Concept Summary: This brackish/saline tidal community of the central and northern Atlantic coast is dominated by *Ruppia maritima* (widgeongrass). It occurs in large beds in estuarine bays as well as small patches within brackish tidal creeks. Substrates are sand or muck, and salinity is generally brackish. *Ruppia maritima* (widgeongrass) has a wide range of salinity tolerance and overlaps with other species, although generally not in the same locations. Common associates include *Zannichellia palustris* (horned pondweed), *Stuckenia pectinata* (sago pondweed), and *Potamogeton perfoliatus* (claspingleaf pondweed) in brackish/fresh areas or *Zostera marina* (seawrack) as waters get deeper and more saline. There can also be a diverse array of macroalgae.

Environmental Description: This association occurs in habitats that are continuously flooded by brackish water; it occurs in subtidal situations, deepwater pools and pannes, tidal creeks, and flats within salt marshes, or along tidal rivers. It also occurs in coastal salt ponds with polyhaline to mesohaline salinity levels. Except in pannes or pools, which are more irregularly flooded, water levels fluctuate with diurnal tides and are generally less than 2 m deep at low tide, although certain areas may be exposed at extremely low tides. Substrate varies from sand to mud.

Vegetation Description: *Ruppia maritima* (widgeongrass) is strongly dominant in this association. It has a wide range of salinity tolerance and overlaps with other species, although generally not in the same locations. Common associates include *Zannichellia palustris* (horned pondweed), *Stuckenia pectinata* (sago pondweed), and *Potamogeton perfoliatus* (claspingleaf pondweed) in brackish to fresh areas and *Zostera marina* (seawrack) as waters get deeper and more saline. There can also be a diverse array of macroalgae. This association grades into eelgrass beds as salinity increases. As salinity decreases, *Ruppia maritima* (widgeongrass) becomes less prominent, and the community grades into fresh/brackish subtidal associations.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Ruppia maritima* (widgeongrass)

Characteristic Species: *Ruppia maritima* (widgeongrass)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Estuarine

DISTRIBUTION

Range: This association occurs along the mid- and north Atlantic coast from Maine to North Carolina.

States/Provinces: CT, DE:S4?, MA, MD, ME, NC?, NH, NJ:S3S4, NY, RI, VA

Federal Lands: NPS (Assateague Island, Cape Cod); USFWS (Back Bay?, Monomoy?, Parker River?)

CONSERVATION STATUS

Rank: GNR (1-Dec-1997)

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: *Ruppia maritima* (widgeongrass) tends to occur in shallower and slightly less saline waters than *Zostera marina* (seawrack) (Orth and Moore 1988). The range of this type is consistent with the "Virginian Province" and "Acadian Province" of Cowardin et al. (1979).

Similar Associations:

- *Ruppia maritima - Schoenoplectus maritimus* Herbaceous Vegetation (CEGL006370)
- *Schoenoplectus pungens - Eleocharis parvula* Herbaceous Vegetation (CEGL006398)
- *Stuckenia pectinata - Potamogeton perfoliatus - (Zannichellia palustris)* Tidal Herbaceous Vegetation (CEGL006027)
- *Zostera marina* Herbaceous Vegetation (CEGL004336)

Related Concepts:

- *Ruppia maritima* Acadian-Virginian Zone Temperate Herbaceous Vegetation (Bartgis 1986) =
- *Ruppia* Community (Moore et al. 2000) ?
- Polyhaline subtidal aquatic bed (Breden 1989) ?
- Southern New England & Gulf of Maine Saline/ Brackish Subtidal Estuarine Community (Rawinski 1984) ?

SOURCES

Description Authors: S.L. Neid and L.A. Sneddon

References: Bartgis 1986, Bowman 2000, Breden 1989, Breden et al. 2001, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming 2001a, Fleming et al. 2001, Gawler 2002, Harrison 2004, Metzler and Barrett 2001, Metzler and Barrett 2004, Moore et al. 2000, Orth and Moore 1988, Rawinski 1984, Reschke 1990, Schafale and Weakley 1990, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2001, Thayer et al. 1984



Figure 84. Northern Atlantic Coast Beaked Ditch-grass Bed in Cape Cod National Seashore (no specific plot). September 2007. NAD 1983 / UTM easting 418116, northing 4640717.

COMMON NAME (PARK-SPECIFIC): NORTH ATLANTIC UPPER OCEAN BEACH

SYNONYMS
USNVC English Name: **Sea-rocket - Northern Seaside Spurge Sparse Vegetation**
USNVC Scientific Name: ***Cakile edentula* ssp. *edentula* - *Chamaesyce polygonifolia* Sparse Vegetation**
USNVC Identifier: **CEGL004400**

LOCAL INFORMATION

Environmental Description: This association is found along the upper beach where drift material is deposited during winter storms. This community occurs in a range of settings from the base of foredunes along accreting beaches to washover flats and the upper edges of salt marshes. The substrate is sandy and highly ephemeral. The site of this association is often eliminated by storms early in the winter and replaced by new substrates and organic debris later in the winter. Soils are droughty and may be flooded during the growing season by storms, when plants intolerant of saltwater are killed.
Vegetation Description: This association is highly variable from site to sites and from year to year. Plant density is usually very low. Most frequent species include *Cakile edentula* (American searocket), *Xanthium strumarium var. canadense* (Canada cockleburr), *Salsola kali ssp. kali* (Russian thistle), *Chamaesyce polygonifolia* (seaside sandmat), *Atriplex patula* (spear saltbush), and *Ammophila breviligulata* (American beachgrass). Other less frequent species include *Honckenya peploides ssp. robusta* (seaside sandplant) and *Atriplex cristata* (crested saltbush).
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Cakile edentula* (American searocket)
		Honckenya peploides ssp. *robusta* (seaside sandplant)
		Salsola kali ssp. *kali* (Russian thistle)
		Xanthium strumarium var. *canadense* (Canada cockleburr)

Characteristic Species: *Cakile edentula* (American searocket), *Honckenya peploides* ssp. *robusta* (seaside sandplant), *Xanthium strumarium* var. *canadense* (Canada cockleburr)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S3	=	1	Maritime Beach Strand	Swain and Kearsley 2001

Local Range: This association occurs throughout the seashore on sandy beaches. Many examples are lost to ATV use and sun bathing.
Classification Comments: Many of the driftlines in the seashore are very disturbed by people using the beach. The approved location of beach vehicle use is often in the location of driftlines (Race Point, Herring Cove Beach, and Nauset Beach). The upper edge of salt marshes which would support driftline vegetation are also often the site of roads (Salt Pond and Hatches Harbor). There are good examples of driftlines at Race Point, the Gut in Wellfleet, Nauset Beach, and Long Point. Plover and least tern exclosures that limit vehicle and pedestrian use from the upper beach often support good examples of this association.
Other Comments: The USNVC association and Swain and Kearsley 2001 community are equivalent in concept.
Local Description Authors: R.E. Zaremba
Plots: CACO.045, CACO.065, CACO.085, CACO.103.

AA (2004) Points: CACO.378, CACO.568
Cape Cod National Seashore Inventory Notes: Mapped in the Beach aggregated association map class in the vegetation map.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Sparse Vegetation (VII)
Physiognomic Subclass	Unconsolidated material sparse vegetation (VII.C.)
Physiognomic Group	Sparsely vegetated sand flats (VII.C.2.)
Physiognomic Subgroup	Natural/Semi-natural sparsely vegetated sand flats (VII.C.2.N.)
Formation	Sand flats (VII.C.2.N.a.)
Alliance	*Cakile edentula* Sparsely Vegetated Alliance (A.1861)
Alliance (English name)	Sea-rocket Sparsely Vegetated Alliance
Association	*Cakile edentula* ssp. *edentula* - *Chamaesyce polygonifolia* Sparse Vegetation
Association (English name)	Sea-rocket - Northern Seaside Spurge Sparse Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Sandy Beach (CES203.301). Central Atlantic Coastal Plain Sandy Beach (CES203.064).

GLOBAL DESCRIPTION

Concept Summary: This is a sparsely vegetated upper beach community occurring on unstable sands and often gravels and cobbles just above mean high tide on maritime beaches and foredunes along the middle and northern Atlantic coast. This association occurs at the wrack line; there is regular deposition of wave-deposited flotsam. They are irregularly flooded by spring or storm tides. Vegetation cover is variable, depending on the amount of exposure to wave and wind action, but is generally sparse and characterized by annuals and biennials. Species composition can change dramatically from year to year but frequently includes *Cakile edentula ssp. edentula* (American searocket), as well as *Salsola kali ssp. kali* (Russian thistle), *Chamaesyce polygonifolia* (seaside sandmat), *Honckenya peploides* (seaside sandplant), *Cenchrus tribuloides* (sanddune sandbur), *Amaranthus retroflexus* (redroot amaranth), *Chenopodium album* (lambsquarters), *Erechtites hieraciifolia* (American burnweed), *Xanthium strumarium* (rough cockleburr), and *Atriplex cristata* (crested saltbush). Globally rare species such as *Polygonum glaucum* (seaside knotweed) and *Amaranthus pumilus* (seaside amaranth) occur in this habitat. Sparse *Ammophila breviligulata* (American beachgrass) can occur sporadically as a common associate, colonizing from the adjacent beachgrass community. Diagnostic species are *Cakile edentula ssp. edentula* (American searocket), *Salsola kali ssp. kali* (Russian thistle), *Atriplex cristata* (crested saltbush), and *Chamaesyce polygonifolia* (seaside sandmat). This community occurs in maritime coastal areas from southern Maine to Cape Hatteras, North Carolina.
Environmental Description: This association occurs on unstable sands and often gravels and cobbles just above mean high tide on beaches and foredunes washed over by spring and storm tides and impacted by wind erosion.
Vegetation Description: This is a sparsely vegetated association characterized by annuals and biennials. Species composition is variable, but frequently includes *Cakile edentula ssp. edentula* (American searocket), *Honckenya peploides* (seaside sandplant), *Salsola kali* (Russian thistle), *Atriplex patula* (spear saltbush), *Cenchrus tribuloides* (sanddune sandbur), *Chamaesyce polygonifolia* (seaside sandmat), *Atriplex cristata* (crested saltbush), *Xanthium strumarium* (rough cockleburr), and *Chenopodium* (goosefoot) spp. Globally rare species such as *Polygonum glaucum* (seaside knotweed) and *Amaranthus pumilus* (seaside amaranth) occur in this habitat.

Ammophila breviligulata (American beachgrass) can occur sporadically, colonizing from the adjacent beachgrass community. Additional infrequent species can include *Chenopodium rubrum* (red goosefoot), *Chenopodium album* (lambsquarters), *Chenopodium berlandieri var. macrocalycium* (pitseed goosefoot), *Cyperus filicinus* (fern flatsedge), *Triplasis purpurea* (purple sandgrass), and *Sesuvium maritimum* (slender seapurslane). Bare substrate can comprise greater than 95% cover in this association.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Atriplex cristata* (crested saltbush)
		Cakile edentula ssp. *edentula* (American searocket)
		Chamaesyce polygonifolia (seaside sandmat)
		Salsola kali ssp. *kali* (Russian thistle)

Characteristic Species: *Atriplex cristata* (crested saltbush), *Cakile edentula* ssp. *edentula* (American searocket), *Chamaesyce polygonifolia* (seaside sandmat), *Salsola kali* ssp. *kali* (Russian thistle)

Other Noteworthy Species:

Species	GRank	Type	Note
Amaranthus pumilus (seaside amaranth)	G2	plant	
Polygonum glaucum (seaside knotweed)	G3	plant	

USFWS Wetland System: Not applicable

DISTRIBUTION

Range: This association ranges from southern Maine to North Carolina.
States/Provinces: CT, DE, MA:S3, MD, ME, NC, NH, NJ:S1S2, NY:S5, RI, VA
Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Cape Hatteras, Fire Island, Gateway, Muskeget Island, Sagamore Hill); USFWS (Back Bay, Chesapeake Marshlands, Monomoy, Parker River)

CONSERVATION STATUS

Rank: G4G5 (1-Dec-1997)
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 2 - Moderate
Comments: This community is common on maritime dunes of the Northeast but is vulnerable to development and shifting wave action due to jetties. J. Harrison (pers. comm. 2006): "In the Chesapeake Marshlands, in Maryland, a small patch of this vegetation was observed on South Marsh Island [see Observation Point CM-15]. Please note many of the associated "maritime" species are not present in the refuge. Although not as well-developed in estuarine environments, consider expanding concept to include narrow sandy shorelines on bay islands."

Similar Associations:

- *Cakile edentula* Great Lakes Shore Sparse Vegetation (CEGL005162)
- *Cakile edentula* ssp. *edentula* - *Mertensia maritima* Sparse Vegetation (CEGL006106)
- *Cakile edentula* ssp. *harperi* Sparse Vegetation (CEGL004401)

Related Concepts:

- *Cakile edentula* - *Chenopodium album* community (Metzler and Barrett 1992) =
- *Cakile edentula* ssp. *edentula* - *Salsola caroliniana* Sparse Vegetation (Bartgis 1986) =
- *Cakiletum edentula* (Conard 1935) =
- Beach (Fender 1937) =
- Beach (McDonnell 1979) =

- Beach (Higgins et al. 1971) =
- Beach community (Johnson 1985b) ?
- Beach community (Hill 1986) =
- Beach community (Baumann 1978b) =
- Beach strand community (MENHP 1991) =
- Beach vegetation (Moul 1973) =
- Coastal beach strand (Sperduto 1994) =
- Coastal beach strand community (Rawinski 1984) ?
- Dune and swale community (Stalter 1990) B
- Dune community (Jenkins 1974) =
- Dune-strand area (Clovis 1968) =
- Embryo dune (Klotz 1986) =
- Marine intertidal gravel/sand beach community (Breden 1989) =
- Marine sandy beach (Clancy 1993b) =
- Maritime beach (Reschke 1990) =
- Middle beach (Nichols 1920) =
- Middle beach (Shreve et al. 1910) =
- Pioneer beach community (Boule 1979) =
- Sea-strand vegetation, beach formation (Harshberger 1900) =

SOURCES

Description Authors: S.L. Neid

References: Bartgis 1986, Baumann 1978b, Berdine 1998, Boule 1979, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1993b, Clovis 1968, Conard 1935, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fender 1937, Fleming et al. 2001, Gawler 2001, Gawler 2002, Godfrey et al. 1978, Harrison 2004, Harshberger 1900, Higgins et al. 1971, Hill 1986, J. Harrison pers. comm., Jenkins 1974, Johnson 1985b, Klotz 1986, MENHP 1991, McDonnell 1979, Metzler and Barrett 1992, Metzler and Barrett 2001, Moul 1973, Nichols 1920, Rawinski 1984, Reschke 1990, Schafale and Weakley 1990, Shreve et al. 1910, Sperduto 1994, Sperduto 2000a, Sperduto 2000b, Stalter 1990, Swain and Kearsley 2001



Figure 85. North Atlantic Upper Ocean Beach in Cape Cod National Seashore (plot CACO.103). Summer 2004. NAD 1983 / UTM easting 411045, northing 4642146.



Figure 86. North Atlantic Upper Ocean Beach in Cape Cod National Seashore (plot CACO.065). Summer 2003. NAD 1983 / UTM easting 402496, northing 4653328.

COMMON NAME (PARK-SPECIFIC): NORTH ATLANTIC COAST ESTUARINE INTERTIDAL MUDFLATS

SYNONYMS
USNVC English Name: **Intertidal Mudflats Sparse Vegetation**
USNVC Scientific Name: **Intertidal Mudflats Sparse Vegetation**
USNVC Identifier: **CEGL006614**

LOCAL INFORMATION

Environmental Description: This intertidal mudflat community occurs within protected embayments and not along the open shore. It is completely exposed at low tide and tidally flooded twice daily. The substrate is composed of sand.
Vegetation Description: Examples of this community at Cape Cod National Seashore lack vegetation.
Most Abundant Species: Examples of this community at Cape Cod National Seashore lack vegetation.
Characteristic Species: Examples of this community at Cape Cod National Seashore lack vegetation.
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
MA	S4*	B	1	Marine Intertidal, Flats	Swain and Kearsley 2001

Local Range: Examples of this community occur on the southern tip of Nauset Beach in Chatham, in the Nauset marsh complex in Salt Pond Bay in Eastham, and in Herring Cove, near Race Point in Provincetown.
Classification Comments: North Atlantic Coast Marine Intertidal Mudflats typically occurs adjacent and seaward of North Atlantic Upper Ocean Beach.
Other Comments: Information not available.
Local Description Authors: E. Largay
Plots: None.
AA (2004) Points: None.
Cape Cod National Seashore Inventory Notes: Mapped in the Beach aggregated map class in the vegetation map. Photograph not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Sparse Vegetation (VII)
Physiognomic Subclass	Unconsolidated material sparse vegetation (VII.C.)
Physiognomic Group	Sparsely vegetated soil flats (VII.C.4.)
Physiognomic Subgroup	Natural/Semi-natural sparsely vegetated soil flats (VII.C.4.N.)
Formation	Tidal mudflats (VII.C.4.N.d.)
Alliance	Estuarine Tidal Mudflat Sparsely Vegetated Alliance (A.3010)
Alliance (English name)	Estuarine Tidal Mudflat Sparsely Vegetated Alliance
Association	Intertidal Mudflats Sparse Vegetation
Association (English name)	Intertidal Mudflats Sparse Vegetation
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This is a saline (>18.0 ppt) intertidal mudflat community that typically lacks vegetation. *Ulva lactuca* (sea-lettuce) may be present or prominent. The substrate consists of silt or sand that is rich in organic matter and poorly drained at low tide. These saline intertidal mudflats extend along the North Atlantic Coast from Maine to New York.

Environmental Description: This association occurs on saline mudflats located between the highest high tide and the lowest low tide along the North Atlantic Coast. Salinity levels are greater than 18.0 parts per thousand of ocean-derived salts. They are completely exposed at low tide and are tidally flooded twice daily. The substrate consists of silt or sand that is poorly drained at low tide and rich in organic matter. These areas are subject to moderated fluctuations in salinity and moisture and are washed by low-energy waves. The substrate may be covered with algae.

Vegetation Description: This association typically does not have vegetation. However, some examples have dense cover of the green algae *Ulva lactuca*.

Most Abundant Species:

Stratum	Lifeform	Species
Floating aquatic	Alga	*Ulva lactuca* (sea-lettuce)

Characteristic Species: *Ulva lactuca* (sea-lettuce)

Other Noteworthy Species: Information not available.

USFWS Wetland System: Estuarine

DISTRIBUTION

Range: These intertidal mudflats extend along the Atlantic Coast from Maine to New York and possibly New Jersey.

States/Provinces: CT, MA, ME, NH, NJ, NY:S4, RI

Federal Lands: NPS (Boston Harbor Islands, Cape Cod, Gateway)

CONSERVATION STATUS

Rank: G5 (23-Mar-2007)

Reasons: This is a very common intertidal maritime community along the Atlantic Coast.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 3 - Weak

Comments: This type is likely covered by the marine classification; however, this mudflat community occurs in coastal vegetation mapping projects, and it seems appropriate to classify it under sparse vegetation for the time being, until the marine classification can be applied to vegetation mapping projects.

Similar Associations:

- *Sagittaria subulata - Limosella australis* Tidal Herbaceous Vegetation (CEGL004473)--is a brackish intertidal mudflat association with salinity levels ranging from 0.5–18.0 and lacks the macroalgae component of CEGL006614.

Related Concepts: Information not available.

SOURCES

Description Authors: E. Largay and G. Edinger

References: Anderson et al. 1976, Bell et al. 2002, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser and Lundgren 2005, MNAP 1991, Metzler and Barrett 2004, Swain and Kearsley 2001, Walz et al. 2008, Welsh 1980, Whitlatch 1982

Discussion

Vegetation Classification and Characterization

The goal of this project was to classify and map the vegetation associations occurring in the 17,645 ha (43,604 ac) acre Cape Cod National Seahshore.This study identified 70 USNVC vegetation associations through the sampling of 127 vegetation plots, 492 AA points, reconnaissance, and data from previous studies.

Eight associations were described from previous studies (Sneddon et al. 1999; Motzkin 1991). Two associations were newly classified: Pitch Pine / Cranberry Interdunal Swale and Salt Hay Dune. The present-day vegetation patterns at Cape Cod National Seashore reflect the legacy of past land use on the sandy peninsula in addition to the coastal climate. Past sheep farming, forest clearing to fire brick kilns, agriculture, military use, cranberry harvesting, tidal ditching, insect outbreaks, invasive plant establishment, land development, land protection, and other past and present land uses have influenced the landscape we see today. Natural distrurbances such as hurricanes, fires, tides, salt spray, shifting sands, and ice storms, continue to shape the vegetation. The most abundant vegetation association in Cape Cod National Seashore is Pitch Pine - Oak Forest which covers 2,385 ha (5,893 ac) of the park. This vegetation type is similar to the natural vegetation of the region (Coastal Lowlands subsection of the Oak-Chestnut Forest Region). It is dominated by pitch pine (*Pinus rigida*) and oaks, primarily black oak (*Quercus* velutina) and white oak (*Quercus alba)* and occurs on nutrient-poor acidic sandy soils. Northeastern Coastal Oak - Heath Forest is also relatively common in Cape Cod National Seashore and lacks pitch pine in the canopy.

Pitch pine barrens (Pitch Pine - Heath Barrens and Coastal Pitch Pine / Scrub Oak Barrens) are extensive throughout the park and cover 1,678 ha (4,149 ac) of the park. These can be distinguished from the Pitch Pine - Oak Forest by the lack of oak species in the canopy. Other unique communities in Cape Cod National Seashore that cover relatively extensive areas and are restricted to dune settings include Northern Beachgrass Dune, Pitch Pine Dune Woodland and Hairgrass Backdune Grassland. North Atlantic Coastal Plain Vine Dune and Northern Interdunal Cranberry Swale are small patch vegetation communities within the dunes.

Black Locust Successional Forests are present in small patches throughout the park. Black locust (*Robinia pseudoacacia*) is not native to Cape Cod and has nitrogen fixing capabilities that create soil conditions favorable to other nonnative plants. However this community type has been decreasing in stand size over time and is not a priority management concern for Cape Cod National Seashore (Von Holle et al. 2006).

Wetland communities are common and diverse in the park as salt, brackish, and freshwater conditions occur there. Salt marshes cover 887 ha (2,192 ac) of the park. Coastal plain pond communities occur within and along the shores of the kettle ponds scattered throughout Cape Cod National Seahshore. Likewise, brackish and freshwater communites occur with increased distance from the influence of the tide along the Pamet and Herring Rivers. Red maple swamps (Lower New England Red Maple - Blackgum Swamp) are relatively common, covering 172 ha (425 ac) while cedar swamps (Coastal Plain Atlantic White-cedar Swamp) are limited. Shrub swamp, shrub swale, salt shrub, bog, and fen communities add to the diversity of wetland vegetation in Cape Cod National Seahshore. Eastern Reed Marsh and Reed-grass Tidal Marsh

are communities that deserve priority management because eastern reed (*Phragmites australis*) is an aggressive plant that threatens the biodiversity of freshwater, salt water, and brackish marshes as well as virtually all coastal and freshwater wetlands.

There are twelve globally rare associations with a global rank of G1–G3 classified in Cape Cod National Seashore by NatureServe and the Natural Heritage Program Network. These communities are high priority targets for protection and management. They include North Atlantic Coastal Plain Vine Dune (G1G2), Sandplain Grassland (G2), Bulblet Flatsedge Coastal Plain Sandy Pondshore (G2), Coastal Plain Pond (G2), Northern Coastal Plain Pondshore Margin (G2G3), Successional Maritime Forest (G2G3), Northern Interdunal Cranberry Swale (G2G3), Pitch Pine Dune Woodland (G2G3), Northern Beach-heather Dune Shrubland (G2G3), Coastal Plain Atlantic White-cedar Swamp (G3), Coastal Pitch Pine / Scrub Oak Barren (G3), and Sandplain Heathland (G3). The global ranks are defined in Appendix J.

Accuracy Assessment

Mapping Associations Individually

The 2003 draft association-level vegetataion map had an overall accuracy of 40.4% using only the first field call and no aggregation of units. This overall accuracy falls far below the VMP standards. The low accuracy is not surprising given that the mappers attempted to identify all polygons at the association-level, including some associations that occur naturally in small patches or are not distinctive on aerial photography. The goal of the USGS/NPS VMP is to map to the association wherever possible, so this effort to map at such a fine scale is an important first step in achieving a higher level of accuracy.

One may argue that fuzzy analysis is the more valid approach when assessing vegetation, since vegetation exhibits variation not only in species composition from stand to stand, but also at one stand over time. One stand may in reality be “between” two types as it succeeds over time, so at times can be called one or the other with equal validity. The same can be said conceptually as well as temporally. Boundaries between vegetation types are almost never abrupt and obvious. A stand that “straddles” two concepts may reasonably be placed in either type. If we account for the ambiguity inherent in mapping vegetation and accept more than one type as correct, six associations meet the VMP standard of 80% from both the producer’s and user’s perspective (Tables 5 and 6).

Aggregating Associations into Map Units

Assembling two or more associations into a single map unit increases the accuracy of the map considerably (Table 7). Polygons labeled with a map unit comprised of two associations can indicate that either of two associations are present or that both are present in some varying proportion.

Map units of reliable or acceptable accuracy: In the following summary, map units reaching 80% or more accuracy from both producer’s and user’s perspective are referred to “reliable”, while those reaching 60–80% are referred to as “acceptable”. Any exceptions to this are explained.

Herbaceous Map Classes:

- Salt Marsh – salt marsh associations exhibit a fairly high degree of variability in photo signatures. North Atlantic High Salt Marsh and North Atlantic Low Salt Marsh were regularly mistaken for each other on aerial photography, and Salt Panne (Salicornia Type) is a very small-patch association that is likely under-mapped but always occurs with salt marsh associations. In addition to these three common associations, a number of small patch and infrequent associations occur in or directly adjacent to salt marshes: Salt Hay Dune, Brackish Meadow, Coastal Salt Pond Marsh, and Spikerush Lawn Tidal Marsh. As a map unit, this type is reliably mapped.
- Cattail Marsh – this map unit is comprised of both freshwater and brackish cattail associations. The two associations are not distinguishable from each other on photography, and it was not always possible to discern the degree of tidal influence. This is an acceptable map unit.
- Beachgrass Dune – the photo signature of beachgrass is not always distinctive, but the environmental setting also aided the photointerpreter in achieving a high accuracy. This is a reliable map unit.
- Coastal Marsh – this map unit is comprised of two associations that occur infrequently in the park. Although the accuracy surpasses 80%, it is based on few samples so is better thought of as acceptable.
- Coastal Plain Pondshore – this map unit is comprised of a number of herbaceous associations that are small patch, linear, and visible on the ground only late in the season, if water levels are sufficiently low to expose the substrate. The environmental setting is distinctive, so as a unit it is predictable and reliably mapped.

Shrub Map Classes:

- Salt Shrub – this association had a distinctive signature and was mapped reliably, so it was not combined with the Salt Marsh map unit. This is a reliable map unit.
- Bog – this association was not aggregated with other associations. The signature is fairly distinct and it is a reliable map unit.
- Cranberry Swale – it was not necessary to aggregate this association with others because the signature and environmental setting are both distinctive. This is a reliable map unit.
- Heathland / Grassland – due to the physiognomic variability of the associations comprising this unit, as well as the overlap in species composition, it is a challenge to distinguish these associations even when in the field. As a map unit, it is distinctive, though, and map accuracy is acceptable.
- Buttonbush – an infrequent type on the park, this is an acceptable map unit. It was not aggregated with other associations.
- Scrub Oak – This type was also not aggregated with other associations. This type was confused with Dune Shrub and with Heathland / Grassland on occasion, but is an acceptable map unit.
- Shrub Swamp – this map unit contains two blueberry shrub swamp types and Successional Wet Meadow that are virtually indistinguishable on photography but are different ecologically. One association is a bog thicket with deep peat,

sphagnum mosses, and is saturated at all times of the year. The other two associations are seasonally flooded and may be dry in the late growing season but can be distinguished by the dominance of highbush blueberry in one. This is an acceptable map unit.

Forest and Woodland Map Classes:
In general, forests and woodlands were of lower accuracy than shrub and herbaceous types.

- Black Locust – this is an acceptable, and very close to reliable, map unit. The signature is distinctive as this species tends to form large clonal patches.
- Oak / Beech Forest – this is an acceptable map unit. It was confused on occasion with Red Maple Swamp, surprisingly.
- Mixed Forest – also an acceptable map unit that was confused with Oak / Beech Forest most frequently. Most of the error is likely due to a varying interpretation of the evergreen versus deciduous component.

Map units of problematic accuracy: Ten map units were problematic in that either producer's or user's accuracy, and sometimes both, were lower than 60%.

Herbaceous Map Classes:

- Old Field – this map unit achieved only 20% accuracy from both producer's and user's perspectives. It was confused with Freshwater Marsh, Red Cedar, and most often with Heathland / Grassland. Sample size was only 5, however, so the confidence interval is broad.
- Phragmites – this unit reached 80% producer's accuracy, but only 53% user's accuracy. It was not predictably confused with any one type – Cattail Marsh and Salt Marsh are understandable errors. Other more puzzling errors were Dune Shrub, Dune Pine Forest, and Scrub Forest. It would be worth investigating whether these were small patches that were subject to GPS error.
- Beach – this map unit is comprised of two associations – North Atlantic Upper Ocean Beach and North Atlantic Coast Estuarine Intertidal Mudflats. Producer's accuracy was 100%, but user's accuracy was only 28%. These associations were confused with unvegetated substrates a large majority of the time. Since Unvegetated Surface was not assessed for accuracy, it was not valid to create a combined map unit. However, it is recommended that future iterations of the map combine these entities, as both the North Atlantic Upper Ocean Beach and North Atlantic Coast Estuarine Intertidal Mudflats are sparsely vegetated associations.
- Dune Shrub and Scrub Forest – these two map units had low accuracies and were most frequently confused with each other. However, they were not further combined into a single map unit because they occur on different environmental settings and could be corrected on future iterations of the map. Dune Shrub is comprised of shrubs of generally shorter stature, generally with greater percentages of bare sand, and on unstable substrate in closer proximity to the shore than is the Scrub Forest.
- Shrub Swale – this map unit is comprised of a single infrequently occurring association that was confused with Shrub Swamp and Phragmites.

Forest and Woodland Map Classes:

- Pitch Pine Barrens and Dune Pine Forest map units had low accuracy (although Pitch Pine Barrens did achieve a user's accuracy of 91%). They were confused with each other frequently, and it would increase map accuracy to further combine these into a single map unit. However, this was not done because they occur on different environmental settings, errors that can be corrected in future iterations. Dune Pine Forest occurs on an unstable shifting sand substrate; trees tend to be sheared by wind on dune crests, and they often exhibit "skirting" at the bases. Pitch Pine Barrens are in general of more closed canopy of less variable height, with a greater shrub cover, and occurring on stable, more sheltered sites closer to the interior of the park.
- Red Maple Swamp – this map unit is comprised of a single association that is not easily aggregated with other associations. Although it did achieve 89% producer's accuracy, user's accuracy was only 42%. This map unit was confused with Shrub Swamp on occasion, but also, inexplicably, Scrub Forest, Oak / Beech Forest, and Black Locust. It would be worth investigating whether errors are partially or wholly due to GPS error.
- Red Cedar – this map unit is comprised of Old-field Eastern Red-cedar Forest. It was most frequently confused with Scrub Forest, an understandable error due probably to different interpretations of deciduous versus evergreen component of Scrub Forest.

One source of error that arose was the discovery of occurrences of associations during accuracy assessment that were not previously known to occur and were therefore not included in the 2003 draft association-level vegetation map. Examples include Eastern Reed Marsh (non-tidal) and Successional Wet Meadow. This circumstance in effect "penalized" the mapper because they were counted as errors. However, including these associations in the aggregated map units analysis effectively countered that problem.

Final Vegetation Map Production

The 2003 draft association-level vegetation map was updated with these changes from the 2004 accuracy assessment and aggregated map classes were added to the attribute table. An additional ten associations were added to the map that were not originally mapped (Table 11). The final 2004 vegetation map for Cape Cod National Seashore includes 29 aggregated association map classes that consist of 61 vegetation associations and three Anderson Level II (modified) categories (Table 12; Figure 5). Nine vegetation associations are not included in the final vegetation map (Table 13). Detail of the vegetation map is included in Appendix H. The final vegetation map class shapefile includes the following attributes for each polygon: aggregated map class name, USNVC formation, formation code, alliance code, alliance scientific and English names, association code, scientific and English names, and local park-specific names. These attributes allow for the production of maps at different hierarchical levels (for example, a map of all deciduous forests can be generated using the Lowland or submontane cold-deciduous forest formation attribute).

This 2004 vegetation map is based on aerial photography that was flown in 2000 and 2001. Since that time, the vegetation in the park continues to change due to natural and human related disturbances. Continued natural succession will influence the mapped vegetation as will

maritime storms. Coastal storms, overwash, sea level rise, and climate change will influence the terrestrial and intertidal vegetation of the islands. Future development and/or management of invasive species will also alter the vegetation. Despite these continual changes, the vegetation map produced by this project provides crucial baseline data for park resource managers.

Conclusions

The proposed map units provide the user with a pragmatic balance between acceptable accuracy while retaining sufficient detail. Four map units described above (Dune Shrub and Scrub Forest, and Pitch Pine Barrens and Dune Pine Forest) could be re-examined in light of the clarification provided on environmental setting. Other inexplicable errors should be further examined for possible GPS error. To increase accuracy of the vegetation map, additional field inventory is recommended. As the accuracy assessment indicates, more information is gathered as more time is spent in the field recording community type data. The vegetation map should be refined from the accuracy assessment, and then checked again in the field, and then updated again. Different forms of imagery can be interpreted in addition to the aerial photos and orthophotos to further refine the map for the park. The map as is, can be used to help steer management plans for the park.

Invasive exotic plants are particularly problematic in some of the marshes, on forest edges, and along trails and roads within the Cape Cod National Seashore; however, they are less of a threat within the interiors of most vegetation communities. The most common and problematic species include eastern reed and multiflora rose. These species may threaten and impede the dynamics of native marsh and forest communities without proper management.

The USNVC vegetation map, detailed vegetation association descriptions, and dichotomous key are essential tools for managing and monitoring the natural associations in the park. These standardized products provide a baseline for assessing the ecological integrity, acreages, and locations of Cape Cod National Seashore vegetation associations. Keeping the map up to date should be a high priority for park resource managers because the vegetation will change in response to various disturbances, natural succession, and management.

The vegetation map can be used to develop interpretive trails and field guides, and will help resource managers identify priority areas for resource protection, restoration, scientific research, and environmental education. The U.S. National Vegetation Classification can also be used in conjunction with the vegetation map to help describe desired vegetation associations for future vegetation management projects and provide a framework for ecological integrity assessments.

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Appendix A. Previous aerial photograph interpretation classifications and interpretation codes crosswalked to association-level vegetation types at Cape Cod National Seashore.

The 1991 vegetation mapping at Cape Cod National Seahore descriptive classification system included the following 26 categories:

1. atlantic white cedar
2. barren
3. bearberry
4. beech
5. beach grass
6. black locust
7. bear oak
8. bayberry-beach plum-black cherry
9. black and white oak
10. cultivated
11. cattail
12. cordgrass
13. water
14. developed
15. dead trees
16. huckleberry
17. highbush blueberry-swamp azalea
18. hairgrass
19. mixed grass
20. meadowsweet-goldenrod
21. pitch pine-oak
22. pitch pine
23. red maple
24. velvet grass
25. cattail and reed
26. reed

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1. beach sand/cobble
2. developed
3. open water
4. disturbed
5. barren dune
6. barren
9. dead vegetation

The following table shows the links between the UMass interpreter's preliminary classification and the NVC types. These assignments were made after extensive field visits and translation by CACO Ecologist Stephen Smith. A table with the Preliminary type code numbers described follows.

AGREGGATED MAP CLASS

NVC CODE/NVC NAME (PRELIMINARY CLASS:PRELIMINARY DESCRIPTION)

DEVELOPED

(Preliminary type: 2: developed)

BARREN/DUNES

BEACH / TIDAL FLAT

CEGL004400 Cakile edentula ssp. edentula - Chamaesyce polygonifolia Sparse Vegetation
(Preliminary types: 1,7,204,209: beach sand/cobble tidal flat/panne)

BEACHGRASS DUNE

CEGL006274 Ammophila breviligulata - Lathyrus japonicus Herbaceous Vegetation
(Preliminary types: 0,5,6,10,11,40,42,44,111,202: barren dune; ammophila dense mix dune w/lichen or deschamp; Truro dune strong herb layer)

SALT MARSH WETLANDS

SALT MARSH

CEGL004192 Spartina alterniflora / (Ascophyllum nodosum) Acadian/Virginian Zone Herbaceous Vegetation
(Preliminary types: 24,90,91: Spartina patens/alternaflora mosaic)

CEGL004308 Salicornia salt panne

CEGL006006 Spartina patens - Distichlis spicata - (Juncus gerardii) Herbaceous Vegetation
(Preliminary types: 23,91,203: Spartina patensherb mix Distichlis overwash)

SALT SHRUB

CEGL003921 Baccharis halimifolia - Iva frutescens / Spartina patens Shrubland
(Preliminary types: 51: Baccharis/Iva frut.)

FRESHWATER WETLANDS

POND OPEN WATER

CEGL002386 Nuphar lutea ssp. advena - Nymphaea odorata Herbaceous Vegetation
(Preliminary types:18,19,93: nymphea/nuphar see 20)

COASTAL PLAIN PONDSHORE

CEGL006345 Juncus militaris Herbaceous Vegetation
(Preliminary types: 20: emergent Peltandra/Pondeteria)

CEGL006346 Eriocaulon aquaticum - Lobelia dortmanna Herbaceous Vegetation
(Preliminary types: 3: open water)

CATTAIL

CEGL004201 Typha angustifolia - Hibiscus moscheutos Herbaceous Vegetation
(Preliminary types: 25: tidal herbaceous)

CEGL006153 Typha (angustifolia, latifolia) - (Schoenoplectus spp.) Eastern Herbaceous Vegetation
(Preliminary types: 28,29,30,113,207: typha mix with herbaceous-shrub Juncus militaris, Triad./Oront.)

PHRAGMITES

CEGL004141 Phragmites australis Eastern North America Temperate Semi-natural Herbaceous Vegetation
(Preliminary types:26,5,295: phragmites, wet shrub)

CEGL004187 Phragmites australis Tidal Herbaceous Vegetation
(Preliminary types: 27,96: tidal phragmites)

CRANBERRY SWALE

CEGL006141 Vaccinium macrocarpon - Morella pensylvanica Dwarf-shrubland
(Preliminary types: 17,34,35,87: Vacc. macrocarpon swale wet grass/herb see 35 former cranberry bog)

FEN

CEGL006302 Myrica gale - Chamaedaphne calyculata/Carex (lasiocarpa, utriculata)-Utricularia spp. Shrub Herbaceous Vegetation"
(Preliminary types: 206: Carex lasiocarpa)

FRESHWATER MARSH

CEGL004202 Zizania aquatica Tidal Herbaceous Vegetation
(Preliminary types: 21: wet grass/herbaceous saturated)

WOODED WETLANDS

SHRUB SWAMP

CEGL006371 Vaccinium corymbosum - Rhododendron viscosum - Clethra alnifolia Shrubland
(Preliminary types: 36,46,47,48,49: Chamadaphne mix tall, wet mix, Alnus Low mix w/herbaceous, Vaccinium corymbosum/sphagnum saturated)

RED MAPLE SWAMP

CEGL006156 Acer rubrum - Nyssa sylvatica / Rhododendron viscosum - Clethra alnifolia Forest
(Preliminary types:68,71,76,97: Acer rubrum mix Chamaecyparis Nyssa sylvatica Fraxinus, wet grass, sedge-rush shrub)

WOODED MARSH

CEGL006349 Scirpus cyperinus Seasonally Flooded Herbaceous Vegetation
(Preliminary types: 22,50,51,52,93: wet grass/herbaceous flooded, Decodon mix, Phalaris)

CEDAR SWAMP

CEGL006188 Chamaecyparis thyoides / Ilex glabra Forest
(Preliminary types:70,77: Chamaecyparis/Ilex glabra mix)

GRASSLAND AND WOODY SUCCESIONAL

DEAD

(Preliminary types:9,802: dead vegetation)

DISTURBED

(Preliminary types:4,8,88,110,700: disturbed herbaceous/grassland managed/mowed)

HEATHLAND / GRASSLAND

CEGL006066 Gaylussaccia baccata - Vaccinium angustifolium - Arctostaphylos uva-ursi / Schizachyrium littorale Dwarf-shrubland
(Preliminary types: 14,15,33, 41,53,84,98,101: Hudsonia/Corema/Arcto.uva mix)

CEGL006067 Morella pensylvanica / Schizachyrium littorale - Danthonia spicata Shrub Herbaceous Vegetation
(Preliminary types:104: dry grass-Pilgrim Heights)

CEGL006143 Hudsonia tomentosa - Arctostaphylos uva-ursi Dwarf-shrubland
(Preliminary types: 30,32,33,38: Arcto. uva ursi, Husonia spp.)

CEGL006161 (changed subsequently to CEGL006621) M.pensylanica/Schizachyrium littorale – Aristida tuberculosa Shrub Herbaceous Vegetation
(Preliminary types: 10,65,111,201,202: Ammophila - Deschampsia, P. rigida sparse heathland)

OLD FIELD

CEGL006107 Dactylis glomerata - Rumex acetosella Herbaceous Vegetation
(Preliminary types: 103: dry heathland/grassland mix, field determine)

RED CEDAR

CEGL006024 Juniperus virginiana Forest
(Preliminary types: 205: Ptown south of Rt 6 wetland conifer - juniper-cedar)

PITCH PINE BARRENS

CEGL005046 Pinus rigida / Vaccinium spp. - Gaylussacia baccata Woodland
(Preliminary types:62:P.rigida/vacc.spp/Gaylussacia baccata)

CEGL006315 Pinus rigida / Quercus ilicifolia / Morella pensylvanica Woodland
Preliminary types: 43,85,86: Quercus ilicifolia dominant/Pinus rigida/heathland)

BLACK LOCUST

CEGL007279 Robinia pseudoacacia Forest
(Preliminary types:73: Robinia pseudoacacia)

SCRUB FOREST

CEGL006145 Prunus serotina - Sassafras albidum - Amelanchier canadensis / Smilax rotundifolia Shrubland
(Preliminary types:114,208: Prunus serotina/Amelanchier/Viburnum/P.rigida/Quercus spps/Acer successional maritime/ Lonicera - Pilgrim heights)

CEGL006379 Amelanchier canadensis - Viburnum spp. - Morella pensylvanica Shrubland
(Preliminary types:42,45: Prunus serotina/Amelanchia canadensis/M. pensylvanica/Viburnum spp.)

SCRUB OAK

CEGL006111 Quercus ilicifolia - Quercus prinoides Shrubland
(Preliminary types: 43,84: Quercus ilicifolia)

DUNE SHRUB

CEGL003886 Smilax glauca - Toxicodendron radicans Vine-Shrubland
(Preliminary types: 44: Vine Smilax/Toxicodendron - dune)

CEGL006295 Morella pensylvanica - Prunus maritima Shrubland
(Preliminary types: 40: Myrica pensylvanica/Rosa rugosa)

DUNE PINE FOREST

CEGL006117 Pinus rigida / Hudsonia tomentosa Woodland
(Preliminary types: 60,63,65: P.rigida/heathland - Hudsonia)

CEGL006127 Pinus rigida / Vaccinium macrocarpon Woodland
(Preliminary types: 63,64,66,89: P. rigida wet swale, Chamadaphne, sphagnum)

MIXED FOREST

CEGL006381 Pinus rigida - Quercus coccinea / Vaccinium pallidum - (Morella pensylvanica) Forest
(Preliminary types:61,79,82,99,100: P.rigida/Quercus spp. Mix, P. rigida, Morella)

OAK BEECH FOREST

CEGL006375 Quercus coccinea - Quercus velutina / Sassafras albidum / Vaccinium pallidum Forest
(Preliminary types: 80, 81, 199, 801: Quercus spp.mix)

CEGL006377 Fagus grandifolia - Quercus alba - Quercus rubra Forest
(Preliminary types: 78, 83: Fagus grandifolia Quercus spp/Fagus grandifolia/Sassafras/Ilex glabra)

Appendix A. Previous aerial photograph interpretation classifications and interpretation codes crosswalked to association-level vegetation types at Cape Cod National Seashore (continued).

Mapper code	Mapper desc_1	Mapper desc_2	USNVC code	HABITAT
0	barren dune	barren dune	CEGL006274	open dunes
1	beach sand/cobble	beach sand/cobble	CEGL004400	open/emergent
2	developed	developed	DEVELOPED	open/emergent
3	open water	open water	CEGL006346	open/emergent
4	disturbed	disturbed	DISTURBED	open/emergent
5	barren dune	barren dune	CEGL006274	open/emergent
6	barren	barren dune	CEGL006274	open/emergent
7	tidal flat/panne	tidal flat/panne	CEGL004400	open/emergent
8	herb/grass managed/mowed	herb/grass managed/mowed	DISTURBED	open/emergent
9	dead vegetation	dead vegetation	DEAD	open/emergent
10	ammophila dense	ammophilia	CEGL006274	open/emergent
11	ammophila sparse		CEGL006274	open/emergent
12	ammophila nursery		CEGL006274	open/emergent
13	ammophila other		CEGL006274	open/emergent
14	dry grassland 1	dry grassland 4,5,6cape covers	CEGL006066	open/emergent
15	dry grassland 2	dry grassland needs clarification	CEGL006066	open/emergent
16	lichen	lichen but some may be deschamp used once	CEGL006391	open/emergent
17	wet dune swale grass/herb	similar to 35 wet dune swale grass/herb	CEGL006141	open/emergent
18	Nymphea/Nuphar	see 20 nymphea, nuphar can't see sp.?	CEGL002386	open/emergent
19	Orontium	see 20 orontium can't see sp?.	orontium	open/emergent
20	emergent Peltandra/Pondeteria	emergent	CEGL006345	open/emergent
21	wet grass/herb 1 (saturated?)	Wet grass/herb 1(saturated) field determine?	wet grass/herb 1 (saturated?)	open/emergent
22	wet grass/herb 2 (flooded?)	wet grass/herb 2(flooded) field determine?	CEGL006349	open/emergent
23	Spartina patens	91 Spartina patens	CEGL006006	open/emergent
24	Spartina alterniflora	Spartina alterniflora	CEGL004192	open/emergent
25	tidal herb	tidal herb	CEGL004201	open/emergent
26	Phragmites	Phragmites	CEGL004141	open/emergent
27	tidal Phragmites	tidal Phragmites	CEGL004187	open/emergent
28	Typha	Typha spp.	CEGL006153	open/emergent
29	Typha mix	Typha mix;should have tidal Typha see 25 28 w/ herb/shrub	CEGL006153	open/emergent
30	Hudsonia	31,32,33 hudsonia spp.	CEGL006143	dwarf shrub
31	Corema	33 maybe32,30 Corema merge with 33or32	CEGL006066	dwarf shrub
32	Arcto. uva-ursi	maybe 30, 33 Arctostaph. uva ursi (merge w/ 30 or leave?)	CEGL006143	dwarf shrub
33	Hudsonia/corama/arcto.uva mix	see above mix or undetermined tends to not be 30	CEGL006066	dwarf shrub
34	Vacc. macrocarpon swale	Vacc. macrocarpon dune swale	CEGL006141	dwarf shrub
35	Vacc. macrocarpon mix	V. macrocarpon mix dune swale	CEGL006141	dwarf shrub
36	Chamadaphne mix	Chamaedaphne	CEGL006371	dwarf shrub

Mapper code	Mapper desc_1	Mapper desc_2	USNVC code	HABITAT
37	Salicornia mix	Salicornia maybe should be 7,25	CEGL004308	dwarf shrub
38	(specific locus)	30 SPECIFIC black & red heath see 30 husonia spp. Diff?	CEGL006143	dwarf shrub
39	sparse heath	30 sparse heath see 30 are we sure it's 30?	CEGL006143	dwarf shrub
40	Myrica penn/Rosa rugosa	myrica p/rosa rugosa	CEGL006295	shrub
41	Low ericaceous mix w/herb	prob with 36,45 low wet ericaceous mix w/herb	Low ericaceous mix w/herb	shrub
42	Prunus serotina/Amelanchia can/Myrica p/Viburnum spp	Pr.serot/Amel/Myrica p/Vib spp	CEGL006379	shrub
43	Quercus ilicifolia	84 Quercus ilicifolia	CEGL006111	shrub
44	Vine Smilax/Toxicodendron (on a dune?)	vine – smilax, Toxicodon	CEGL003886	shrub
45	Alnus/Amelanchier/ Myrica gale	Myrica gale/Alnus/Amel	CEGL006379	shrub
46	Tall mix wet (where?)	tall wet mix unknown-Alnus mix?	CEGL006371	shrub
47	Low mix wet w/herb	low wet mix	unknown	shrub
48	Vacc. corymbosum/sphagnum saturated	Vacc. corymbosum/sphag sat.	CEGL006371	shrub
49	Vacc. Cory/mix flooded	V. cory flooded	CEGL006371	shrub
50	Decodon mix (maybe Phalaris?)	see 52,51,93 decodon mix(maybe phalaris?)	CEGL006349	shrub
51	Baccharis/Iva frut.	Baccharis/iva mix	CEGL003921	shrub
52	Unknown wet shrub	unknown wet shrub	CEGL004141	shrub
53	Unknown dry shrub	unknown dry shrub	unknown dry shrub	shrub
54	Tall wet shrub w/dead standing tree/shrub	tall wet shrub w/dead standing (specific locale) some ilex v.	tall wet shrub w/dead standing (specific locale) some ilex v.	shrub
55	unknown		unknown	
56	unknown		unknown	
57	unknown		unknown	
58	unknown		unknown	
59	unknown		unknown	
60	P.rigida/heath	63, 65 Pinus rigida w/heath Hudsonia	CEGL006117	woodland
61	P.rigida/Quercus spp. mix	82 merge with 82- maybe some should be P.rig/Morella; see	CEGL006381	woodland
62	P.rigida/vacc.spp/Gaylu. Ba	P.rig/Vacc spp/Gaylu bacc	CEGL006203	woodland
63	P. rigida swale	60 drop	CEGL006203	woodland
64	P.rigida wet swale		CEGL006194	woodland
65	P.rigida sparse w/heath		CEGL006117	woodland
66	P.rigida/Chamadaphne/sphag.		CEGL006194	woodland
67	Juniper/Myrica penn. Mix		CEGL006024/6145	woodland
68	Acer rubrum mix		CEGL006156	woodland
69	Juniper old field		CEGL006024	woodland
70	Chamaecyparis N. Atlantic		CEGL006188	woodland
71	Acer r./Chamaecyparis		CEGL006396	woodland
72	Quercus spp. Savannah/grass		CEGL006351	woodland
73	Robinia pseudo.		CEGL007279	woodland

Mapper code	Mapper desc_1	Mapper desc_2	USNVC code	HABITAT
74	Pinus sylvestris		Pinus sylvestris	woodland
76	Acer rubrun/Nyssa sylv/Frax mix		CEGL006156	forest
77	Chamaecyparis/Ilex glabra mix		CEGL006188	forest
78	Fagus grandifolia		CEGL006377	forest
79	P.rigida dom/Quercus spp.		CEGL006381	forest
80	Quercus spp.mix		CEGL006375	forest
81	Quercus spp.dom/P.rigida		CEGL006375	forest
82	P.rigida/Quercus spp. Mix		CEGL006381	forest
83	Quercus spp/Fagus grand/Sassafras/Ilex glab.		CEGL006377	forest
84	Quercus ilici /heath	43 Quercus ilicifolia w/heath	CEGL006066	shrub
85	Querc ilic dominant/Pinus rigida/heath	86 q. ilici, Pinus rigida, heath see 43 with pine	CEGL006315	shrub
86	Querc ilic/Pinus rigid mix	85 see above	CEGL006315	shrub
87	cranberry bog	former cranberry bog	CEGL006141	dwarf shrub
88	disturbed heath/grass	disturbed heath-see 30,33,4	DISTURBED	dwarf shrub
89	wet P.rigida		CEGL006194	woodland
90	Spartina patens/alterna mosaic	Sp. patens & alterni. Mosaic	CEGL004192	open/emergent
91	Sp. patens & herb mix	merged with 23	CEGL004097	open/emergent
92	unknown		unknown	
93	phalaris	Thought was large phalaris – field visit	phalaris	open/emergent
94	mowed wet herb	mowed farm in Truro salt marsh? salt marsh hay?	mowed wet herb	open/emergent
95	phrag/shrub	26, 27 phragmites/shrub	CEGL004141	open/emergent
96	unknown phrag mix tidal	27 unknown phrag mix tidal	CEGL004187	open/emergent
97	Acer rubrum w/wet grass/sedge/rush?/shrub		CEGL006395	woodland
98	Sparse P.rigida w/grass or Gaylu. bacc		CEGL006066	woodland
99	unknown		unknown	forest
100	unknown wood/tree		unknown wood/tree	dwarf shrub
101	corema, pinus rigida, Quercus ilicifolia	drop corema, p.rigida, q. ilicifolia what was I thinking?	CEGL006154	
102	unknown		unknown	
103	dry heath/grass mix field determine	dry heath/grass mix field determine	CEGL006107	
104	dry grass-Pilgrim heights	dry grass-Pilgrim heights	CEGL006067	
105	unknown		unknown	
106	unknown		unknown	
107	unknown wet herb/shrub mix (Pilgrim Lake) field determine	unknown wet herb/shrub mix (Pilgrim Lake) field determine	CEGL006153	
108	unknown wet shrub/herb Pilgrim lake	unknown wet shrub/herb	unknown wet shrub/herb Pilgrim lake	
109	Celastrus cliff pilgrim lake	Celastrus cliff pilgrim lake	CEGL006107	
110	Right of way shrub	right of way managed mess	DISTURBED	shrub

Mapper code	Mapper desc_1	Mapper desc_2	USNVC code	HABITAT
111	mix dune w/lichen or deschamp; Truro dune prob some 40, 44,42 strong herb layer	mix dune w/lichen or deschamp; Truro dune prob some 40, 44,42 strong herb layer	CEGL006274	
113	maybe 26–29? Typha/Phrag mix	maybe 26–29? Typha/Phrag mix	CEGL006153	
114	Lonicera Pilgrim heights drop	Lonicera Pilgrim heights drop	CEGL006145	
199	Quercus coccinea - Quercus velutina / Sassafras albidum / Vaccinium pallidum Forest		CEGL006375	
201	lichen or deschampia (spelling)	lichen or deschampia (spelling)	CEGL006391	
202	Ammophila & Deschampia	Ammophila & Deschampia	CEGL006274	
203	Spartina patens & Distichlas sand overwash VA5Ne1 lesley	Spartina patens & Distichlas sand overwash VA5Ne1 lesley	CEGL006006	
204	Cakile sand flat VI1C2Nd	Cakile sand flat VI1C2Nd	CEGL004400	
205	Ptown south of Rt 6 wetland conifer - junper-cedar????	Ptown south of Rt 6 wetland conifer - junper-cedar????	CEGL006024	
206	Carex lasio. per Lesley rare community	Carex lasio. per Lesley rare community	Carex lasio. per Lesley rare community	
207	Juncus mil.? Triad/Oront per Lesley rare?	Juncus mil.? Triad/Oront per Lesley rare?	Juncus mil. Triad/Oront per Lesley rare	
208	Prunus serot. / Amelanchier / Viburnum / P.pine / Quercus spp / Acer successional maritime	Prunus serot. / Amelanchier / Viburnum / P.pine / Quercus spp / Acer successional maritime	CEGL006145	
209	tidal flat with flow barren	tidal flat with flow barren	succesional maritime	
700	ptown/hatches harbor unknown messed with/tidal/mowed mess	ptown/hatches harbor unknown messed with/tidal/mowed mess	DISTURBED	
801	unknown		unknown	
802	dead trees	dead trees	DEAD	

Appendix B. Detailed information about the aerial photography and orthophoto acquired from MassGIS.

An orthophoto mosaic developed from a set of digital 1:5,000 scale 2001 MassGIS digital ortho photo quarter quads (DOQs) from the Commonwwealth of Massachusetts was used to digitize vegetation polygons. These medium resolution true color images taken in April 2001 were considered the "basemap" for the Commonwealth by MassGIS and the Executive Office of Environmental Affairs (EOEA) until 2005 DOQs became available in 2006 (MassGIS 2007). Keystone Aerial Surveys Inc. (KAS) of Philadelphia, PA performed all work for the "basemap" project. The source imagery was acquired with Leica RC-30 calibrated aerial mapping cameras at a flying height of approximately 5,000 m (15,000 feet). Endlap (forward overlap) was 60%, except 80% in areas with tall structures, with (high) sidelap of 42%. These medium resolution true-color images taken in April 2001 have a horizontal accuracy of +/-3 meters at the 95% confidence level at the nominal scale of 1:5,000.

Ground control points were established and matched 1994 black and white aerial photography for Cape Cod National Seashore . These photos were used for photointerpretation and more specifically for photosignature verification during the on-screen digitizing of vegetation communities using the 2001 digital orthophoto mosaic of Cape Cod National Seashore available from MassGIS.

The processing of the photos was conducted by two firms. Intermap Technologies of Englewood, Colorado and Ottawa and Calgary, Canada processed the mainland portion of the Commonwealth east of the 165000-meter line (in MA State Plane coordinates) and Chas. H. Sells, Inc. of Charlton, MA processed the remaining area west of this line (approximately 72 degrees longitude), as well as the Islands. These vendors provided scanning, softcopy aerial triangulation, orthorectification, image mosaicking and quality control.

Ground and photogrammetric control (elevation model) for the orthorectification of the aerial photography was available statewide from the previous black-and-white 1:30,000 digital orthophotography program conducted from 1992–2000. Ground control targets were set out prior to the flight and photo recognizable points were substituted for targets that were lost. Horizontal control (referenced to NAD83) conforms to the Federal Geodetic Control Committee specifications for Second Order Class 2 GPS surveys. Vertical control (referenced to NAVD88) is within 10 cm. It is tied to second order Class II NGRS benchmarks. In addition the latitude, longitude and ellipsoidal heights of continuously operating GPS reference stations were incorporated into the control adjustment. Orthometric heights were directly measured or estimated from GPS derived ellipsoidal heights. The transfer of control from that project made the creation of these new data much more efficient, and assured a very high level of accuracy and compatibility.

The color negatives were scanned at 14 (12.5 Sells) microns and then inverted. The pixels were subsequently resampled to 0.5 meters ground resolution. Each pixel is coded with three 8-bit values representing the amounts of Red, Green, and Blue in the pixel. This produces a 24-bit

RGB image. 8-bit (values ranging 0–255) Red, Green, and Blue values are packed into a single 24-bit identity. This allows for a maximum of 16,777,216 unique combinations of colors.

The imagery was radiometrically balanced prior to mosaicking. Only minor adjustments were made to the brightness and contrast. In the Intermap data, to avoid color distortion of land areas, color balancing was preceded by the removal of data in large bodies of water and the ocean. The water pixels were then merged back in. Since the Sells data did not contain large bodies of water (except for the Quabbin Reservoir), it was not processed in this manner.

The original 0.5 meter data was delivered to MassGIS in GeoTIFF format in orthoquad tiles representing 4 x 4 km on the ground (8000 rows x 8000 columns, equaling 64,000,000 pixels). Since each pixel contains 24 bits (3 bytes) of data, a full resolution image covering one orthoquad tile is approximately 192,000,000 bytes (183 Megabytes) in size. The tiles are based on the Orthophoto Index Grid and are named <sheet-id>.tif, where the <sheet-id> is the first 3 digits of the state plane XY coordinate pair for the lower right corner of each cell. Header files (named <sheet-id>.tfw) were also delivered for use in some GIS software. Imagery is georeferenced to Massachusetts State Plane (Lambert Conformal Conic Projection) NAD83 denominated in meters.

BSC Group fulfilled land survey requirements by performing highly precise ground control survey & independent verification and validation of spatial accuracy.

A metadata record for the mosaic was prepared according to current Federal Geographic Data Committee standards (FGDC 1998a). Metadata were produced in ARCGIS 9.1 using the USGS metadata compiler program (MP) to locate errors and omissions (USGS 2004). After all errors and omissions were corrected, MP was used to generate final TXT, HTML, and XML versions of each metadata record which are stored in the air photo archive.

Appendix C. Cape Cod National Seashore Vegetation Plot Sampling Form.

A. General Information

Plot Number:_____ Park Name:_____
Survey date: _____Surveyors:_____
Easting: _____ E Northing:_____N EPE/APE:_____ DOP:_____ Map datum: _____Zone:_____

B. Environmental Description

Representative sketch of stand and landscape position

Picture No.:_____

Slope: _____
Aspect: _____
Elevation: _____

Stoniness:
__ Stone free <0.1%
__ Moderately stony 0.1-1%
__ Stony 3-15%
__ Very stony 15-50%
__ Exceedingly stony 50-90%
__ Stone piles >90%

Topographic position:
__ Interfluve (ridgetop) __ Low slope
__ High slope __ Toe slope
__ High level __ Low level
__ Midslope __ Channel wall
__ Backslope __ Channel bed
__ Step in slope __ Basin Floor
__ Other: _____

Hydrologic regime:
__ Permanently flooded
__ Saturated (wet, but never flooded)
__ Intermittently exposed
__ Temporarily flooded
__ Semi-permanently flooded
__ Intermittently flooded
__ Seasonally flooded
__ Artificially flooded

Average soil texture:
__ sand __ clay loam
__ sandy loam __ clay
__ loam __ peat
__ silt loam __ muck
__ other: _____

Soil drainage:
__ Rapidly drained
__ Well drained
__ Moderately well drained
__ Somewhat poorly drained
__ Poorly Drained
__ Very poorly drained

Soil profile description: note depth, texture, and color of each horizon. Note significant changes such as depth to mottling, depth to water table, root penetration depth

Horizon	Depth	Texture	Color	pH	Comments

Unvegetated surface:
_____ % Bedrock
_____ % Litter, duff
_____ % Large rocks (> 10 cm)
_____ % Wood (> 1 cm)
_____ % Small rocks (0.2-10 cm)
_____ % Water
_____ % Sand (0.1-2 mm)
_____ % Bare soil
_____ % Other:_____

Plot representativeness: Note homogeneity of vegetation in plot versus rest of community

Environmental Comments: Note surrounding vegetation, landscape context, herbivory, stand health, recent/historic anthropogenic evidence, etc.

C. Vegetation Cowardin System: _____ Terrestrial _____ Palustrine _____ Estuarine

Leaf type:	Leaf phenology:	Physiognomic type:			height	% cover
__ Broad-leaf	__ Deciduous	__ Forest	__ Woodland	T1 Emergent tree		
__ Semi-broad leaf	__ Semi-decidous	__ Sparse woodland	__ Scrub thicket	T2 Tree canopy		
__ Semi-needle leaf	__ Semi-Evergreen	__ Shrubland	__ Sparse shrubland	T3 Tree sub-canopy		
__ Needle-leaf	__ Evergreen	__ Dwarf shrubland	__ Dwarf scrub thicket	S1 Tall shrub		
__ Graminoid	__ Perennial	__ Sparse dwarf shrubland	__ Herbaceous	S2 Short shrub		
__ Broad-leaf herbaceous	__ Annual	__ Non-vascular	__ Sparsely vegetated	H Herbaceous		
__ Pteridophyte				N Non-vascular		
R = 1 or few (+) = occasional 1 = <5% 2- = 5-12% 2+ = 13-25% 3 = 26-50% 4 = 51-75% 5 = 76+%				E Epiphyte		
				V Vine / liana		

Species / percent cover: starting with uppermost stratum, list all species and % cover for each in the stratum. For forests and woodlands, list on a separate line below each tree species the DBH of all trees above 10 cm diameter. Separate the measurements with a comma and note whether in cm or inches.

Appendix D. Plants observed in Cape Cod National Seashore during vegetation plot and thematic accuracy assessment sampling.

Nomenclature follows *the PLANTS Database, Version 3.5, Database* developed by the Natural Resource Conservation Service in cooperation with the Biota of North America Program (United States Department of Agriculture, Natural Resources Conservation Service 2006). For this report, some common names listed in the *PLANTS Database* were changed to reflect the common names typically used by ecologists and resource managers in this region. Plants denoted with an asterisk (*) were observed in the field but not sampled. Species marked with a superscript "e" indicates an exotic species to Massachusetts (Massachusetts Invasive Plant Advisory Group 2005; Merhoff et al. 2003).

Family	Scientific Name	Common Name
Aceraceae	*Acer platanoides*[e]	Norway maple
	Acer rubrum	red maple
	Acer rubrum var. *rubrum*	red maple
Alismataceae	*Sagittaria latifolia*	broadleaf arrowhead
	*Sagittaria teres**	slender arrowhead
Anacardiaceae	*Rhus copallinum*	flameleaf sumac
	Rhus glabra	smooth sumac
	Toxicodendron radicans	eastern poison ivy
	Toxicodendron vernix	poison sumac
Apiaceae	*Angelica lucida*	seacoast angelica
	Daucus carota	Queen Anne's lace
	*Hydrocotyle umbellata**	manyflower marshpennywort
	Lilaeopsis chinensis	eastern grasswort
	Ptilimnium capillaceum	Herbwilliam
	Sanicula marilandica	Maryland sanicle
	Sium suave	hemlock waterparsnip
Aquifoliaceae	*Ilex glabra*	Inkberry
	Ilex opaca	American holly
	Ilex verticillata	common winterberry
Araceae	*Orontium aquaticum*	Goldenclub
	Peltandra virginica	green arrow arum
Araliaceae	*Aralia nudicaulis*	wild sarsaparilla
Asclepiadaceae	*Asclepias amplexicaulis*	clasping milkweed
	Asclepias incarnata	swamp milkweed
	Asclepias syriaca	common milkweed
Asteraceae	*Achillea millefolium*	common yarrow
	Ambrosia artemisiifolia	annual ragweed
	Antennaria spp.	Pussytoes
	Arctium minus	lesser burdock
	Artemisia campestris ssp. *caudata*	field sagewort
	Artemisia stelleriana	Oldwoman
	Aster spp.	Aster
	Baccharis halimifolia	eastern baccharis
	Bidens sp.	Beggarticks
	Bidens cernua	nodding beggartick
	*Bidens connate**	purplestem beggarticks

Family	Scientific Name	Common Name
Asteraceae (cont)	*Bidens discoidea*	small beggarticks
	Bidens frondosa	devil's beggartick
	Bidens tripartite	threelobe beggarticks
	Cirsium arvense[e]	Canada thistle
	Cirsium discolor	field thistle
	Cirsium muticum	swamp thistle
	Cirsium vulgare[e]	bull thistle
	Conyza canadensis	Canadian horseweed
	Conyza canadensis var. *canadensis**	Canadian horseweed
	Conyza canadensis var. *pusilla**	Canadian horseweed
	Erechtites hieraciifolia	American burnweed
	Eupatorium spp.	thoroughwort
	Eupatorium hyssopifolium	hyssopleaf thoroughwort
	Eupatorium maculatum	spotted joepyeweed
	Eupatorium perfoliatum	common boneset
	Eupatorium pilosum	rough boneset
	Euthamia tenuifolia	slender goldentop
	Euthamia graminifolia	flat-top goldentop
	Euthamia graminifolia	flat-top goldentop
	Hieracium venosum	rattlesnakeweed
	Hypochaeris radicata	hairy catsear
	Ionactis linariifolius	flaxleaf whitetop aster
	Iva frutescens	Jesuit's bark
	Lactuca spp.	lettuce
	Lactuca biennis	tall blue lettuce
	Leucanthemum vulgare	oxeye daisy
	Pityopsis falcata	sickleleaf silkgrass
	Pluchea odorata	sweetscent
	Prenanthes spp.	rattlesnakeroot
	Pseudognaphalium obtusifolium	rabbittobacco
	*Rudbeckia hirta**	blackeyed Susan
	Sericocarpus asteroides	toothed whitetop aster
	Solidago spp.	goldenrod
	Solidago bicolor	white goldenrod
	Solidago canadensis	Canada goldenrod
	Solidago juncea	early goldenrod
	Solidago latissimifolia	Elliott's goldenrod
	*Solidago nemoralis**	gray goldenrod
	Solidago odora	anisescented goldenrod
	Solidago puberula	downy goldenrod
	Solidago rugosa	wrinkleleaf goldenrod
	Solidago rugosa ssp. *rugosa*	wrinkleleaf goldenrod
	Solidago sempervirens	seaside goldenrod
	Solidago uliginosa	bog goldenrod
	Sonchus arvensis	field sowthistle
	Symphyotrichum dumosum var. *dumosum*	rice button aster
	Symphyotrichum ericoides var. *ericoides*	white heath aster
	Symphyotrichum lateriflorum var. *lateriflorum*	calico aster
	Symphyotrichum novae-angliae	New England aster

Family	Scientific Name	Common Name
Asteraceae (cont)	*Symphyotrichum novi-belgii* var. *novi-belgii*	New York aster
	Symphyotrichum patens var. *patens*	late purple aster
	Symphyotrichum puniceum var. *puniceum*	purplestem aster
	Symphyotrichum subulatum	eastern annual saltmarsh aster
	Symphyotrichum tenuifolium	perennial saltmarsh aster
	Symphyotrichum undulatum	waxyleaf aster
	Taraxacum officinale	common dandelion
	Xanthium strumarium	rough cockleburr
	Xanthium strumarium var. *canadense**	Canada cockleburr
Balsaminaceae	*Impatiens capensis*	jewelweed
Berberidaceae	*Berberis thunbergii*[e]	Japanese barberry
Betulaceae	*Alnus incana**	gray alder
	*Alnus serrulata**	hazel alder
	Betula papyrifera	paper birch
	Betula populifolia	gray birch
	Corylus americana	American hazelnut
Blechnaceae	*Woodwardia areolata*	netted chainfern
	Woodwardia virginica	Virginia chainfern
Brassicaceae	*Alliaria petiolata*[e]	garlic mustard
	Cakile edentula	American searocket
	Lepidium campestre[e]	field pepperweed
	Raphanus raphanistrum	wild radish
Cabombaceae	*Brasenia schreberi*	watershield
Campanulaceae	*Lobelia dortmanna**	Dortmann's cardinalflower
Caprifoliaceae	*Lonicera* sp.	honeysuckle
	Lonicera japonica[e]	Japanese honeysuckle
	Lonicera morrowii[e]	Morrow's honeysuckle
	Sambucus nigra ssp. *canadensis*	common elderberry
	Viburnum dentatum var. *lucidum*	southern arrowwood
	Viburnum lantanoides	hobblebush
	Viburnum lentago	nannyberry
	Viburnum nudum var. *cassinoides*	withe-rod
Caryophyllaceae	*Honckenya peploides*	seaside sandplant
	Honckenya peploides ssp. *robusta**	seaside sandplant
	Saponaria officinalis	bouncingbet
	Spergularia canadensis	Canadian sandspurry
	Spergularia salina	salt sandspurry
Celastraceae	*Celastrus orbiculatus*	oriental bittersweet
	Euonymus alatus[e]	winged burning bush
Chenopodiaceae	*Atriplex cristata*	crested saltbush
	*Atriplex patula**	spear saltbush
	Atriplex prostrata	triangle orache
	Chenopodium album	lateflowering goosefoot
	Salicornia bigelovii	dwarf saltwort
	Salicornia maritima	slender grasswort
	Salicornia virginica	Virginia grasswort
	Salsola kali	Russian thistle
	Suaeda maritima	herbaceous seepweed
Cistaceae	*Helianthemum canadense*	longbranch frostweed

Family	Scientific Name	Common Name
Cistaceae (cont)	*Helianthemum dumosum**	bushy frostweed
	Hudsonia ericoides	pinebarren goldenheather
	Hudsonia tomentosa	woolly beachheather
	Lechea maritima	beach pinweed
Cladoniaceae	*Cladina* spp.	reindeer lichen
	Cladina rangiferina	greygreen reindeer lichen
	Cladina stellaris	star reindeer lichen
	Cladonia sp.	cup lichen
Clethraceae	*Clethra alnifolia*	coastal sweetpepperbush
Clusiaceae	*Hypericum canadense*	lesser Canadian St. Johnswort
	Hypericum mutilum	dwarf St. Johnswort
	Hypericum perforatum	common St. Johnswort
	Triadenum virginicum	Virginia marsh St. Johnswort
Convolvulaceae	*Calystegia sepium*	hedge false bindweed
	Calystegia sepium ssp. *sepium*	hedge false bindweed
Cupressaceae	*Chamaecyparis thyoides*	Atlantic white cedar
	Juniperus sp.	juniper
	Juniperus virginiana	eastern redcedar
Cyperaceae	*Carex* spp.	sedge
	Carex canescens	silvery sedge
	Carex disperma	softleaf sedge
	Carex hormathodes	marsh straw sedge
	Carex lacustris	hairy sedge
	Carex lasiocarpa	woollyfruit sedge
	Carex lurida	shallow sedge
	Carex pensylvanica	Pennsylvania sedge
	Carex pseudocyperus	cypresslike sedge
	Carex stricta	upright sedge
	Carex umbellata	parasol sedge
	Cladium mariscoides	smooth sawgrass
	*Cyperus dentatus**	toothed flatsedge
	Cyperus filicinus	fern flatsedge
	Cyperus lupulinus ssp. *lupulinus*	Great Plains flatsedge
	Dulichium arundinaceum	threeway sedge
	Eleocharis sp.	spikerush
	*Eleocharis acicularis**	needle spikerush
	Eleocharis obtusa	blunt spikerush
	Eleocharis olivacea	bright green spikerush
	Eleocharis palustris	common spikerush
	Eleocharis parvula	dwarf spikerush
	Eleocharis robbinsii	Robbins' spikerush
	Eleocharis rostellata	beaked spikerush
	Eleocharis tenuis	slender spikerush
	*Eriophorum virginicum**	tawny cottongrass
	Eriophorum viridicarinatum	thinleaf cottonsedge
	*Fimbristylis autumnalis**	slender fimbry
	Rhynchospora alba	white beaksedge
	Rhynchospora capitellata	brownish beaksedge
	Rhynchospora fusca	brown beaksedge

Family	Scientific Name	Common Name
Cyperaceae (cont)	*Schoenoplectus acutus* var. *acutus*	hardstem bulrush
	Schoenoplectus americanus	chairmaker's bulrush
	Schoenoplectus maritimus	cosmopolitan bulrush
	Schoenoplectus novae-angliae	New England bulrush
	Schoenoplectus pungens	common threesquare
	Schoenoplectus robustus	sturdy bulrush
	Schoenoplectus subterminalis	swaying bulrush
	Schoenoplectus tabernaemontani	softstem bulrush
	Scirpus cyperinus	woolgrass
Dennstaedtiaceae	*Dennstaedtia punctilobula*	eastern hayscented fern
	Pteridium aquilinum	western brackenfern
Droseraceae	*Drosera filiformis**	threadleaf sundew
	Drosera intermedia	spoonleaf sundew
	Drosera rotundifolia	roundleaf sundew
Dryopteridaceae	*Athyrium* spp.	ladyfern
	Dryopteris intermedia	intermediate woodfern
	Dryopteris marginalis	marginal woodfern
	Onoclea sensibilis	sensitive fern
Elaeagnaceae	*Elaeagnus umbellata*[e]	autumn olive
Empetraceae	*Corema conradii*	broom crowberry
Ericaceae	*Arctostaphylos uva-ursi*	kinnikinnick
	Chamaedaphne calyculata	leatherleaf
	Epigaea repens	trailing arbutus
	Gaultheria procumbens	eastern teaberry
	Gaylussacia baccata	black huckleberry
	Gaylussacia dumosa	dwarf huckleberry
	Gaylussacia frondosa	blue huckleberry
	Kalmia angustifolia	sheep laurel
	Lyonia ligustrina	maleberry
	Rhododendron viscosum	swamp azalea
	Vaccinium angustifolium	lowbush blueberry
	Vaccinium corymbosum	highbush blueberry
	Vaccinium macrocarpon	cranberry
	Vaccinium oxycoccos	small cranberry
	Vaccinium pallidum	Blue Ridge blueberry
Eriocaulaceae	*Eriocaulon aquaticum*	sevenangle pipewort
Euphorbiaceae	*Chamaesyce maculata*	spotted sandmat
	Chamaesyce polygonifolia	seaside sandmat
	Euphorbia cyparissias[e]	cypress spurge
Fabaceae	*Apios americana*	groundnut
	Baptisia tinctoria	horseflyweed
	Lathyrus japonicus	beach pea
	Robinia pseudoacacia[e]	black locust
	Trifolium arvense	rabbitfoot clover
	Trifolium pratense	red clover
	Vicia cracca	bird vetch
Fagaceae	*Fagus grandifolia*	American beech
	Quercus alba	white oak
	Quercus coccinea	scarlet oak

Family	Scientific Name	Common Name
Fagaceae (cont)	*Quercus ilicifolia*	bear oak
	Quercus prinoides	dwarf chinkapin oak
	Quercus velutina	black oak
Fucaceae	*Ascophyllum nodosum*	yellow tang*
Geasteraceae	*Geaster hygrometricus*	earth star
Gentianaceae	*Bartonia virginica*	yellow screwstem
Grossulariaceae	*Ribes* spp.	currant
	Ribes hirtellum	hairystem gooseberry
Haloragaceae	*Myriophyllum tenellum**	slender watermilfoil
	Proserpinaca palustris	marsh mermaidweed
Iridaceae	*Iris versicolor*	harlequin blueflag
Juglandaceae	*Carya alba*	mockernut hickory
	Carya glabra	pignut hickory
Juncaceae	*Juncus* spp.	rush
	Juncus ambiguus	seaside rush
	Juncus articulatus	jointleaf rush
	*Juncus bufonius**	toad rush
	Juncus canadensis	Canadian rush
	Juncus effusus	common rush
	Juncus gerardii	saltmeadow rush
	Juncus greenei	Greene's rush
	Juncus militaris	bayonet rush
	Juncus pelocarpus	brownfruit rush
	Juncus tenuis	poverty rush
Lamiaceae	*Lycopus* spp.	waterhorehound
	Lycopus americanus	American water horehound
	Lycopus uniflorus	northern bugleweed
	*Lycopus virginicus**	Virginia water horehound
	Prunella vulgaris	common selfheal
	Scutellaria galericulata	marsh skullcap
	Teucrium canadense	Canada germander
Lauraceae	*Sassafras albidum*	sassafras
Lemnaceae	*Lemna minor*	common duckweed
Lentibulariaceae	*Utricularia* spp.	bladderwort
	Utricularia cornuta	horned bladderwort
Leucobryaceae	*Leucobryum* sp.	leucobryum moss
Liliaceae	*Asparagus officinalis*	garden asparagus
	Convallaria majalis	European lily of the valley
	Lilium philadelphicum	wood lily
	Maianthemum canadense	Canada mayflower
	Maianthemum racemosum ssp. *racemosum*	feathery false lily of the valley
	Maianthemum stellatum	starry false lily of the valley
	Polygonatum biflorum	smooth Solomon's seal
Lycopodiaceae	*Lycopodiella inundata*	inundated clubmoss
	Lycopodium digitatum	fan clubmoss
Lythraceae	*Decodon verticillatus*	swamp loosestrife
	Lythrum salicaria[e]	purple loosestrife
Malvaceae	*Hibiscus moscheutos* ssp. *moscheutos*	crimsoneyed rosemallow
Menyanthaceae	*Nymphoides cordata**	little floatingheart

Family	Scientific Name	Common Name
Mniaceae	*Mnium* sp.	mnium calcareous moss
Monotropaceae	*Monotropa uniflora*	Indianpipe
Myricaceae	*Comptonia peregrina*	sweet fern
	Morella pensylvanica	northern bayberry
	Myrica gale	sweetgale
Nymphaeaceae	*Nymphaea odorata*	American white waterlily
Nyssaceae	*Nyssa sylvatica*	blackgum
Oleaceae	*Ligustrum vulgare*[e]	European privet
	Syringa vulgaris[e]	common lilac
Onagraceae	*Epilobium* sp.	willowherb
	Ludwigia palustris	marsh seedbox
	Oenothera biennis	common evening-primrose
Orchidaceae	*Calopogon tuberosus* var. *tuberosus*	tuberous grasspink
	Cypripedium acaule	moccasin flower
	Platanthera sp.*	fringed orchid
	Pogonia ophioglossoides	snakemouth orchid
Orobanchaceae	*Epifagus virginia**	beechdrops
Osmundaceae	*Osmunda cinnamomea*	cinnamon fern
	Osmunda regalis	royal fern
Oxalidaceae	*Oxalis stricta*	common yellow oxalis
Papaveraceae	*Chelidonium majus*[e]	celandine
Parmeliaceae	*Usnea* sp.	beard lichen
Phytolaccaceae	*Phytolacca americana*	American pokeweed
Pinaceae	*Pinus banksiana*	jack pine
	Pinus rigida	pitch pine
	Pinus sylvestris[e]	Scotch pine
Plantaginaceae	*Plantago maritima*	goose tongue
Plumbaginaceae	*Limonium carolinianum*	Carolina sealavender
Poaceae	*Agrostis* spp.	bentgrass
	Agrostis capillaris	colonial bentgrass
	Agrostis hyemalis	winter bentgrass
	Agrostis scabra	rough bentgrass
	Agrostis stolonifera	creeping bentgrass
	Aira praecox	yellow hairgrass
	Ammophila breviligulata	American beachgrass
	Andropogon virginicus	broomsedge bluestem
	Anthoxanthum odoratum	sweet vernalgrass
	Bromus tectorum[e]	cheatgrass
	Calamagrostis canadensis	bluejoint
	Dactylis glomerata	orchardgrass
	Danthonia spicata	poverty oatgrass
	Deschampsia flexuosa	wavy hairgrass
	Dichanthelium sp.	rosette grass
	Dichanthelium acuminatum	tapered rosette grass
	Dichanthelium acuminatum var. *acuminatum*	tapered rosette grass
	Dichanthelium clandestinum	deertongue
	Distichlis spicata	inland saltgrass
	Echinochloa crus-galli	barnyardgrass
	Elymus repens	quackgrass

Family	Scientific Name	Common Name
Poaceae (cont)	*Elymus virginicus var. halophilus*	Virginia wildrye
	Festuca rubra	red fescue
	Festuca trachyphylla	hard fescue
	*Glyceria acutiflora**	creeping mannagrass
	Glyceria canadensis	rattlesnake mannagrass
	Glyceria melicaria	melic mannagrass
	Glyceria obtusa	Atlantic mannagrass
	Holcus lanatus	common velvetgrass
	Leersia oryzoides	rice cutgrass
	Leersia virginica	whitegrass
	Leptochloa panacea ssp. *brachiata*	fineleaf sheep fescue
	Lolium pratense	meadow ryegrass
	Lolium perenne	perennial ryegrass
	Panicum spp.	panicgrass
	Panicum virgatum	switchgrass
	Panicum virgatum var. *virgatum*	switchgrass
	Phalaris arundinacea[e]	reed canarygrass
	*Phleum pretense**	timothy
	Phragmites australis[e]	common reed
	Poa compressa[e]	Canada bluegrass
	Poa palustris	fowl bluegrass
	Puccinellia maritima	seaside alkaligrass
	Puccinellia fasciculata	saltmarsh alkaligrass
	Schizachyrium scoparium	little bluestem
	Spartina alterniflora	smooth cordgrass
	Spartina cynosuroides	big cordgrass
	Spartina patens	saltmeadow cordgrass
	Spartina pectinata	prairie cordgrass
	Thinopyrum pycnanthum	tick quackgrass
	*Zizania aquatica**	annual wildrice
	Zizania palustris	northern wildrice
Polygalaceae	*Polygala polygama*	racemed milkwort
	*Polygala sanguinea**	purple milkwort
	Polygala senega	Seneca snakeroot
Polygonaceae	*Polygonella articulata*	coastal jointweed
	Polygonum spp.	knotweed
	Polygonum arifolium	halberdleaf tearthumb
	Polygonum hydropiperoides	swamp smartweed
	Polygonum pensylvanicum	Pennsylvania smartweed
	Polygonum ramosissimum	bushy knotweed
	Rumex spp.	dock
	Rumex acetosella[e]	common sheep sorrel
	Rumex aquaticus var. *fenestratus*	western dock
	Rumex crispus	curly dock
	Rumex obtusifolius	bitter dock
	Rumex orbiculatus	greater water dock
Polytrichaceae	*Polytrichum* sp.	polytrichum moss
	Polytrichum commune	polytrichum moss
Pontederiaceae	*Pontederia cordata*	pickerelweed

Family	Scientific Name	Common Name
Potamogetonaceae	*Potamogeton* sp.	pondweed
Primulaceae	*Glaux maritima*	sea milkwort
	Lysimachia terrestris	earth loosestrife
	Trientalis borealis	starflower
Pyrolaceae	*Chimaphila maculata*	striped prince's pine
	Chimaphila umbellata	pipsissewa
	Pyrola americana	American wintergreen
Ranunculaceae	*Ranunculus* spp.	buttercup
	Thalictrum dioicum	early meadow-rue
Rosaceae	*Amelanchier* sp.	serviceberry
	Amelanchier canadensis	Canadian serviceberry
	Amelanchier stolonifera	running serviceberry
	Fragaria virginiana	Virginia strawberry
	Geum vernum	spring avens
	Malus spp.	apple
	Malus pumila	paradise apple
	*Photinia floribunda**	purple chokeberry
	Photinia melanocarpa	black chokeberry
	Photinia pyrifolia	red chokeberry
	Prunus maritima	beach plum
	Prunus pensylvanica	pin cherry
	Prunus serotina	black cherry
	Prunus virginiana	chokecherry
	Pyrus communis	common pear
	Rosa carolina	Carolina rose
	Rosa multiflora[e]	multiflora rose
	Rosa palustris	swamp rose
	Rosa rugosa	rugosa rose
	Rosa virginiana	Virginia rose
	Rubus sp.	blackberry
	Rubus allegheniensis	Allegheny blackberry
	Rubus flagellaris	northern dewberry
	Rubus hispidus	bristly dewberry
	Rubus idaeus	American red raspberry
	Rubus occidentalis	black raspberry
	Spiraea alba var. *latifolia*	white meadowsweet
	Spiraea tomentosa	steeplebush
Rubiaceae	*Cephalanthus occidentalis*	common buttonbush
	Galium sp.	bedstraw
	Galium aparine	stickywilly
	Galium circaezans	licorice bedstraw
	*Galium palustre**	common marsh bedstraw
Ruppiaceae	*Ruppia maritima**	widgeongrass
Salicaceae	*Populus alba*[e]	white poplar
	Populus grandidentata	bigtooth aspen
	*Populus tremuloides**	quaking aspen
	Salix sp.	willow
Sarraceniaceae	*Sarracenia purpurea*	purple pitcherplant
Scrophulariaceae	*Agalinis paupercula*	smallflower false foxglove

Family	Scientific Name	Common Name
Scrophulariaceae (cont)	*Agalinis purpurea**	purple false foxglove
	*Gratiola aurea**	golden hedgehyssop
	Limosella australis	Welsh mudwort
	Linaria vulgaris	butter and eggs
	Melampyrum lineare	narrowleaf cowwheat
	Nuttallanthus canadensis	Canada toadflax
	Verbascum thapsus	common mullein
Simaroubaceae	*Ailanthus altissima*[e]	tree of heaven
Smilacaceae	*Smilax glauca*	cat greenbrier
	Smilax rotundifolia	roundleaf greenbrier
Solanaceae	*Solanum dulcamara*[e]	climbing nightshade
Sparganiaceae	*Sparganium* sp.	bur-reed
	Sparganium erectum ssp. *stoloniferum*	simplestem bur-reed
Sphagnaceae	*Sphagnum* spp.	sphagnum
Thelypteridaceae	*Thelypteris palustris*	eastern marsh fern
	Thelypteris simulata	bog fern
Tiliaceae	*Tilia americana*	American basswood
Typhaceae	*Typha* sp.	cattail
	Typha ×glauca	cattail hybrid
	Typha angustifolia	narrowleaf cattail
	Typha latifolia	broadleaf cattail
Ulvaceae	*Ulva lactuca**	sea lettuce
Urticaceae	*Boehmeria cylindrica*	smallspike false nettle
Violaceae	*Viola lanceolata*	bog white violet
	Viola sagittata var. *ovata*	arrowleaf violet
Vitaceae	*Parthenocissus quinquefolia*	Virginia creeper
	Vitis spp.	grape
	Vitis aestivalis	summer grape
	Vitis labrusca	fox grape
Xyridaceae	*Xyris* sp.	yelloweyed grass
	Xyris difformis	bog yelloweyed grass
	*Xyris torta**	slender yelloweyed grass

Appendix E. Dichotomous field key to the vegetation associations of Cape Cod National Seashore.

Keys to the Vegetation Associations at Cape Code National Seashore

These are dichotomous keys, with numbered couplets. Each couplet (designated by a boxed number above it) has two statements to choose from. Begin with couplet 1, decide which statement best applies to your setting, and proceed to the couplet indicated after that statement. Continue in this vein and you will eventually arrive at the type that should fit your setting. If there is a couplet where it's unclear which choice is better, make a note and try both directions from that couplet. When you get through the key to a type, refer to the full description to confirm.

It may be possible to reach the same vegetation type at different points in the key. This is by design. Vegetation types are inherently variable, and at their extremes may look quite different. There are two names and a number for each association, all in bold type. The first name is the association's common name followed by a USNVC identifier code in the format CEGL00xxxx. The second name is the aggregated map unit name in the vegetation map.

What if the key doesn't work? There are several possible reasons:

- You may be using the wrong key. Each key covers a subset of all possible types.
- You may be trying to type a transition zone. The classification is designed to impose clear conceptual boundaries on types that grade into each other in reality. Although ecotones are important, they are not classified as separate units. Before using the key, make sure you have done a reconnaisance in the area to be sure you are in a portion of the stand that is truly representative.
- You may be applying the key to vegetation at a scale that is different from that used to develop the classification. For example, a stand of trees must be at least a few acres in extent to be a forest. It is possible to identify a forest type from stands smaller than that, but often there is so much "edge" that its identity is usually very difficult to discern. Conversely, many herbaceous communities occur naturally in patches less than 0.5 acre in size. Other communities, such as shrub zones along rivers or lakes are linear in form – not very wide, but quite long. It is important to be cognizant of the average patch size of vegetation when applying the key.

A “key to the keys”

The keys have been divided into manageable portions to facilitate their use. It is, however, important that you have the correct key! Please refer to the following to choose the appropriate key.

1

Vegetation primarily woody (trees or tall shrubs exhibiting tree-like growth dominant; canopy closed to partially open – includes “woodland” class of USNVC) 2

Vegetation primarily herbaceous or sparse.....6

2

Forested communities.....3

Shrubland communities 4

3

Forests and Woodlands of uplands .....**Upland Forests, Woodlands, and Shrublands Key**

Forests of wetlands ..... **Wetland Forests Key**

4

Shrublands of uplands (not wetlands).....5

Shrublands of wetlands.....**Shrub Swamps and Bogs Key**

5

Interior shrublands and uplands..... **Shrublands and Grasslands Key**

Coastal upland shrublands of uplands.....**Upland Forests, Woodlands, and Shrublands Key**

6

Non-forested to sparse vegetation of uplands (may include interdunal swales) **Beaches and Dune Vegetation Key**

Herbaceous vegetation of wetlands 7

7

Vegetation influenced by tidal flow (salt to fresh) ..... **Salt and Brackish Marshes and Sparse Vegetation Key**

Vegetation of freshwater, boggy, streamside, coastal plain pond or other wetland habitats..... .....**Herbaceous Freshwater Wetlands Key**

Key to the communities of Beaches and Dune Vegetation

1

Vegetation of beaches and foredunes, fully exposed to oceanic influences; dominated by annuals, perennial grasses and forbs, or sparsely vegetated 2

Vegetation on the lee side of dunes; marginally protected from oceanic influences (low areas of dunes and backdunes); vegetation herbaceous, low or tall shrubs or shrubs mixed with forbs 4

2

Beach community occuring at the wrack line on well-drained sands but flooded irregularly by storm tides, dominated by annuals such as American searocket (*Cakile edentula*)..... **North Atlantic Upper Ocean Beach (CEGL004400) Beach**

Vegetation of dunes bordering beaches or salt marshes; perennial grasses and forbs predominant; may be somewhat sparse 3

3

Vegetation of low dunes bordering salt marshes; upland form of saltmeadow cordgrass (*Spartina patens*) is characteristic, mixed with quackgrass (*Elymus repens)*, as well as a robust blue-grey grass resembling quackgrass, tick quackgrass (*Thinopyrum pycnanthum);* American beachgrass (*Ammophila breviligulata*) may also be present..... **Salt Hay Dune (CEGL006149) Salt Marsh**

Vegetation of foredunes, American beachgrass (*Ammophila breviligulata*) commonly present..... **Northern Beachgrass Dune (CEGL006274) Beachgrass Dune**

4

Vegetation of interdunal swales, wetland plants present (but substrate may be dry, particularly in late season) 5

Woody or non-woody vegetation of backdunes, not influenced by the water table..... 7

5

Interdunal swale with a scattered to closed pitch pine canopy; cranberry (*Vaccinium macrocarpon*) and smooth sawgrass (*Cladium mariscoides)* also present in the understory ..... **Pitch Pine / Cranberry Interdunal Swale (CEGL006127) Dune Pine Forest**

Non-forested interdunal swale 6

6

Cranberry (*Vaccinium macrocarpon*) dominant or abundant; steeplebush (*Spiraea tomentosa)* and northern bayberry (*Morella pensylvanica*) may also be present; smooth sawgrass (*Cladium mariscoides)* and other sedges and rushes often present..... **Northern Interdunal Cranberry Swale (CEGL006141) Cranberry Swale**

Cranberry (*Vaccinium macrocarpon*) absent; interdunal swale dominated by sedges and rushes..... **Coastal Freshwater Marsh (CEGL006935) Coastal Marsh**

7

Backdune vegetation of variable structure – grasses, dwarf-shrubs, low shrubs and vines growing as patches or often intermixed.....8

Upland forests, woodlands or tall shrublands of backdunes.....11

8

Vegetation of stabilized dunes – grasses and forbs dominant; shrubs sparse or absent; wavy hairgrass (*Deschampsia flexuosa*) abundant in some examples; American beachgrass (*Ammophila breviligulata*) present with field sagewort (*Artemisia campestris* ssp. *caudata*), beach pinweed (*Lechea maritma),* coastal jointweed (*Polygonella articulata*), little bluestem (*Schizachyrium scoparium*), seaside goldenrod (*Solidago sempervirens*), sickleleaf silkgrass (*Pityopsis falcata*) often present ..... **Hairgrass Backdune Grassland (CEGL006621)**
Beachgrass Dune

Vegetation dominated by woody vegetation of various heights or by vines 9

9

Dune community dominated by vines, often growing over low dead shrubs .....**North Atlantic Coastal Plain Vine Dune (CEGL003886)**
Dune Shrub

Dune community dominated by dwarf-shrubs or low shrubs; patches of open sand may be present 10

10

Dune community dominated by low beachheather (*Hudsonia tomentosa*) or kinnikinnick (*Arctostaphylos uva-ursi*); typically northern bayberry (*Morella pensylvanica*) and beach plum (*Prunus maritima*) are common associates..... **Northern Bayberry Dune Shrubland (CEGL006295)**
Dune Shrub

Dwarf-shrub vegetation of backdunes or bluffs; woolly beachheather (*Hudsonia tomentosa)* and / or kinnikinnick (*Arctostaphylos uva-ursi*) dominant, with associates such as beach pinweed (*Lechea maritima),*coastal jointweed (*Polygonella articulata*) and scattered beach plum (*Prunus maritima*) ..... **Northern Beach-heather Dune Shrubland (CEGL006143)**
Heathland / Grassland

11

Pitch pine (*Pinus rigida*)dominant; tree oaks (*Quercus* spp.) may be present at low cover..... **Pitch Pine Dune Woodland (CEGL006117)**
Dune Pine Forest

Woody vegetation primarily deciduous trees or tall shrubs.....12

12

Vegetation sheltered from direct maritime influences; oaks (*Quercus* spp.) make up only a minor portion of the canopy (substantially less than 50% cover); generally has a well-developed structure with an understory and herbaceous layer of native species; weedy exotics generally negligible or absent ..... **Successional Maritime Forest** (**CEGL006145)**
Scrub Forest

Vegetation of bluffs and former agricultural lands; vegetation head-high, dense to open, multi-stemmed with a level wind-sheared canopy; weedy species such as honeysuckle (*Lonicera* spp.) and multiflora rose (*Rosa multiflora)* usually present..... **Northern Tall Maritime Shrubland (CEGL006379)**
Scrub Forest

Key to interior Shrublands and Grasslands

1

Tall deciduous shrublands (2–5 meters) 2

Shrubs shorter than 2 meters; tree species absent or very sparse [short pitch pines (*Pinus rigida*) may be present), or herbaceous vegetation (native and nonnative species) 3

2

Fleshy-fruited tree species such as black cherry (*Prunus serotina*), serviceberry (*Amelanchier* spp.), sassafras (*Sassafras albidum*) prevalent; weedy species such as honeysuckle (*Lonicera* spp.) or multiflora rose (*Rosa multiflora)* present ..... **Northern Tall Maritime Shrubland (CEGL006379)**
Scrub Forest

Wet meadow vegetation dominated by shrus including steeplebush (*Spiraea tomentosa*), southern arrowwood (*Viburnum dentatum* var. *lucidum*), coastal sweetpepperbush (*Clethra alnifolia*), and northern dewberry (*Rubus flagellaris)*; bluejoint (*Calamagrostis canadensis)* and eastern hayscented fern (*Dennstaedtia punctilobula)* common ..... **Successional Wet Meadow (CEGL006571)**
Shrub Swamp

3

Low heath shrubs dominant (more than 75% cover); kinnickinnick (*Arctostaphylos uva-ursi),* broom crowberry (*Corema conradii),* pinebarren goldenheather (*Hudsonia ericoides),* horseflyweed (*Baptisia tinctoria),* lowbush blueberry (*Vaccinium angustifolium),* and black huckleberry (*Gaylussacia baccata)* common; scattered low pitch pines (*Pinus rigida*) may be present ..... **Sandplain Heathland (CEGL006066)**
Heathland / Grassland

Vegetation primarily herbaceous – grasses prevalent; scattered shrubs or patches of shrubs may be present 4

4

Old fields and upland grasslands 5

Wet meadow vegetation dominated by shrus including steeplebush (*Spiraea tomentosa*), southern arrowwood (*Viburnum dentatum* var. *lucidum*), coastal sweetpepperbush (*Clethra alnifolia*), and northern dewberry (*Rubus flagellaris)*; bluejoint (*Calamagrostis canadensis)* and eastern hayscented fern (*Dennstaedtia punctilobula)* common ..... **Successional Wet Meadow (CEGL006571)**
Shrub Swamp

5

Little bluestem (*Schizachyrium scoparium)* dominant or codominant 6

Vegetation primarily nonnative weeds; abandoned pastures and frequently mowed areas ..... **Northeastern Old Field (CEGL006107)**
Old Field

6

Vegetation primarily native species: little bluestem (*Schizachyrium scoparium)*, poverty oatgrass (*Danthonia spicata*), bushy frostweed (*Helianthemum dumosum)*, longbranch frostweed (*Helianthemum canadense)* characteristic; scattered heath shrubs and northern bayberry (*Morella pensylvanica*) may be present.....**Sandplain Grassland (CEGL006067)**
Heathland / Grassland

Little bluestem (*Schizachyrium scoparium)* dominant, wrinkleleaf goldenrod (*Solidago rugosa)* typically codiminant; abandoned pastures and frequently mowed areas..... **Little Bluestem Old Field (CEGL006333)**
Old Field

Key to Upland Forests, Woodlands and Shrublands

1

Evergreen [dominated by conifers or American holly (*Ilex opaca*)] forests and woodlands: deciduous trees < 20–25% of the total canopy cover 2

Deciduous or mixed forests and woodlands: deciduous trees > 25% of the total canopy cover 6

2

Eastern redcedar (*Juniperus virginiana*) vegetation of old fields, usually away from the coast or near the coast but sheltered; structure highly variable but canopy often quite dense; understory alien grasses and forbs, although little bluestem (*Schizachyrium scoparium*) may be present in quantity as well..... **Old-field Eastern Red-cedar Forest (CEGL006024)**
Red Cedar

Pitch pine prevalent..... 3

3

Pitch pine forest / woodland of sand dunes; black oak (*Quercus velutina*) and red maple (*Acer rubrum*) usually present as well; pitch pines (*Pinus rigida*) may be very stunted; large patches of open sand are common, and species such as woolly beachheather (*Hudsonia tomentosa),* kinnickinnick (*Arctostaphylos uva-ursi),* pinweed (*Lechea* spp.), northern bayberry (*Morella pensylvanica),* beach plum (*Prunus maritima)* or others typical of sand dunes also present..... **Pitch Pine Dune Woodland (CEGL006117)**
Dune Pine Forest

Pitch pine (*Pinus rigida*) forests and woodlands of more interior and sheltered areas of the park, not directly proximate to the beach and maritime dune system 4

4

Pitch pines (*Pinus rigida*) and tree oaks (*Quercus* spp.) prevalent; a mixed forest covering large sections of Cape Cod .....**Pitch Pine - Oak Forest (CEGL006381)**
Mixed Forest

Tree oaks (*Quercus* spp.) absent or nearly so 5

5

Scrub oak (*Quercus* spp.) minor or lacking; grasses and / or tree oaks (*Quercus* spp.) may or may not be present in quantity; canopy closed to partially open; sedges, grasses or blueberries and huckleberries prominent in the ground layer; in some occurrences, wavy hairgrass (*Deschampsia flexuosa)* sometimes present in quantity, without heath layer.....**Pitch Pine - Heath Barrens (CEGL005046)**
Pitch Pine Barrens

Scrub oak (*Quercus ilicifolia*) usually present in quantity; canopy more open; black cherry (*Prunus serotina),* and scattered black oak (*Quercus velutina*) may be associates; northern bayberry (*Morella pensylvanica*) and dwarf shrubs such as pinebarren goldenheather (*Hudsonia ericoides),* kinnickinnick (*Arctostphylos uva-ursi*) and broom crowberry (*Corema conradii)* characteristic ..... **Coastal Pitch Pine / Scrub Oak Barren (CEGL006315) Pitch Pine Barrens**

6

Oaks (*Quercus* spp.) are minor or absent (considerably less than 50% cover) 7

Tree or scrub oaks (*Quercus* spp.) are prevalent in the canopy; canopy may be stunted or tall.....8

7

Tall shrubland, woodland or forest (canopy height very variable in height and closure) of fleshy-fruited species such as black cherry (*Prunus serotina*), serviceberry (*Amelanchier* spp.), black chokeberry (*Photinia melanocarpa*), sassafras (*Sassafras albidum*), blackgum (*Nyssa sylvatica*), southern arrowwood (*Viburnum dentatum var. lucidum*), beach plum (*Prunus maritima*)..... **Northern Tall Maritime Shrubland** (**CEGL006379) Scrub Forest**

Forest or woodland dominated by black locust (*Robinia pseudoacacia)* or co-dominated by tree of heaven (*Ailanthus altissima)*..... **Black Locust Successional Forest (CEGL007279) Black Locust**

8

Scrub oaks (*Quercus* spp.) dominant; tree oaks (*Quercus* spp.) absent; usually occurs in association with pine barrens ..... **Outwash Scrub Oak Barrens (CEGL006111) Scrub Oak**

Tree oaks (*Quercus* spp.) dominant.....9

9

Canopy strongly dominated black oak (*Quercus velutina*), white oak (*Quercus alba*), and scarlet oak (*Quercus coccinea*) in various combinations; pitch pine (*Pinus rigida*) usually present at low cover; sassafras (*Sassafras albidum*) and serviceberry (*Amelanchier* spp.) associated; understory a well-developed shrub layer of low heaths, lowbush blueberry (*Vaccinium angustifolium*), and black huckleberry (*Gaylussacia baccata*); herbs may include moccasin flower (*Cypripedium acaule),* Canada mayflower (*Maianthemum canadense)*, western brackenfern (*Pteridium aquilinum)*..... **Northeastern Coastal Oak - Heath Forest (CEGL006375) Oak / Beech Forest**

Canopy a mixture of oaks (*Quercus* spp.) with American beech (*Fagus grandifolia*) and hickories (*Carya* spp.) prevalent.....10

10

Forest dominated by oaks (*Quercus* spp.) with American beech (*Fagus grandifolia*) a conspicuous component ..... **Northeastern Atlantic Coastal Oak - Beech Forest (CEGL006377) Oak / Beech Forest**

Hickories (*Carya* spp.) an important component of the canopy; may occur on large islands in salt marshes; on Try Island in Wellfleet; outside Cape Cod National Seashore boundary.....**Northeastern Dry Oak - Hickory Forest (CEGL006336)**
Not mapped-outside park boundary

Key to Wetland Forests

1

Swamp forests with Atlantic white cedar (*Chamaecyparis thyoides)* present in quantity 2

Swamp forests or woodlands dominated by red maple (*Acer rubrum*); Atlantic white cedar (*Chamaecyparis thyoides)* absent.....4

2

Dense, dark white cedar swamp on peat with hummocks and water-filled pools.....**Coastal Plain Atlantic White-cedar Swamp (CEGL006188) Cedar Swamp**

Canopy more open or mixed with deciduous trees, especially red maple (*Acer rubrum*) 3

3

Leatherleaf (*Chamaedaphne calyculata*) bog mat with interrupted Atlantic white cedar (*Chamaecyparis thyoides)* canopy .....**Atlantic White-cedar Bog (CEGL006321) Not mapped-outside park boundary**

Atlantic white cedar (*Chamaecyparis thyoides)* swamp occurring on pond borders; deciduous trees red maple (*Acer rubrum*) and blackgum (*Nyssa sylvatica)* usually common in canopy; shrub layer usually dominated by highbush blueberry (*Vaccinium corymbosum)*.....**Seasonally Flooded Atlantic White-cedar Swamp (CEGL006364) Not mapped-outside park boundary**

4

Red maple (*Acer rubrum*) swamp with well-developed canopy; associates include black gum (*Nyssa sylvatica),* scattered pitch pine (*Pinus rigida*), and sassafras (*Sassafras albidum*); shrub layer characterized by highbush blueberry (*Vaccinium corymbosum),* coastal sweetpepperbush (*Clethra alnifolia),* swamp azalea (*Rhododendron viscosum),* and others.....**Lower New England Red Maple - Blackgum Swamp (CEGL006156) Red Maple Swamp**

Open canopy of young red maples (*Acer rubrum*) usually occurring on streamsides; tall sedges such as upright sedge (*Carex stricta),* hairy sedge (*Carex lacustris),* woolgrass (*Scirpus cyperinus),* and cattails (*Typha* spp.) form a dense herbaceous layer; poison sumac (*Toxicodendron vernix)* present in some examples.....**Red Maple / Tussock Sedge Wooded Marsh (CEGL006119) Wooded Marsh**

Key to Shrub Swamps and Bogs

1

Shrublands of brackish or freshwater stream banks (less commonly in isolated basins); sweetgale (*Myrica gale)* or alders (*Alnus incana, Alnus serrulata)* or swamp loosestrife (*Decodon verticillatus)* present in abundance.....2

Shrub wetlands of kettleholes, basins, bogs, pond borders, or interdunal swales 4

2

Small linear occurrences characterized by swamp loosestrife (*Decodon verticillatus*) .....**Swamp-loosestrife Shrub Swamp (CEGL005089)**
Not mapped-small patch inclusion in Shrub Swamp

Taller shrubs such as sweetgale (*Myrica gale)* or alders (*Alnus incana, Alnus serrulata*) prevalent.....3

3

Sweetgale (*Myrica gale)* characteristic; occurring on levee of river or in abandonded cranberry bogs .....**Northern Coastal Shrub Swale (CEGL006339)**
Shrub Swale

Alders (*Alnus incana, Alnus serrulata*) prevalent; other shrubs include poison sumac (*Toxicodendron vernix),* coastal sweetpepperbush (*Clethra alnifolia),* inkberry (*Ilex glabra)* and others; vines common; shrub swamp of tidal river..... **North Atlantic Fresh Tidal Shrub Swamp (CEGL006337)**
Not mapped-outside park boundary

4

Shrub swamps of very wet basins with deep muck or peat substrate 5

Shrublands of basins with shallow or no standing water, on shores of ponds with permanent water and wet meadows 8

5

Common buttonbush (*Cephalanthus occidentalis*) wetland of deep muck and nearly constant standing water; Sphagnum (*Sphagnum* spp.*)* mat absent; herbs sparse to absent ..... **Northeastern Buttonbush Shrub Swamp (CEGL006069)**
Buttonbush

Shrub bogs with Sphagnum (*Sphagnum* spp.*)* (peat development may range from shallow to deep).....6

6

Shrub bogs dominated by highbush blueberry (*Vaccinium corymbosum*).....**Highbush Blueberry Bog Thicket (CEGL006190)**
Shrub Swamp

Bogs of deep basins with sphagnum (*Sphagnum* spp.) mat; leatherleaf (*Chamaedaphne calyculata*) or dwarf huckleberry (*Gaylussacia dumosa)* strongly dominant or present with high cover of sedges 7

7

Bog dominated by dwarf ericaceous shrubs, usually leatherleaf (*Chamaedaphne calyculata)* or dwarf huckleberry (*Gaylussacia dumosa)*; other shrubs such as sheep laurel (*Kalmia angustifolia*), northern bayberry (*Morella pensylvanica)*, and swamp azalea (*Rhododendron viscosum)* often present; bog plants such as sundews (*Drosera intermedia, Drosera rotundifolia)* and cranberry (*Vaccinium macrocarpon)* typical ..... **Southern New England Bog (CEGL006008)**
Bog

Peatland with scattered shrubs such as highbush blueberry (*Vaccinium corymbosum)* or leatherleaf (*Chamaedaphne calyculata)* and high cover of sedges and grasses, particularly the woollyfruit sedge (*Carex lasiocarpa)* and bluejoint (*Calamagrostis canadensis)*; sweetgale (*Myrica gale)* not present in Cape Cod examples..... **Medium Fen (CEGL006302)**
Fen

8

Wet meadow vegetation dominated by shrus including steeplebush (*Spiraea tomentosa*), southern arrowwood (*Viburnum dentatum* var. *lucidum*), coastal sweetpepperbush (*Clethra alnifolia*), and northern dewberry (*Rubus flagellaris)*; Bluejoint (*Calamagrostis canadensis)* and eastern hayscented fern (*Dennstaedtia punctilobula)* common..... **Successional Wet Meadow (CEGL006571)**
Shrub Swamp

Wet meadow setting absent; shrub swamps of basins and pondshores 9

9

Highbush blueberry (*Vaccinium corymbosum*) shrub wetland with thin layer of peat overlying sand; often occurs on the margins of ponds that draw down in late summer..... **Blueberry Wetland Thicket (CEGL006371)**
Shrub Swamp

Cranberry (*Vaccinium macrocarpon*) or swamp loosestrife (*Decodon verticillatus)* dominant or abundant 10

10

Cranberry (*Vaccinium macrocarpon*) dominant or abundant; occurring in low areas of dunes..... **Northern Interdunal Cranberry Swale (CEGL006141)**
Cranberry Swale

Swamp loosestrife (*Decodon verticillatus)* prevalent; occurs on borders of ponds; substrate variable; muck may be moderately deep, but in dry years substrate is exposed and herbs such as earth loosestrife (*Lysimachia terrestris)*, Virginia marsh St. Johnswort (*Triadenum virginicum)*, beggarticks (*Bidens* spp.) and others appear in late season..... **Swamp-loosestrife Coastal Plain Pond (CEGL006087)**
Coastal Plain Pondshore

Key to Herbaceous Freshwater Wetlands

1

Vegetation of nontidal fresh water (ponds, basins, marshes, rivers) 2

Vegetation of creeks, marshes and rivers influenced by slightly brackish (but not saline) tides 18

2

Vegetation of ponds or pondshores or rivers; near or in open water body 3

Vegetation of marshes or bog-like sedge meadows; low areas not associated with large open water bodies 12

3

Emergent vegetation of rivers 4

Vegetation of pond or lake shores, substrate may be dry at end of growing season 7

4

Vegetation dominated by broad-leaved perennials ..... **Northeastern Leafy Forb Marsh (CEGL006191) Freshwater Marsh**

Vegetation dominated by graminoids 5

5

Cattails (*Typha* spp.) or reed grass dominant 6

Woolgrass (*Scirpus cyperinus)* present in quantity with common rush (*Juncus effusus)*, eastern marsh fern (*Thelypteris palustris)* and other herbs; cattails (*Typha* spp.) absent ..... **Woolgrass Marsh (CEGL006349) Wooded Marsh**

6

Cattails (*Typha* spp.) dominant or mixed with bulrushes ..... **Eastern Cattail Marsh (CEGL006153) Cattail Marsh**

Common reed (*Phragmites australis*) dominant ..... **Eastern Reed Marsh (CEGL004141) Phragmites**

7

Vegetation of high pondshore margin; scattered shrubs from adjacent border usually present ..... **Bluejoint Pondshore Margin (CEGL006243) Coastal Plain Pondshore**

Vegetation emergent (growing in water) or on central shoreline; shrubs absent 8

8

Vegetation dominated by tall, coarse bayonet rush (*Juncus militaris*) ..... **Bayonet Rush Pondshore (CEGL006345) Coastal Plain Pondshore**

Vegetation comprised of shorter or slender grasslike plants or by grasses or by forbs 9

9

Pondshore vegetation 10

Floating vegetation dominated by American white waterlily (*Nymphaea odorata*) ..... **Coastal Plain Pond (CEGL006086) Coastal Plain Pondshore**

10

Sparse to somewhat sparse vegetation of sandy shores dominated by rosette-leaved forbs; occurs in deeper portions of pond, where during high water only the narrow culms visible ..... **Pipewort Sandy Pondshore (CEGL006346)**
Coastal Plain Pondshore

Sparse to relatively dense vegetation of central pondshore 11

11

Substrate sandy or with thin layer of organic material; species composition variable but may include brownish beaksedge (*Rhynchospora capitellata),* toothed flatsedge (*Cyperus dentatus),* spoonleaf sundew (*Drosera intermedia),* golden hedgehyssop (*Gratiola aurea),* brownfruit rush (*Juncus pelocarpus),* bog white violet (*Viola lanceolata),* slender goldentop (*Euthamia tenuifolia)* and others ..... **Bulblet Flatsedge Coastal Plain Sandy Pondshore (CEGL006210)**
Coastal Plain Pondshore

Substrate usually mucky over sand; threeway sedge (*Dulichium arundinaceum)* and earth loosestrife *(Lysimachia terrestris)* particularly characteristic ..... **Northern Coastal Plain Pondshore Margin (CEGL006035)**
Coastal Plain Pondshore

12

Vegetation bog-like with quaking mat; very wet; sedges dominant 13

Vegetation of isolated basins or swales with shallow water that draws down in late summer 15

13

The slender-culmed woollyfruit sedge (*Carex lasiocarpa)* characteristic ..... **Medium Fen (CEGL006302)**
Fen

Threeway sedge (*Dulichium arundinaceum)* or woolgrass (*Scirpus cyperinus)* present in quantity 14

14

Threeway sedge (*Dulichium arundinaceum)* abundant and growing in a soupy sphagnum (*Sphagnum* spp.) mat ..... **Threeway Sedge Acidic Fen (CEGL006077)**
Fen

Woolgrass (*Scirpus cyperinus)* present in quantity on a floating mat ..... **Woolgrass Marsh (CEGL006349)**
Wooded Marsh

15

Common threesquare (*Schoenopectus pungens*), Canadian rush (*Juncus canadensis)* and common rush (*Juncus effusus)* characteristic ..... **Coastal Freshwater Marsh (CEGL006935)**
Coastal Marsh

Common threesquare (*Schoenopectus pungens*) absent 16

16

Woolgrass (*Scirpus cyperinus*) characteristic ..... **Woolgrass Marsh (CEGL006349)**
Wooded Marsh

Woolgrass (*Scirpus cyperinus*) not characteristic 17

17

Common reed (*Phragmites australis*) dominant..... **Eastern Reed Marsh (CEGL004141)**
Phragmites

Wet meadow vegetation dominated by bluejoint (*Calamagrostis canadensis),* eastern hayscented fern (*Dennstaedtia punctilobula)* with shrubs including steeplebush (*Spiraea tomentosa*), southern arrowwood (*Viburnum dentatum* var. *lucidum*), coastal sweetpepperbush (*Clethra alnifolia*), and northern dewberry (*Rubus flagellaris)* ..... **Successional Wet Meadow (CEGL006571)**
Shrub Swamp

18

Vegetation of river shores.....19

Vegetation on upper edges of salt marshes where it is influenced by freshwater seepage from adjacent uplands; Narrowleaf cattail (*Typha angustifolia*) strongly dominant; Smooth sawgrass (*Cladium mariscoides)* and other fen species absent.....**Cattail Brackish Tidal Marsh (CEGL004201)**
Cattail Marsh

19

Tall graminoid vegetation.....20

Short graminoid vegetation or diminutive forbs of mudflats.....22

20

Northern wildrice (*Zizania palustris*) dominant .....**Atlantic Coast Wild Rice Tidal Marsh (CEGL004202)**
Freshwater Marsh

Cattails (*Typha* spp.) dominant.....21

21

Narrowleaf cattail (*Typha angustifolia)* and crimsoneyed rosemallow (*Hibiscus moscheutos ssp. moscheutos)* present in quantity; few other associates present..... **Cattail Brackish Tidal Marsh (CEGL004201)**
Cattail Marsh

Broadleaf cattail (*Typha latifolia*) and sedges present in quantity ..... **Eastern Cattail Marsh (CEGL006153)**
Cattail Marsh

22

Smooth cordgrass (*Spartina alterniflora*) dominant or codominant.....23

Smooth cordgrass (*Spartina alterniflora*) absent.....24

23

Smooth cordgrass (*Spartina alterniflora*) dominant; the diminutive eastern grasswort (*Liliaeopsis chinensis)* forming an "understory"..... **Brackish Tidal Low Marsh (CEGL004193)**
Not mapped-outside park boundary

Smooth cordgrass (*Spartina alterniflora*) and sturdy bulrush (*Schoenoplectus robustus*) dominant; occurs along the Pamet River and at the upper edge of a salt marsh where groundwater may emerge.....**Alkali Bulrush Brackish Marsh (CEGL006416)**
Salt Marsh

24

Transitional tidal marsh dominated by chairmaker's bulrush (*Schoenoplectus americanus*) and saltmeadow cordgrass (*Spartina patens*) occurring between high marsh and uplands; influenced by irregular tidal flooding and may receive some groundwater seepage from adjacent uplands ..... **Transitional Tidal Marsh (CEGL006612)**
Salt Marsh

Sparse vegetation consisting of short forbs on mud flat; Welsh mudwort (*Limosella australis)* forming a turfy “lawn, in association with scattered rushes, sedges and grasses .. **North Atlantic Coastal Plain River Brackish Intertidal Mudflat (CEGL004473)**
Not mapped-outside park boundary

Key to communities of Salt and Brackish Marshes and Sparse Vegetation

1

Vegetation of coastal salt ponds (including Pilgrim Lake) irregularly breached by storms 2

Vegetation of tidal salt or brackish marshes and mudflats 3

2

Cosmopolitan bulrush (*Schoenoplectus maritimus)*, dwarf spikerush (*Eleocharis parvula)*, saltmeadow cordgrass (*Spartina patens)* and common threesquare (*Schoenoplectus pungens)* characteristic ..... **Coastal Salt Pond Marsh (CEGL006398) Salt Marsh**

Cattails (*Typha* spp.) dominant ..... **Cattail Brackish Tidal Marsh (CEGL004201) Cattail Marsh**

3

Vegetation of tidal rivers 4

Vegetation of coastal marshes associated with barrier beaches 11

4

Tall graminoid vegetation 5

Short graminoid vegetation or diminutive forbs of mudflats 6

5

Northern wildrice (*Zizania palustris*) dominant ..... **Atlantic Coast Wild Rice Tidal Marsh (CEGL004201) Freshwater Marsh**

Cattails (*Typha* spp.) dominant ..... **Cattail Brackish Tidal Marsh (CEGL004201) Cattail Marsh**

6

Smooth cordgrass (*Spartina alterniflora*) dominant or codominant 7

Smooth cordgrass (*Spartina alterniflora*) not dominant or codominant 8

7

Smooth cordgrass (*Spartina alterniflora*) dominant; the diminutive eastern grasswort (*Liliaeopsis chinensis)* forming an "understory" ..... **Brackish Tidal Low Marsh (CEGL004193) Not mapped-outside park boundary**

Smooth cordgrass (*Spartina alterniflora*) and sturdy bulrush (*Schoenoplectus robustus*) dominant; occurs along the Pamet River and at the upper edge of a salt marsh where groundwater may emerge ..... **Alkali Bulrush Brackish Marsh (CEGL006416) Salt Marsh**

8

Sparse vegetation of mudflats 9

Transitional tidal marsh dominated by chairmaker's bulrush (*Schoenoplectus americanus*) and saltmeadow cordgrass (*Spartina patens*) occurring between high marsh and uplands; influenced by irregular tidal flooding and may receive some groundwater seepage from adjacent uplands ..... **Transitional Tidal Marsh (CEGL006612) Salt Marsh**

9

Brackish mudflat dominated by short forbs; Welsh mudwort (*Limosella australis)* forming a turfy "lawn, in association with scattered rushes, sedges and grasses.. **North Atlantic Coastal Plain River Brackish Intertidal Mudflat (CEGL004473)**
Not mapped-outside park boundary

Intertidal saline mudflats occurring within protected embayments; lacking vegetation but sea lettuce (*Ulva lactuca*) may be present ..... **North Atlantic Coast Estuarine Intertidal Mudflats Sparse Vegetation (CEGL006614)**
Beach

10

Shrubs dominant; eastern baccharis (*Baccharis halimifolia)* and Jesuit's bark (*Iva frutescens)* characteristic ..... **Irregularly Flooded Eastern Tidal Salt Shrub (CEGL003921)**
Salt Shrub

Vegetation herbaceous with few or no shrubs or sparsely vegetated mudflats 11

11

Vegetation herbaceous with few or no shrubs 12

Intertidal saline mudflats occurring within protected embayments; typically lacks vegetation but sea lettuce (*Ulva lactuca*) may be present..... **North Atlantic Coast Estuarine Intertidal Mudflats Sparse Vegetation (CEGL006614) Beach**

12

Common reed (*Phragmites australis)* dominant..... **Reed-grass Tidal Marsh (CEGL004187)**
Phragmites

Vegetation comprised of native species.....13

13

Vegetation of low salt marsh and tidal creeks, regularly flooded.....14

Vegetation of high salt marsh, or adjacent to uplands 16

14

Submerged vegetation of tidal creeks in low salt marsh..... **Northern Atlantic Coast Beaked Ditch-grass Bed (CEGL006167)**
Not Mapped, Submerged Aquatic Vegetation

Low salt marsh dominated by grasses 15

15

Big cordgrass (*Spartina cynosuroides)* dominant; adjacent to tidal creeks ..... **Atlantic Giant Cordgrass Marsh (CEGL004195)**
Not mapped-outside park boundary

Smooth cordgrass (*Spartina alterniflora*) heavily dominant with few other associates..... **North Atlantic Low Salt Marsh (CEGL004192)**
Salt Marsh

16

Vegetation of high salt marsh and salt pannes; irregularly flooded; low species diversity.....17

Vegetation adjacent to uplands; generally higher species diversity 18

17

Salt pannes – low ponded areas dominated by saltworts, exposed mud prevalent.....**Salt Panne (Salicornia Type) (CEGL004308)**
Salt Marsh

Saltmeadow cordgrass (*Spartina patens)* dominant, or codominant with inland saltgrass (*Distichlis spicata)*; low diversity low marsh.....**North Atlantic High Salt Marsh (CEGL006006)**
Salt Marsh

18

Beaked spikerush (*Eleocharis rostellata*) present in quantity; Smooth sawgrass (*Cladium mariscoides)* and sundews (*Drosera intermedia*, *Drosera rotundifolia*) absent.....**Spikerush Lawn Tidal Marsh (CEGL006611)**
Salt Marsh

Cattails (*Typha* spp.) or grasses dominant.....19

19

Cattails (*Typha* spp.) dominant.....**Cattail Brackish Tidal Marsh (CEGL004201)**
Cattail Marsh

Grasses dominant.....20

20

Switchgrass (*Panicum virgatum*) characteristic; seaside goldenrod (*Solidago sempervirens*) and saltmeadow cordgrass (*Spartina patens)* associated..... **Brackish Meadow (CEGL006150)**
Salt Marsh

Switchgrass (*Panicum virgatum*) not characteristic 21

21

Saltmeadow cordgrass (*Spartina patens*) dominant or codominant 22

Smooth cordgrass (*Spartina alterniflora*) and sturdy bulrush (*Schoenoplectus robustus*) dominant; occurs along the Pamet River and at the upper edge of a salt marsh where groundwater may emerge.....**Alkali Bulrush Brackish Marsh (CEGL006416)**
Salt Marsh

22

Transitional tidal marsh dominated by chairmaker's bulrush (*Schoenoplectus americanus*) andsaltmeadow cordgrass (*Spartina patens*) occurring between high marsh and uplands; influenced by irregular tidal flooding and may receive some groundwater seepage from adjacent uplands.....**Transitional Tidal Marsh (CEGL006612)**
Salt Marsh

Prairie cordgrass (*Spartina pectinata)* or robust sedges (*Schoenoplectus robustus, Schoenoplectus maritimus),* and sweetscent (*Pluchea odorata)* present in quantity with saltmeadow cordgrass (*Spartina patens)* .....**Northern Brackish Meadow (CEGL006368)**
Coastal Marsh

Appendix F. Accuracy assessment data form.

Accuracy Assessment Form for USGS-NPS Vegetation Mapping Program

Plot Number: _____ Park: _____ Date: _____ Observers: _____

Easting:_ _ _ _ _ _ E Northing:_ _ _ _ _ _ _ N EPE/APE:____ DOP:____ Map datum:_____ Zone:____

Topographic Description _____ Elevation: _____ Aspect: _____ Canopy Closure: _____

Vegetation Association at Point: _____

Veg Assoc 1 w/in 50 m of point: _____

Veg Assoc 2 w/in 50 m of point: _____

Major Species by Strata: _____

_____

Rationale for Classification: _____

Comments: _____

_____

Plot Number: _____ Park: _____ Date: _____ Observers: _____

Easting:_ _ _ _ _ _ E Northing:_ _ _ _ _ _ _ N EPE/APE:____ DOP:____ Map datum:_____ Zone:____

Topographic Description _____ Elevation: _____ Aspect: _____ Canopy Closure: _____

Vegetation Association at Point: _____

Veg Assoc 1 w/in 50 m of point: _____

Veg Assoc 2 w/in 50 m of point: _____

Major Species by Atrata: _____

_____

Rationale for Classification: _____

Comments: _____

_____

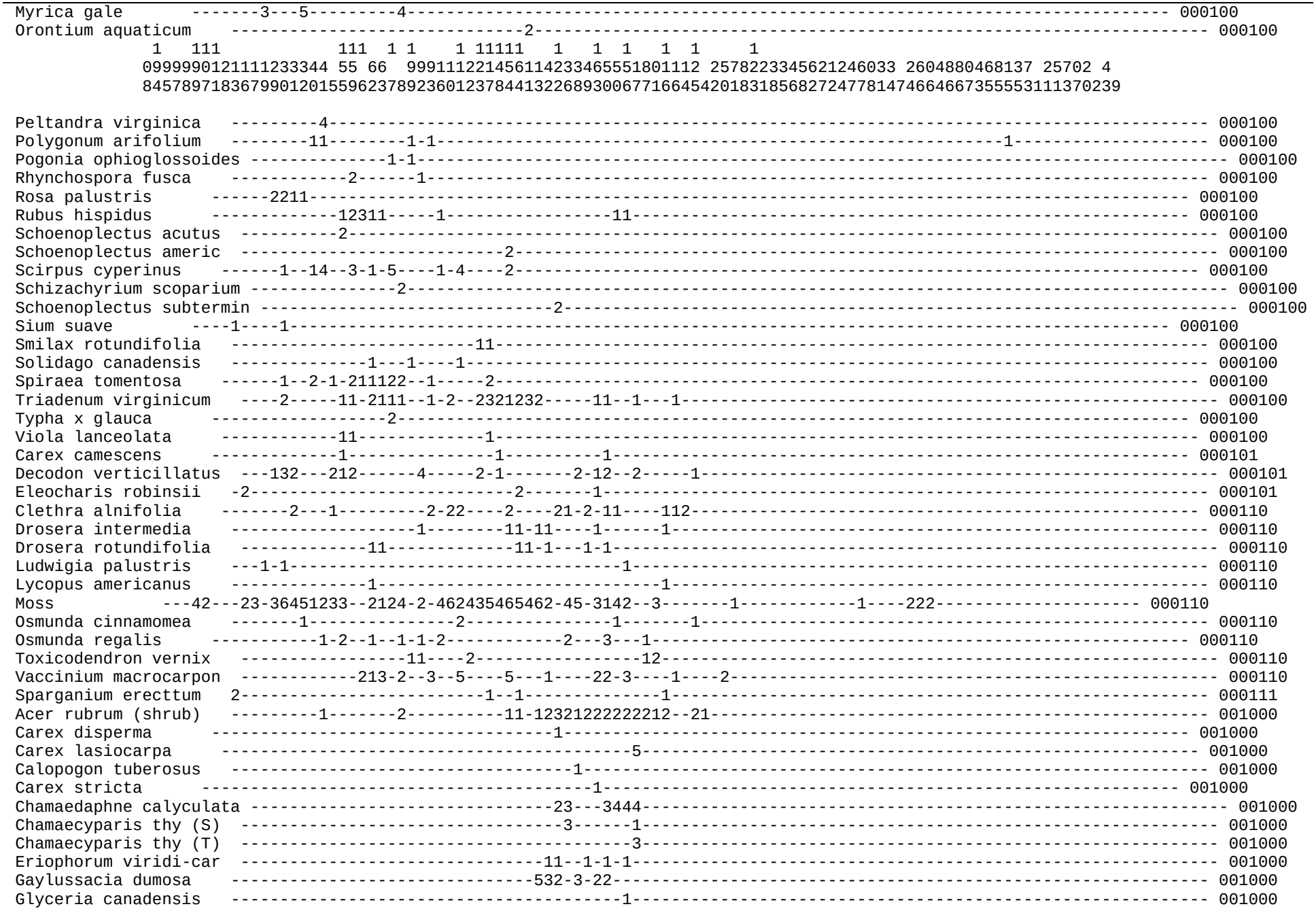
Appendix G. Data analysis of NatureServe 2002–2003 plots, heathland data (Gwilliam 1998), and forest data (Motzkin and Foster 2002).

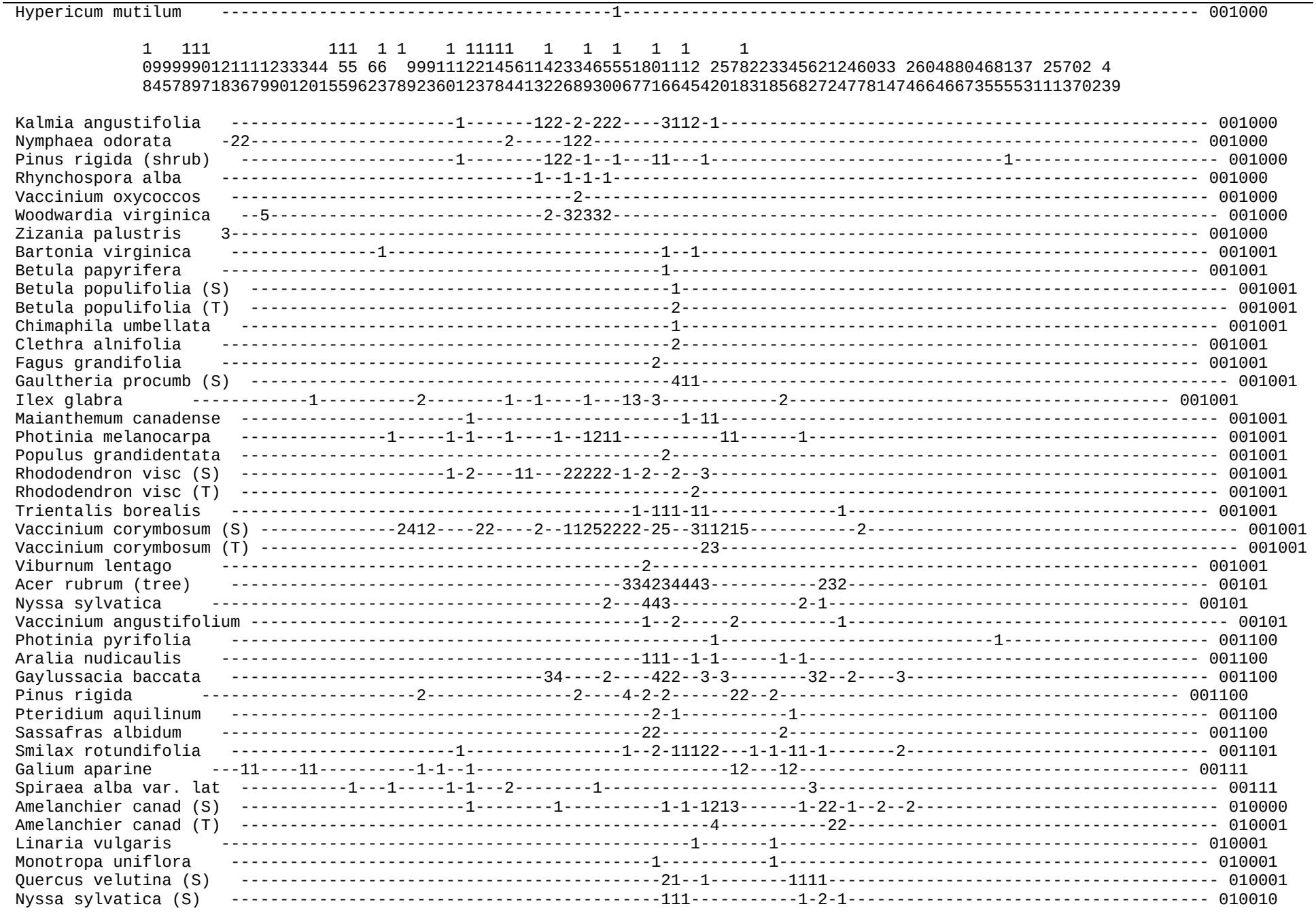
Data analysis of NatureServe 2002–2003 plots

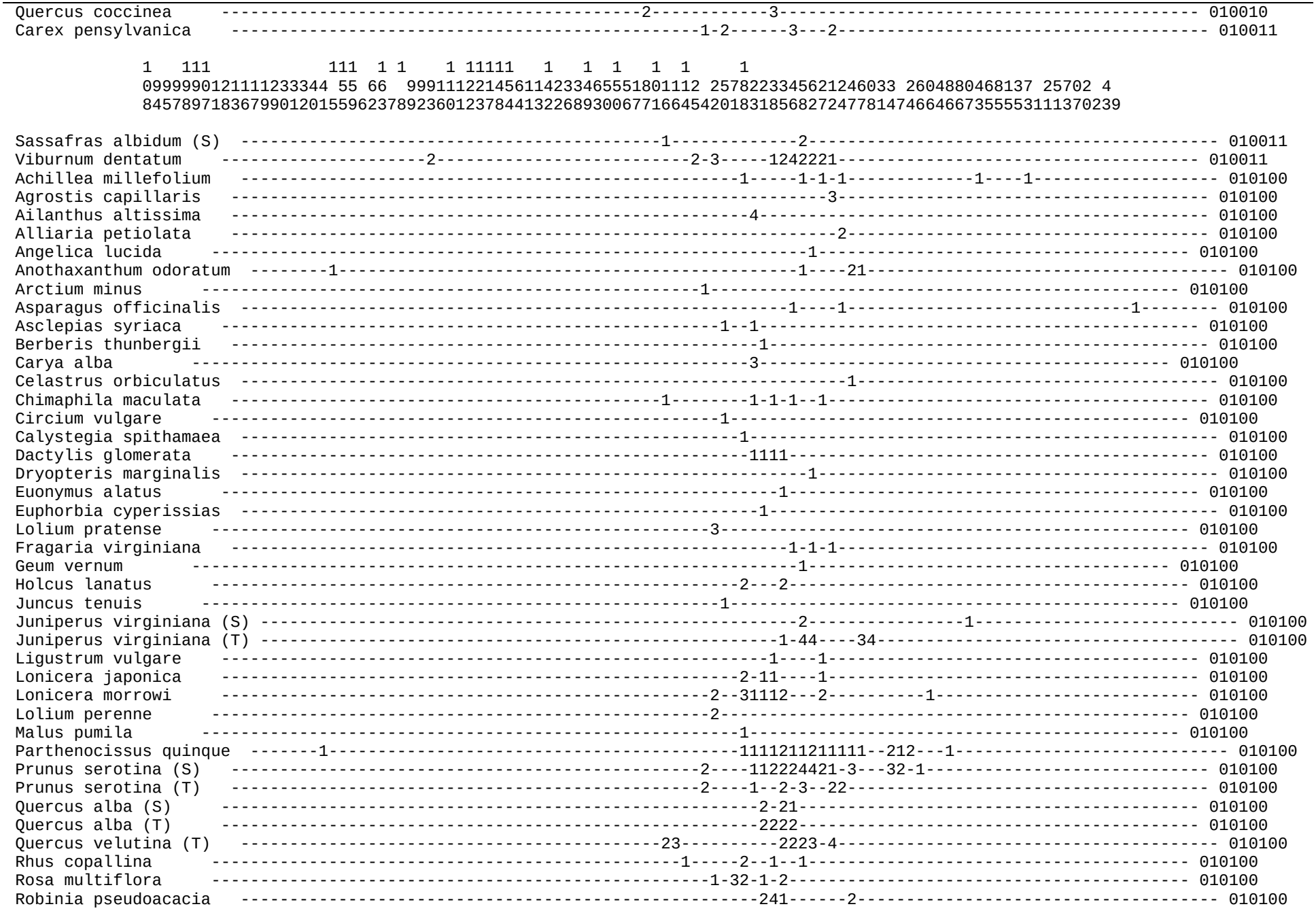
TWO-WAY ORDERED TABLE ** samples = CAPE COD NATIONAL SEASHORE plot numbers

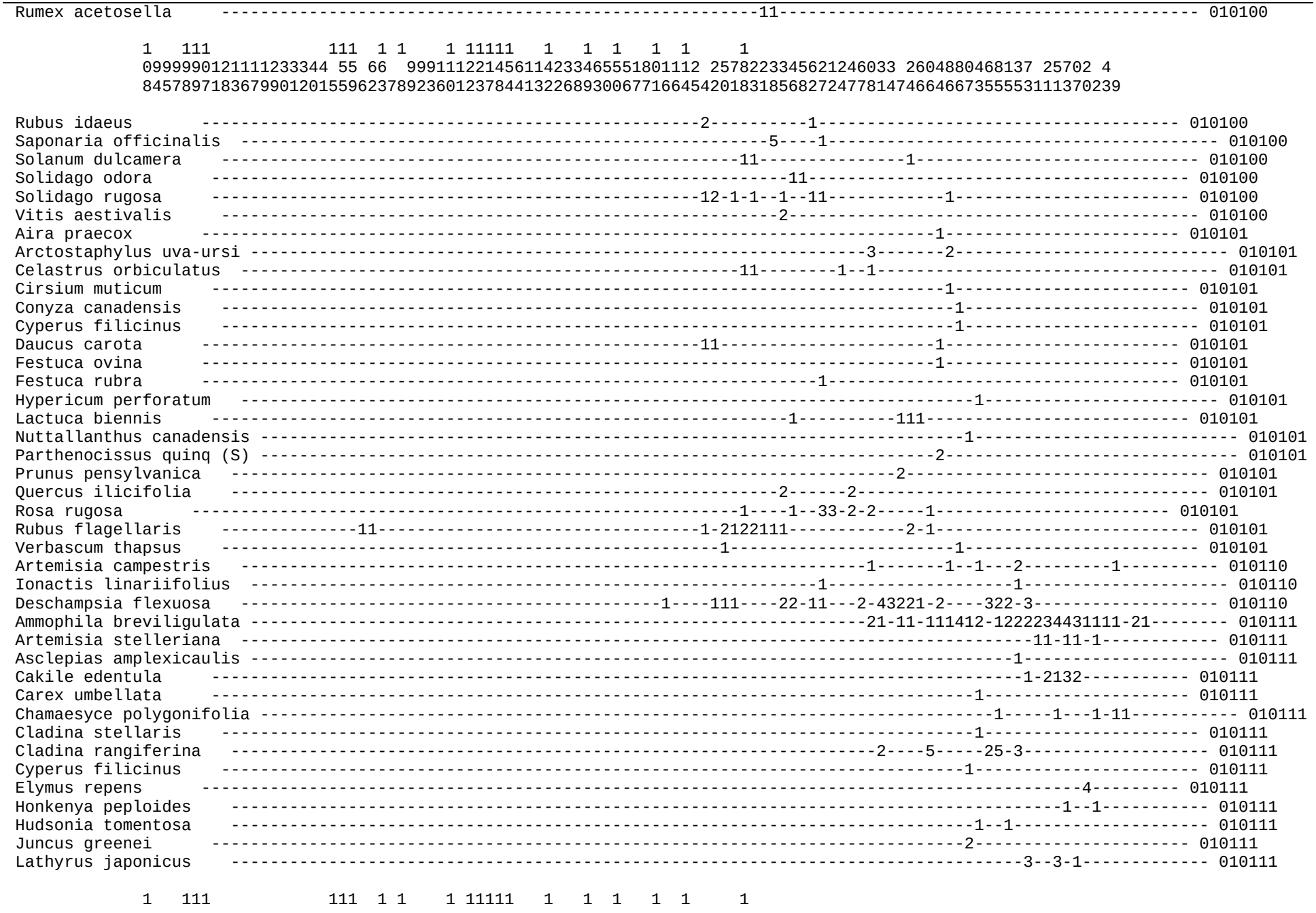
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                8457897183679901201559623789236012378441322689300677166454201831856827247781474664667355553111370239

Euthamia tenuifolia   ------------2--1-------------1-----------------1--1---------------------------------------------- 00000
Limosella australis   --------4------------------------------------------------------------------------------------------ 00000
Lycopus uniflorus    --------1--------------1--1-1---------------------------------------------------------------------- 00000
Rumex obtusifolius    -------12------------------------------------------------------------------------------------------ 00000
Thelypteris palustris  ----1---1221-34-311-32-1---------------------------------------------------------------------------- 00001
Typha latifolia     --2---52-11------1--5------------------------------------------------------------------------------- 00001
Agrostis scabra     -------------1------------------------------------------------------------------------------------- 000100
Alnus serrulata     ----------------------4---------------------------------------------------------------------------- 000100
Symphyotrichum later   --------------------1------------------------------------------------------------------------------ 000100
Symphyotrichum punic   -------1------------------------------------------------------------------------------------------ 000100
Bidens frondosa     ---221---------------------------------------------------------------------------------------------- 000100
Boehmeria cylindrica   --------------------1------------------------------------------------------------------------------ 000100
Calamagrostis canad   ---------2---------1-----32122---------------------------------------------------------------------- 000100
Carex lasiocarpa     --------------------------5------------------------------------------------------------------------- 000100
Carex muricata      ------------1-1-1------------------------------------------------------------------------------------ 000100
Carex pseudocyperus   --------1------------------------------------------------------------------------------------------ 000100
Cephalanthus occid    ---545---------------------------------2---------------------------------------------------------- 000100
Cladium mariscoides   ------------1---4--4----------1-------------------------------------------------------------------- 000100
Dulichium arundinaceum  -----------1-----------------32-------------1------------------------------------------------------ 000100
Eleocharis tenuis    --------------1------------1---------------------------------------------------------------------- 000100
Eriocaulon aquaticum   -2------------------------------------------------------------------------------------------------ 000100
Euthamia graminifolia  -------------23-----------------------------------------1---------------------------------------- 000100
Eupatorium maculatum   -------------1-------------------------------------------------------------------------------------- 000100
Eupatorium perfoliatum  --------------1------------------------------------------------------------------------------------ 000100
Glyceria melicaria    -----2---------------------------------------------------------------------------------------------- 000100
Glyceria obtusa     -----------2---------1---------------------------------------------------------------------------- 000100
Hypericum canadense   -------------------------1---1------------1---------------------------------------------------- 000100
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Impatiens capensis    ---------1--------1-------------------------------------------------------------------------------- 000100
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Juncus articulatus    --------1------------------------------------------------------------------------------------------ 000100
Juncus canadensis    --------1--11111------1-----11-------------1---------------------------------------------------- 000100
Juncus effusus      --------2112-221-------13-------------1------------------------------------------------------------ 000100
Juncus militaris     -3--------------------------4---------------------------------------------------------------------- 000100
Juncus pelocarpus    ----1-----------------------1---------------------------------------------------------------------- 000100
Lemna minor       3--------1--------1-------------------------------------------------------------------------------- 000100
Leersia oryzoides    3-------------------------1------------------------------------------------------------------------ 000100
Leersia virginica    ----1---------------------------------------------------------------------------------------------- 000100
Lyonia ligustrina    ----------------------------11---------------------------------------------------------------------- 000100
Lythrum salicaria    --------------1-----1-------------------------------------------------------------------------------- 000100
Lysimachia terrestris  ---------1----------11-1--1-1----------1------------------------------------------------------------ 000100
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Orontium aquaticum 000100
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Peltandra virginica 000100
Polygonum arifolium 000100
Pogonia ophioglossoides 000100
Rhynchospora fusca 000100
Rosa palustris 000100
Rubus hispidus 000100
Schoenoplectus acutus 000100
Schoenoplectus americ 000100
Scirpus cyperinus 000100
Schizachyrium scoparium 000100
Schoenoplectus subtermin 000100
Sium suave 000100
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Drosera intermedia 000110
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Moss 000110
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Osmunda regalis 000110
Toxicodendron vernix 000110
Vaccinium macrocarpon 000110
Sparganium erecttum 000111
Acer rubrum (shrub) 001000
Carex disperma 001000
Carex lasiocarpa 001000
Calopogon tuberosus 001000
Carex stricta 001000
Chamaedaphne calyculata 001000
Chamaecyparis thy (S) 001000
Chamaecyparis thy (T) 001000
Eriophorum viridi-car 001000
Gaylussacia dumosa 001000
Glyceria canadensis 001000


Hypericum mutilum
001000
1 111 111 1 1 1 11111 1 1 1 1 1 1
0999990121111233344 55 66 99911122145611423346555180111 2 2578223345621246033 2604880468137 25702 4
8457897183679901201559623789236012378441322689300677166454201831856827247781474664667355553111370239
Kalmia angustifolia
001000
Nymphaea odorata
001000
Pinus rigida (shrub)
001000
Rhynchospora alba
001000
Vaccinium oxycoccos
001000
Woodwardia virginica
001000
Zizania palustris
001000
Bartonia virginica
001001
Betula papyrifera
001001
Betula populifolia (S)
001001
Betula populifolia (T)
001001
Chimaphila umbellata
001001
Clethra alnifolia
001001
Fagus grandifolia
001001
Gaultheria procumb (S)
001001
Ilex glabra
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Maianthemum canadense
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Photinia melanocarpa
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Populus grandidentata
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001001
Rhododendron visc (T)
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Trientalis borealis
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Vaccinium corymbosum (S)
001001
Vaccinium corymbosum (T)
001001
Viburnum lentago
001001
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Nyssa sylvatica
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Vaccinium angustifolium
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Aralia nudicaulis
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Gaylussacia baccata
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Smilax rotundifolia
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Galium aparine
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Spiraea alba var. lat
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010000
Amelanchier canad (T)
010001
Linaria vulgaris
010001
Monotropa uniflora
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Quercus velutina (S)
010001
Nyssa sylvatica (S)
010010


Quercus coccinea 2 3 010010
Carex pensylvanica 1-2 3---2 010011
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845789718367990120155962378923601237844132268930067716645420183185682724778147466466735555311137023 9
Sassafras albidum (S) 1 2 010011
Viburnum dentatum 2 2-3 1242221 010011
Achillea millefolium 1 1-1-1 1 1 010100
Agrostis capillaris 3 010100
Ailanthus altissima 4 010100
Alliaria petiolata 2 010100
Angelica lucida 1 010100
Anothaxanthum odoratum 1 1 21 010100
Arctium minus 1 010100
Asparagus officinalis 1 1 1 010100
Asclepias syriaca 1 1 010100
Berberis thunbergii 1 010100
Carya alba 3 010100
Celastrus orbiculatus 1 010100
Chimaphila maculata 1 1-1-1 1 010100
Circium vulgare 1 010100
Calystegia spithamaea 1 010100
Dactylis glomerata 1111 010100
Dryopteris marginalis 1 010100
Euonymus alatus 1 010100
Euphorbia cyperissias 1 010100
Lolium pratense 3 010100
Fragaria virginiana 1-1-1 010100
Geum vernum 1 010100
Holcus lanatus 2 2 010100
Juncus tenuis 1 010100
Juniperus virginiana (S) 2 1 010100
Juniperus virginiana (T) 1-44 34 010100
Ligustrum vulgare 1 1 010100
Lonicera japonica 2-11 1 010100
Lonicera morrowi 2 31112 2 1 010100
Lolium perenne 2 010100
Malus pumila 1 010100
Parthenocissus quinque 1 1111211211111 212 1 010100
Prunus serotina (S) 2 112224421-3 32-1 010100
Prunus serotina (T) 2 1 2-3 22 010100
Quercus alba (S) 2-21 010100
Quercus alba (T) 2222 010100
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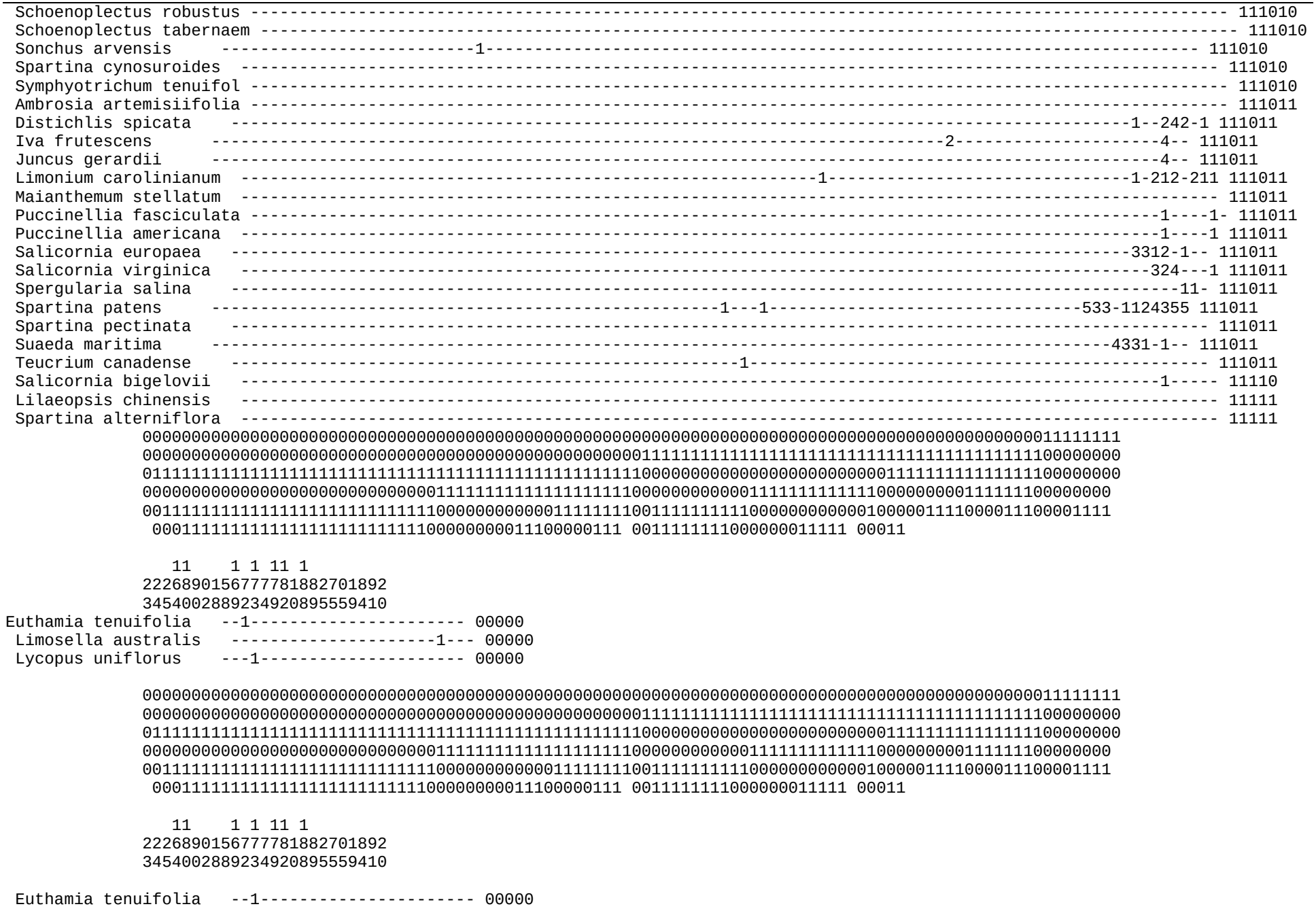

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8457897183679901201559623789236012378441322689300677166454201831856827247781474664667355553111370239
Rubus idaeus 2 1 010100
Saponaria officinalis 5 1 010100
Solanum dulcamera 11 1 010100
Solidago odora 11 010100
Solidago rugosa 12-1-1--1--11 1 010100
Vitis aestivalis 2 010100
Aira praecox 1 010101
Arctostaphylus uva-ursi 3 2 010101
Celastrus orbiculatus 11 1--1 010101
Cirsium muticum 1 010101
Conyza canadensis 1 010101
Cyperus filicinus 1 010101
Daucus carota 11 1 010101
Festuca ovina 1 010101
Festuca rubra 1 010101
Hypericum perforatum 1 010101
Lactuca biennis 1 111 010101
Nuttallanthus canadensis 1 010101
Parthenocissus quinq (S) 2 010101
Prunus pensylvanica 2 010101
Quercus ilicifolia 2 2 010101
Rosa rugosa 1 1--33-2-2 1 010101
Rubus flagellaris 11 1-2122111 2-1 010101
Verbascum thapsus 1 1 010101
Artemisia campestris 1 1--1 2 1 010110
Ionactis linariifolius 1 1 010110
Deschampsia flexuosa 1 111 22-11 2-43221-2 322-3 010110
Ammophila breviligulata 21-11-111412-1222234431111-21 010111
Artemisia stelleriana 11-11-1 010111
Asclepias amplexicaulis 1 010111
Cakile edentula 1-2132 010111
Carex umbellata 1 010111
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Cladina rangiferina 2 5 25-3 010111
Cyperus filicinus 1 010111
Elymus repens 4 010111
Honkenya peploides 1--1 010111
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Juncus greenei 2 010111
Lathyrus japonicus 3--3-1 010111
1 111 111 1 1 1 11111 1 1 1 1 1 1

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Oenothera biennis    ----------------------------------------------------------------------1--------------1-1---------- 010111
Pityopsis falcata    ----------------------------------------------------------------------1-----12-------------------- 010111
Rosa rugosa (H)     ------------------------------------------------------------------------------1--1--------- 010111
Salsola kali       ---------------------------------------------------------------------------111----------- 010111
Xanthium strumarium   ------------------------------------------------------------------------3-1------------ 010111
Morella pensylvanica   -------------2222---------------1--1-2---1------211----11--1221244241224---------------------------- 0110
Prunus maritima     ------------------------------------------------------1---------1222431---1---------------------- 0110
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Thinopyrum pycnanthum  ---------------------------------------------2---2----------------------------223-------- 01110
Lepidium campestre    ------------------------------------------------------------1----2------------------------ 01110
Panicum virgatum     ---------------------------------------------4-------------------------------------2-------- 01110
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Raphanus raphanistrum  ---------------------------------------------11---------------------------------------------- 100
Festuca filiformis    --------2-----------------------------------------1----1--1----------1------------------------ 1010
Pseudognaphalium obtus  ------------------------------------------------------------------1---------------------------- 1010
Solidago sempervirens  ---------------------------------------------2------1-1-22-1---111-13---112---1-1-1---------- 1010
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Rumex crispus      ---------------------------------------------1---------------------1-----------1------------ 1011
Symphyotrichum nova-belg ------------1111------------------------------------------------------------------------- 1100
Bidens discoidea     ---------11--------------------------------1-------------------------------------------------- 1100
Hibiscus moscheutos   ----------1------------------------------------------------------------------------------------ 1100
Typha angustifolia    ------------------5-1-----5---------1-----1------------------------------------------------- 1100
Atriplex prostrata    ------------------------------------------------------------------------------1-1--1-1----1-- 11100
Baccharis halimifolia  ------------------------------------------------------------3-----3------------------------ 11100
Symphiotrichum subulatum ------------------------------------------------------------------------1---------------------- 11100
Asclepias incarnata   ------------------------------------------------------------------------------------------------ 111010
Echinochloa crus-gallii ---------------------------------------------------------------------------------------------- 111010
Eleocharis parvula    ------------------------------------------------------------------------------------------------ 111010
Eleocharis robinsii   ------------------------------------------------------------------------------------------------ 111010
Erechtites hieracifolia ---------------------------------------------------------------------------------------------- 111010
Glaux maritima      ------------------------------------------------------------------------------------------------ 111010
Juncus ambiguus     ------------------------------------------------------------------------------------------------ 111010
Onoclea sensibilis    ------------------------------------------------------------------------------------------------ 111010
Phragmites australis   -------------21------------------------------------------------------------------------------ 111010

            1   111            111  1 1    1 11111   1   1  1   1  1     1
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Pluchea odorata var succ --------------------------------------------------------------------------------------------- 111010
Polygonum hydropiperoid ---------1------------------------------------------------------------------------------------ 111010
Polygonum ramosissimum  ----------------------------------------1----------------------------------------------------- 111010
Schoenoplectus pungens  -----------1--3----------4------------------------------------------------------------------- 111010
Schoenoplectus maritimus --------------------------------------------------------------------------------------------- 111010
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Schoenoplectus robustus 111010
Schoenoplectus tabernaem 111010
Sonchus arvensis 111010
Spartina cynosuroides 111010
Symphyotrichum tenuifol 111010
Ambrosia artemisiifolia 111011
Distichlis spicata 111011
Iva frutescens 111011
Juncus gerardii 111011
Limonium carolinianum 111011
Maianthemum stellatum 111011
Puccinellia fasciculata 111011
Puccinellia americana 111011
Salicornia europaea 111011
Salicornia virginica 111011
Spergularia salina 111011
Spartina patens 111011
Spartina pectinata 111011
Suaeda maritima 111011
Teucrim canadense 111011
Salicornia bigelovii 11110
Lilaeopsis chinensis 11111
Spartina alterniflora 11111
Euthamia tenuifolia 00000
Limosella australis 00000
Lycopus uniflorus 00000
Euthamia tenuifolia 00000

```
Limosella australis   ---------------------1--- 00000
Lycopus uniflorus    ---1---------------------- 00000
Rumex obtusifolius    ---------------1--------- 00000
Thelypteris palustris  ---2-----------1--------- 00001
Typha latifolia     ---------------2--------- 00001
Agrostis scabra     ------------------------- 000100
Alnus serrulata     ------------------------- 000100
Symphyotrichum later   ------------------------- 000100
Symphyotrichum punic   ------------------------- 000100
Bidens frondosa     ------------------------- 000100
Boehmeria cylindrica   ------------------------- 000100
Calamagrostis canad   ----------1-------------- 000100
Carex lasiocarpa     ------------------------- 000100
Carex muricata      ------------------------- 000100
Carex pseudocyperus   ------------------------- 000100
Cephalanthus occid    ------------------------- 000100
Cladium mariscoides   ------------------------- 000100
Dulichium arundinaceum  ------------------------- 000100
Eleocharis tenuis    ------------------------- 000100
Eriocaulon aquaticum   ------------------------- 000100
Euthamia graminifolia  ------------------------- 000100
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Eupatorium perfoliatum  ------------------------- 000100
Glyceria melicaria    ------------------------- 000100
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Ilex verticillata    ------------------------- 000100
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Iris verisicolor     ------------------------- 000100
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Juncus effusus      ------------------------- 000100
Juncus militaris     ------------------------- 000100
Juncus pelocarpus    ------------------------- 000100
Lemna minor       ------------------------- 000100
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Lyonia ligustrina    ------------------------- 000100
Lythrum salicaria    ------------------------- 000100
Lysimachia terrestris  ------------------------- 000100
Myrica gale       ------------------------- 000100
Orontium aquaticum    ------------------------- 000100
                11    1 1 11 1
              22268901567777818827018 92
              34540028892349208955594 10
Peltandra virginica   ------------------------- 000100
Polygonum arifolium   ------------------------- 000100
Pogonia ophioglossoides ------------------------- 000100
Rhynchospora fusca    ------------------------- 000100
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Rosa palustris      ------------------------ 000100
Rubus hispidus      ------------------------ 000100
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Schoenoplectus americ  ------------------------ 000100
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Schizachyrium scoparium ------------------------ 000100
Schoenoplectus subterm  ------------------------ 000100
Sium suave        ------------------------ 000100
Smilax rotundifolia   ------------------------ 000100
Solidago canadensis   ------------------------ 000100
Spiraea tomentosa    ------------------------ 000100
Triadenum virginicum   ------------------------ 000100
Typha x glauca      ------------------------ 000100
Viola lanceolata     ------------------------ 000100
Carex canescens     ------------------------ 000101
Decodon verticillatus  ------------------------ 000101
Eleocharis robinsii   ------------------------ 000101
Clethra alnifolia    ------------------------ 000110
Drosera intermedia    ------------------------ 000110
Drosera rotundifolia   ------------------------ 000110
Ludwigia palustris    ------------------------ 000110
Lycopus americanus    ------------------------ 000110
Moss           --------------------2---- 000110
Osmunda cinnamomea    ------------------------ 000110
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Toxicodendron vernix   ------------------------ 000110
Vaccinium macrocarpon  ------------------------ 000110
Sparganium erectum    ------------------------ 000111
Acer rubrum (S)     ------------------------ 001000
Carex disperma      ------------------------ 001000
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Carex stricta      ------------------------ 001000
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Chamaecyparis thy (S)  ------------------------ 001000
Chamaecyparis thy (T)  ------------------------ 001000
Eriophorum virid-car   ------------------------ 001000
Gaylussacia dumosa    ------------------------ 001000
Glyceria canadensis   ------------------------ 001000
Hypericum mutilum    ------------------------ 001000

               11    1 1 11 1
             22268901567777818827018 92
             34540028892349208955594 10

Kalmia angustifolia   ------------------------ 001000
Nymphaea odorata     ------------------------ 001000
Pinus rigida (S)     ------------------------ 001000
Rhynchospora alba    ------------------------ 001000
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Woodwardia virginica  ------------------------ 001000
Zizania palustris     ------------------------ 001000
Bartonia virginica    ------------------------ 001001
Betula papyrifera     ------------------------ 001001
Betula populifolia (S)  ---------------------- 001001
Betula populifolia (T)  ---------------------- 001001
Chimpaphila umbellata  ----------------------- 001001
Clethra alnifolia     ------------------------ 001001
Fagus grandifolia     ------------------------ 001001
Gaultheria procumbens  ----------------------- 001001
Ilex glabra       ----------------------- 001001
Maianthemum canadense  ----------------------- 001001
Photinia melanocarpa   ----------------------- 001001
Populus grandidentata  ----------------------- 001001
Rhododendron visc (S)  ----------------------- 001001
Rhododendron visc (T)  ----------------------- 001001
Trientalis borealis   ------------------------ 001001
Vaccinium corymbosum (S) --------------------- 001001
Vaccinium corymbosum (T) --------------------- 001001
Viburnum lentago      ------------------------ 001001
Acer rubrum (T)     ------------------------- 00101
Nyssa sylvatica     ------------------------- 00101
Vaccinium angustifolium ---------------------- 00101
Photinia pyrifolia    ------------------------ 001100
Aralia nudicaulis     ------------------------ 001100
Gaylussacia baccata   ------------------------ 001100
Pinus rigida (T)      ------------------------ 001100
Pteridium aquilinum   ------------------------ 001100
Sassafras albidum     ------------------------ 001100
Smilax rotundifolia   -----1------------------ 001101
Galium aparine      ------------------------ 00111
Spiraea alba var. lat  ----------------------- 00111
Amelanchier canad (S)  ----------------------- 010000
Amelanchier canad (T)  ----------------------- 010001
Linaria vulgaris      ------------------------ 010001
Monotropa uniflora    ------------------------ 010001
Quercus velutina (S)   ----------------------- 010001
Nyssa sylvatica (S)   ------------------------ 010010
Quercus coccinea      ------------------------ 010010
Carex pensylvanica    ------------------------ 010011

               11    1 1 11 1
             22268901567777818827018 92
             34540028892349208955594 10

Sassafras albidum (S)  ----------------------- 010011
Viburnum dentatum     ------------------------ 010011
Achillea millefolium   ----------------------- 010100
```

```
Agrostis capillaris   ------------------------ 010100
Ailanthus altissima   ------------------------ 010100
Alliaria petiolata    ------------------------ 010100
Angelica lucida     ------------------------ 010100
Anthoxanthum odoratum  ------------------------ 010100
Arctium minus      ------------------------ 010100
Asparagus officinale   ------------------------ 010100
Asclepias syricaca    ------------------------ 010100
Berberis thunbergii   ------------------------ 010100
Carya alba        ------------------------ 010100
Celastrus orbiculatus  ------------------------ 010100
Chimaphila maculata   ------------------------ 010100
Cirsium vulgare     ------------------------ 010100
Calystegia spithamaea  ------------------------ 010100
Dactylis glomerata    ------------------------ 010100
Dryopteris marginalis  ------------------------ 010100
Euonymus alatus      ------------------------ 010100
Euphorbia cyperissias  ------------------------ 010100
Lolium pratense     ------------------------ 010100
Fragaria virginiana   ------------------------ 010100
Geum vernum       ------------------------ 010100
Holcus lanatus      ------------------------ 010100
Juncus tenuis      ------------------------ 010100
Juniperus virginiana (S) ------------------------ 010100
Juniperus virginiana (T) --3---------------------- 010100
Ligustrum vulgare    ------------------------ 010100
Lonicera japonica    ------------------------ 010100
Lonicera morrowi     ------------------------ 010100
Lolium perenne      ------------------------ 010100
Malus pumila       ------------------------ 010100
Parthenocissus quinque  ------------------------ 010100
Prunus serotina (S)   ------------------------ 010100
Prunus serotina (T)   ------------------------ 010100
Quercus alba (S)     ------------------------ 010100
Quercus alba (T)     ------------------------ 010100
Quercus velutina (T)   ------------------------ 010100
Rhus copallina      ------------------------ 010100
Rosa multiflora     ------------------------ 010100
Robinia pseudoacacia   ------------------------ 010100
Rumex acetosella     ------------------------ 010100

               11    1 1 11 1
             22268901567777818827018 92
             34540028892349208955594 10

Rubus idaeus       ------------------------ 010100
Saponiria officinalis  ------------------------ 010100
Solanum dulcamera    ------------------------ 010100
Solidago odora      ------------------------ 010100
```

```
Solidago rugosa     ------------------------ 010100
Vitis aestivalis    ------------------------ 010100
Aira praecox        ------------------------ 010101
Arctostaphylos uva-ursi ------------------------ 010101
Celastrus orbiculatus  ------------------------ 010101
Cirsium muticum     ------------------------ 010101
Conyza canadensis    ------------------------ 010101
Cyperus filicinus    ------------------------ 010101
Daucus carota       ------------------------ 010101
Festuca ovina       ------------------------ 010101
Festuca rubra       ------------------------ 010101
Hypericum perforatum   ------------------------ 010101
Lactuca biennis     ------------------------ 010101
Nutthallanthus canadensis------------------------ 010101
Parthenocissus quinq (S) ------------------------ 010101
Prunus pensylvanica   ------------------------ 010101
Quercus ilicifolia    ------------------------ 010101
Rosa rugosa        ------------------------ 010101
Rubus flagellaris    -------------------1----- 010101
Verbascum thapsus    ------------------------ 010101
Artemisia campestris   ------------------------ 010110
Ionactis linariifolius  ------------------------ 010110
Deschampsia flexuosa   ------------------------ 010110
Ammophila breviligulata ------------------------ 010111
Artemisia stelleriana  ------------------------ 010111
Asclepias amplexicaulis ------------------------ 010111
Cakile edentula     ------------------------ 010111
Carex umbellata     ------------------------ 010111
Chamaecyse polygonifolia ------------------------ 010111
Cladina stellaris    ------------------------ 010111
Cladina rangiferina   ------------------------ 010111
Cyperus filicinus    ------------------------ 010111
Elymus repens       ------------------------ 010111
Honkenya peploides    ------------------------ 010111
Hudsonia tomentosa    ------------------------ 010111
Juncus greenei       ------------------------ 010111
Lathyrus japonicus    ------------------------ 010111

               11    1 1 11 1
             22268901567777818827018 92
             34540028892349208955594 10

Lechea maritima     ------------------------ 010111
Oenothera biennis    ------------------------ 010111
Pityopsis falcata    ------------------------ 010111
Rosa rugosa        ------------------------ 010111
Salsola kali        ------------------------ 010111
Xanthium strumarium   ------------------------ 010111
Morella pensylvanica   --2--2-------------1----- 0110
```

```
 Prunus maritima     -----1------------------- 0110
 Toxicodendron radicans  --32---------------------- 0110
 Thinopyrum pycnanthum  --1----1----------12----- 01110
 Lepidium campestre    -------------------1----- 01110
 Panicum virgatum     ------------------1------ 01110
 Rosa carolina      ------------------11----- 01111
 Calystegia sepium    ---1---1---1------------- 100
 Raphanus raphanistrum  -------1----------------- 100
 Festuca filiformis    ------------------32----- 1010
 Pseudognaphalium obtus  ------------------1------ 1010
 Solidago sempervirens  1-2-22-4--1---1----1----- 1010
 Toxicodendron rad (H)  ---------------3--------- 1010
 Rumex crispus      1------1-----------1----- 1011
 Symphyotrichum nova-belg -----------21------------ 1100
 Bidens discoidea     11----------------------- 1100
 Hibiscus moscheutos   -----------1------------- 1100
 Typha angustifolia    12-2--1--1--------------- 1100
 Atriplex prostrata    1-----------1----1------- 11100
 Baccharis halimifolia  --42-3-----2------------- 11100
 Symphyotrichum subulatum 1-----2--------1--------- 11100
 Asclepias incarnata   ---------------1--------- 111010
 Echinochloa crus-gallii ---------------1--------- 111010
 Eleocharis parvula    -5------2--11-3222------- 111010
 Eleocharis robinsii   ----2-------------------- 111010
 Erechtites hieracifolia 1------------------------ 111010
 Glaux maritima      ----2-------------------- 111010
 Juncus ambiguus     -1----------------------- 111010
 Onoclea sensibilis    ---1--------------------- 111010
 Phragmites australis   ----1-153----4---1------- 111010


               11    1 1 11 1
             22268901567777818827018 92
             34540028892349208955594 10

 Pluchea odorata var succ 12-1--1-1-111--414---1--1 111010
 Polygonum hydropiperoid -1-------------1--------- 111010
 Polygonum ramosissimum  ---------111------------ 111010
 Schoenoplectus pungens  43-43---------2---------- 111010
 Schoenoplectus maritimus ------3-2-----1---------- 111010
 Schoenoplectus robustus -----1---42-11----------4 111010
 Schoenoplectus tabernaem ---------------2--------- 111010
 Sonchus arvensis     1-------1----------1----- 111010
 Spartina cynosuroides  ------------4------------ 111010
 Symphyotrichum tenuifol ----1-------1----2------- 111010
 Ambrosia artemisiifolia ------------------1------ 111011
 Distichlis spicata    -1--21------2----1-1----2 111011
 Iva frutescens      -----3-1--111---11------- 111011
 Juncus gerardii     --2-1------------1------- 111011
```

```
 Limonium carolinianum  ------1---1-------------- 111011
 Maianthemum stellatum  ------------------1------ 111011
 Puccinellia fasciculata --1---------------------- 111011
 Puccinellia americana  ----1---------1-------1-- 111011
 Salicornia europaea   ----------1-1-1-12----11- 111011
 Salicornia virginica   ------------------------- 111011
 Spergularia salina    --------------1-------1-- 111011
 Spartina patens     223112-14121213--122----- 111011
 Spartina pectinata    ------------------44----- 111011
 Suaeda maritima     1-----1---111----2----2-- 111011
 Teucrium canadense    -------1--1----1--22----- 111011
 Salicornia bigelovii   ----------------------1-- 11110
 Lilaeopsis chinensis   ----------------------2--1 11111
 Spartina alterniflora  ---11----1--112-1---54552 11111

              11111111111111111111111
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              00000000000000000001100001
              111111111111111111
              000000000000000111
              000000111111111
            ********** TWINSPAN completed **********
```

Analysis of heathland data (Gwilliam 1998)

```
          1111  12232222223333331111112444433324
        12345656787890490123678261345123490123478950
 14 CarePens -1----11111111---111--1----------11--1------ 0000
 20 CladAlpe 1111--33221122--21-------321-1---------1---- 0000
 24 CoreConr 1-114444434443455----------3-------- 0000
 21 CladCris 2111111----------1---1--------1---- 00010
  7 AsclAmpl ----1------------------------------------ 000110
 10 AsteUndu -111------------------------------------- 000110
 11 AstaSPP  111-1------------------------------------ 000110
 32 HudsEric 11121133331111---------------------------- 000110
 38 LichSPP4 ------11-1---------------------------------- 000110
 46 PolyPoly --111------------------------------------- 000110
 47 PolyRamo 1---------------------------------------- 000110
 49 PolySPP  1111--1111---------------------------------- 000110
 56 QuerIlic 11--11----3333----------34--------- 000110
 57 QuerPrin -----------21------------------------------ 000110
 64 UsneSPP  -111------------------------------------- 000110
 66 VaccVaci --1-------1111----------1--------- 000110
  8 AsteLine 11111-------11--------1-------11111--------- 000111
 25 DantSpic 111-----------1----------1--------- 000111
 37 LichSPP2 1111111111---1-1----------3---11--------- 000111
 39 LichSPP3 --11-----------------------11--------- 000111
 42 PannDepa 1111-111----------11------------ 000111
 43 PannLanu 1111--1----------1-------11------------ 000111
 53 RubuSPP  1----------1----------1------------ 000111
 22 CladRang ----11-----------------------11---------- 001000
 62 SchiScop 1111111111--------1-12-1-2---111---------- 001000
  2 AmalSPP  -------1-----------------------11--------- 001001
 17 CetrIsla 1111111----------223-2-1112111---------- 001001
 29 FungSPP  --1----------1---------11--------- 001001
 36 LechMari 1-111----------1-----11-1111---------- 001001
 41 MyriPens 12---1----------2----------23-221--------- 001001
 61 SoliSemp --11----------1--11-111--------- 001001
 65 VaccAngu --------11--------2----------1---------- 001001
  1 AchiMill ----------11--------- 001010
  4 AralNudi ----------11--------- 001010
  9 AstePate ----------11--------- 001010
 27 FestRubr ----------11---1--------- 001010
 28 FragVirg ----------11--------- 001010
 45 PoaComp  ----------1--------- 001010
 50 PrunMari ----------1----------11-122--------- 001010
 51 PrunSero ----------1----------1--------- 001010
 52 RosaCaro ----------111--------- 001010
 59 SmilStel ----------11--------- 001010
  6 ArteCamp ----------1---------- 001011
 13 BiasSPP  ----------1---------- 001011
 15 CareSali ----------11---------- 001011
 16 MossSPP  ----------11---------- 001011
 31 HierVeno ----------11---------- 001011
 34 HypoRadi ----------1---------- 001011
 35 JuniVirg ----------1211---------- 001011
 54 Rume Ace ----------1---------- 001011
 60 SoliOdor ----------1-------22---1-1---------- 001011
 63 ToxiRadi ----------11---------- 001011
  5 ArctUvau 44-344344444554-2555555555444444555542-2----- 0011
 23 CladUnci -1111-2111----------111-322343111------1-2-- 01
 33 HudsTome 122311----------211-1----4211---------3- 01
 48 PolyArti ----------1-1111---------1 01
  3 AmmoBrev ----------1----11111-----21--- 100
 18 ChryFalc ----------1111------1---- 100
 19 CypeSPP  ----------1-1-1---------1- 100
 12 Bare   ----23222-11112113133-32232223422--453455555 101
 26 DescFlex 11111-1212-------2122--112121322211--1-313-- 101
 30 GaylBacc ----------1113----------2----------5------- 110
 44 PinuRigi 34221223322332---43---1--------22--5542----- 110
 55 QuerAlba ------1---1----------3----- 110
 40 MelyLine ----------2------- 111
```

```
58 QuerVelu --------1---------------3----111---44-4----- 111

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      12345656787890490123678261345123490123478950

14 CarePens -1----11111111---111--1----------11--1------ 0000
20 CladAlpe 1111--33221122--21-------321-1---------1---- 0000
24 CoreConr 1-114444434443455-----------------3-------- 0000
21 CladCris 2111111-------------------1---1--------1---- 00010
7 AsclAmpl ----1------------------------------------ 000110
10 AsteUndu -111------------------------------------- 000110
11 AstaSPP  111-1------------------------------------ 000110
32 HudsEric 11121133331111------------------------------ 000110
38 LichSPP4 ------11-1---------------------------------- 000110
46 PolyPoly --111------------------------------------ 000110
47 PolyRamo 1---------------------------------------- 000110
49 PolySPP  1111--1111---------------------------------- 000110
56 QuerIlic 11--11----3333-------------------34--------- 000110
57 QuerPrin ----------21------------------------------ 000110
64 UsneSPP  -111------------------------------------- 000110
66 VaccVaci --1-------1111--------------------1--------- 000110
8 AsteLine 11111--------11--------1-------11111--------- 000111
25 DantSpic 111----------1-----------------1--------- 000111
37 LichSPP2 1111111111---1-1------------3---11--------- 000111
39 LichSPP3 --11-----------------------------11--------- 000111
42 PannDepa 1111-111---------------------11------------- 000111
43 PannLanu 1111--1-------------1-------11------------- 000111
53 RubuSPP  1--------------1-------------1------------- 000111
22 CladRang ----11-------------------------11---------- 001000
62 SchiScop 1111111111--------1-12-1-2----111---------- 001000
2 AmalSPP  -------1-----------------------11--------- 001001
17 CetrIsla 1111111------------223-2-1112111---------- 001001
29 FungSPP  --1-------------------1---------11--------- 001001
36 LechMari 1-111---------------1-----11-1111---------- 001001
41 MyriPens 12---1-----------2----------23-221--------- 001001
61 SoliSemp --11---------------------1--11-111--------- 001001
65 VaccAngu --------11--------2-------------1----------- 001001
1 AchiMill ---------------------------------11--------- 001010
4 AralNudi ---------------------------------11--------- 001010
9 AstePate ---------------------------------11--------- 001010
27 FestRubr ----------------------------11---1--------- 001010
28 FragVirg ----------------------------------11--------- 001010
45 PoaComp  ----------------------------------1--------- 001010
50 PrunMari ---------------1------------11-122--------- 001010
51 PrunSero ----------------------1----------1--------- 001010
52 RosaCaro ---------------------------------111--------- 001010
59 SmilStel ---------------------------------11--------- 001010
6 ArteCamp ----------------------------1------------ 001011
13 BiasSPP  ----------------------------1------------ 001011
15 CareSali ----------------------------11------------- 001011
16 MossSPP  ----------------------------11------------- 001011
31 HierVeno ----------------------------11----------- 001011
34 HypoRadi ----------------------------1------------ 001011
35 JuniVirg ----------------------------1211----------- 001011
54 Rume Ace ----------------------------1------------ 001011
60 SoliOdor ------------------1-------22---1-1---------- 001011
63 ToxiRadi ----------------------------11------------- 001011
5 ArctUvau 44-344344444554-2555555554444445555542-2----- 0011
23 CladUnci -1111-2111----------111-322343111------1-2-- 01
33 HudsTome 122311-------------211-1----4211---------3- 01
48 PolyArti -------------------------1-1111----------1 01
3 AmmoBrev ------------------------1----11111-----21--- 100
18 ChryFalc ----------------------------1111------1---- 100
19 CypeSPP  ----------------------------1-1-1---------1- 100
```

```
12 Bare   ----23222-11112113133-32232223422--453455555 101
26 DescFlex 11111-1212-------2122--112121322211--1-313-- 101
30 GaylBacc ----------1113-----------2----------5------- 110
44 PinuRigi 34221223322332---43---1--------22--5542----- 110
55 QuerAlba ------1---1--------------------------3----- 110
40 MelyLine -----------------------------------2------- 111
58 QuerVelu --------1---------------3----111---44-4----- 111

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     ********** TWINSPAN completed **********
```

TWINSPAN samples (#) and Gwilliam plot numbers (H99#####)

1 H9901110	23 H9907120
2 H9901120	24 H9907210
3 H9901210	25 H9907220
4 H9901220	26 H9908110
5 H9902210	27 H9908120
6 H9902220	28 H9908210
7 H9903110	29 H9908220
8 H9903120	30 H9909110
9 H9903210	31 H9909120
10 H9903220	32 H9909210
11 H9904110	33 H9909220
12 H9904120	34 H9910110
13 H9904210	35 H9910120
14 H9904220	36 H9910210
15 H9905110	37 H9910220
16 H9905120	38 H9911110
17 H9905210	39 H9911120
18 H9905220	40 H9911210
19 H9906210	41 H9911220
20 H9906220	42 H9912110
21 H9906220	43 H9912120
22 H9907110	44 H9912210

Analysis of forest data (Motzkin and Foster 2002)

1171822 357 2351224644445666677888 1233455317 256 1612357124557824677 3135 3483488667
79344899878361830723045944568450317552935631142301889235960170202417795676012667485612 2

4 ARALNU 31233------1-1-11-1----------1---2----------1-1-1-----2-----1---------- 00000
55 QUERPR ----13----------1-1----------1--1---------- 00000
1 ACERRU 351----------1---------- 000010
14 CLETAL 6---------- 000010
23 FAGUGR 3---------- 000010
34 LONIMO ---2---------- 000010
35 LYONLI 3---------- 000010
42 NYSSSY 4---------- 000010
43 OSMUCI 1---------- 000010
47 PRENTR 1---------- 000010
58 RHODVI 4---------- 000010
73 SOLIRU ---1---------- 000010
81 VIBUNU -13--4----------1----------1----------1-----1---------- 000010
28 ILEXGL -3----------3---------- 000011
31 KALMAN 11----------2---------- 000011
50 PTERAQ 112-3--------22---------2---11-1---------- 000011
72 SOLIOD -1----------1---------- 000011
60 RIBEHI ----------1---------- 000100
82 VITIAE ----------1---------- 000100
24 GAULPR 3241262143-11121212234313354424434112221321 33----------1----------2-- 000101
62 ROSACA -----1---------- 000101
68 SASSAL ---1-2----------3----------1---------- 000101
22 EPIGRE 111--4------11-1-11-211-11--1121111--1-11--221-1-1----------1- 00011
51 PYRORO ----1----------1-----1---------- 00011
79 VACCPA 11232242425-1111224-44224232321235211222 33-21----------1-----2-1----------1331 00011
15 COMPPE ------1---1----------1--------1-----2111-------1--1----------1----------11 001
25 GAYLBA 346-64555546665655666666566656666566436666462 32-632445--2-131-32-1-11----3--2162-43455 001
77 VACCAN 11251----3-6136324444-3435141251312212-24366544251222--31--2-2--11-1-21--1--12-34-1--1- 001
52 QUERAL 5253621121-56562545564454645533236454344552463123121111411343342442532111-1--1-11-111-1 010
41 MYRIPE 2111-13----21-1111111-11-1111-1--1-----12-1--21312-1---1-1-123--2-12--11--1------41---- 0110
57 QUERVE 425-62112436666465666666665546466445545465343424616665542455656656445431311-1111-3112-- 0110
36 MAIACA 2111---------1----------1-1--1---------- 0111
70 SMILGL ---112-----1----------1----------11--------- 0111
71 SMILRO 11612----------1--1----11----11----------1----12----1-1-------1-11-------1---------- 0111
2 AMEL -11212-----1-1-11-11----1----11-1--1-------2111-1111---11--111--111111----------1---- 1000
6 ARONAR --1-1----------1----------1-1---------- 1000
61 ROBIPS ----2----------1----------1----1-1----------1--1---------- 1000
65 RUBUAL ---1----------1---------- 1000
49 PRUNSE -1-431-----211-11-11---2------1--1---------1-1111111-1--1-1121111111221-----1--1------- 1001
59 RHUSCO -----1----------1---------- 1001
46 PINURI 5651436666622-3523155446656466644456666635564666664466666644665663663666666666646656666 1010
53 QUERCO ----1----------3--34-2-4--34---------21-------1-23-26---------- 1010
54 QUERIL -216466666633122211222242213125214423445545316131425523533463424434442 1-111254425335466 1010
78 VACCCO ----------11----------1----1-1----1-2-2--1114--11----1---------111--------3-------2-- 1010
13 CHIMUM ----------1----11----------1----------1--11---------- 1011
21 DRYOIN ----------2-1----------1----------1---------- 1011
40 MOSS 41----2-------1-----1--1-11-11111--11--111-111-1--111111111211-11111-11-1112121-1--1-1- 1011
11 CAREPE 1--111-----1-11111111-1----1-1-111-31-1-1111-1-211-11344443-3551--2--1---11---1-2-2131- 1100
18 CYPRAC -1----------1----------1-------1----11---------1- 1100
37 MELALI ----------1-----1----------1--1------1----------1-1---1-11---1-1---1-------11-- 1100
64 RUBU ----------1----------1------1----------1------ 1100
32 LICHEN 1-----1----------1--1----------111----2--1-------1111121-11-1-1-1-1-212523312-22111 11010
5 ARCTUV ------31211---11-1--1-1111111----1111-311122-212-112124412-211211112111122225133666634 6 110110
45 PARTQU --11----------1----------1--1----------1-- 110110
66 RUBUFL -----1----------1----------1------- 110110
7 ASTELI ----------1---- 110111
16 CORECO ------2--15----------1-------1-----1----------2556 110111
26 HUDSER ----------1--1--- 110111
30 JUNIVI ----------1------- 110111
69 SCHISC ----------1------1-----1---1-1-1-111----1-11---- 111000
3 AMMOBR ----------1---------- 111001
27 HYPORA ----------1---------- 111001
44 PANICO ----------1---------- 111001
56 QUERRU ----------1-------- 111001

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74 SOLISE  ------------------------------------------------------------------1---------- 111001
76 TRIEBO  1111---------------------------------------212-111--1-2-----------1-211-221-1------ 111001
20 DESCFL  1--1---------1111-1----1--1---------------11-556521212234632232224646266526254611121 2-- 11101
39 MONOUN  ----------------------1---11--------------1-1-----1-----11--11----1------111-------- 11101
48 PRUNMA  ------------------------------------------------------1------11-------111-------- 11101
80 VIBUDE  -----1-----------------------------------------11---------1-------1-------1---------- 11101
8 ASTEPN  ----------------------------------------------1---1-----1-1---------------------------- 111100
9 BAPTTI  ----------------------------------------------1----------------1------------------- 111100
17 CORYAM  ---------------------------------------------------1-----1------------------------- 111100
29 ILEXVE  ---------------------------------------------------1---------------------------------- 111100
63 ROSAVI  ---------------------------------------------------1---------------------------------- 111100
75 TOXIRA  ----------------------------------------------1-111-----1--------1--1111---------- 111100
10 CARE  ------------------------------------------------------------1--------------------- 111101
12 CHIMMA  ---------------------------------------------------1------111---111111-1----1---1------ 111101

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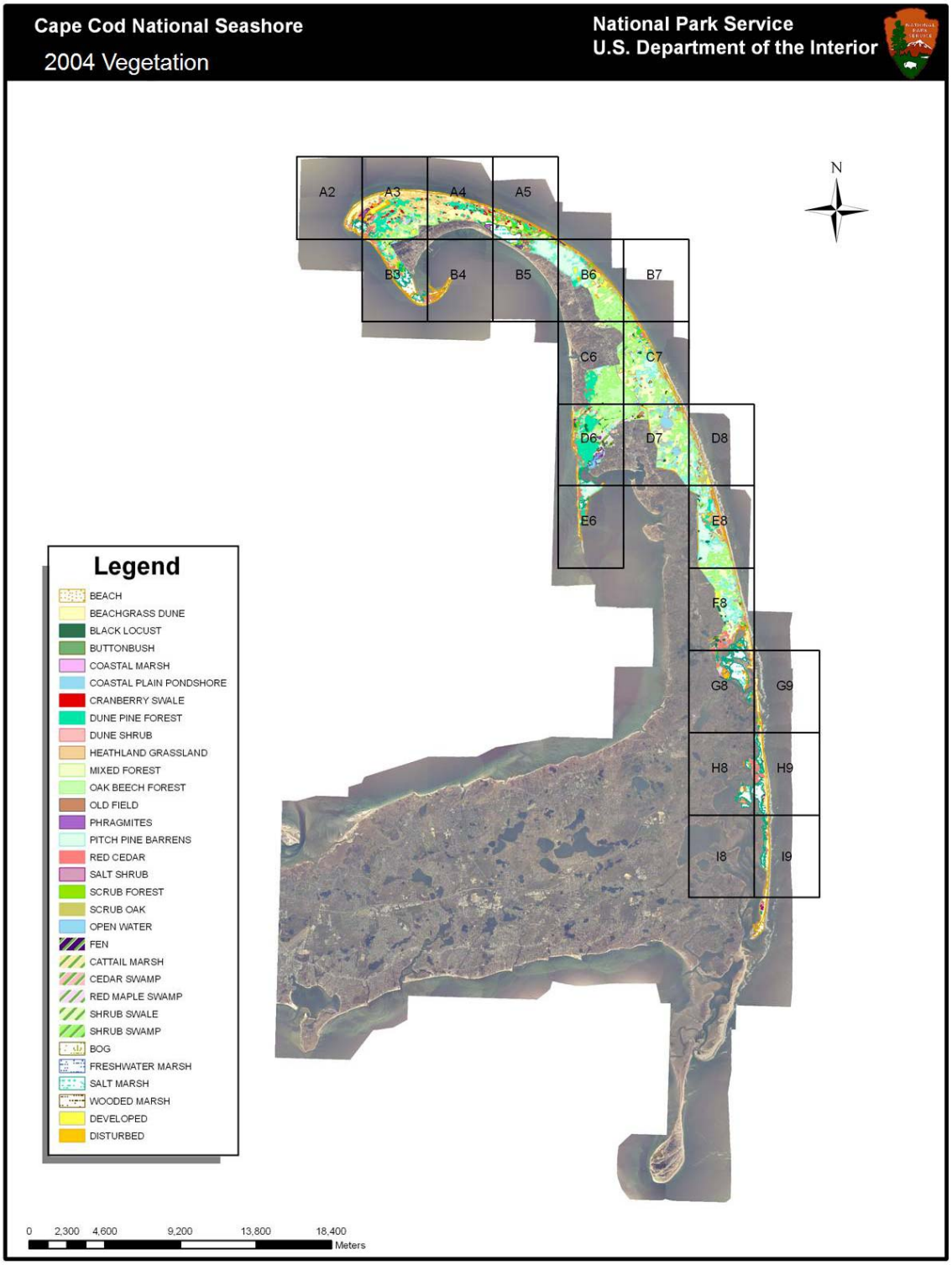
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33 LONIJA  ------------------------------------------------------------------1---------------- 111101
38 MONOHY  ----------------------------------------------------------1---1--------------------1-- 11111
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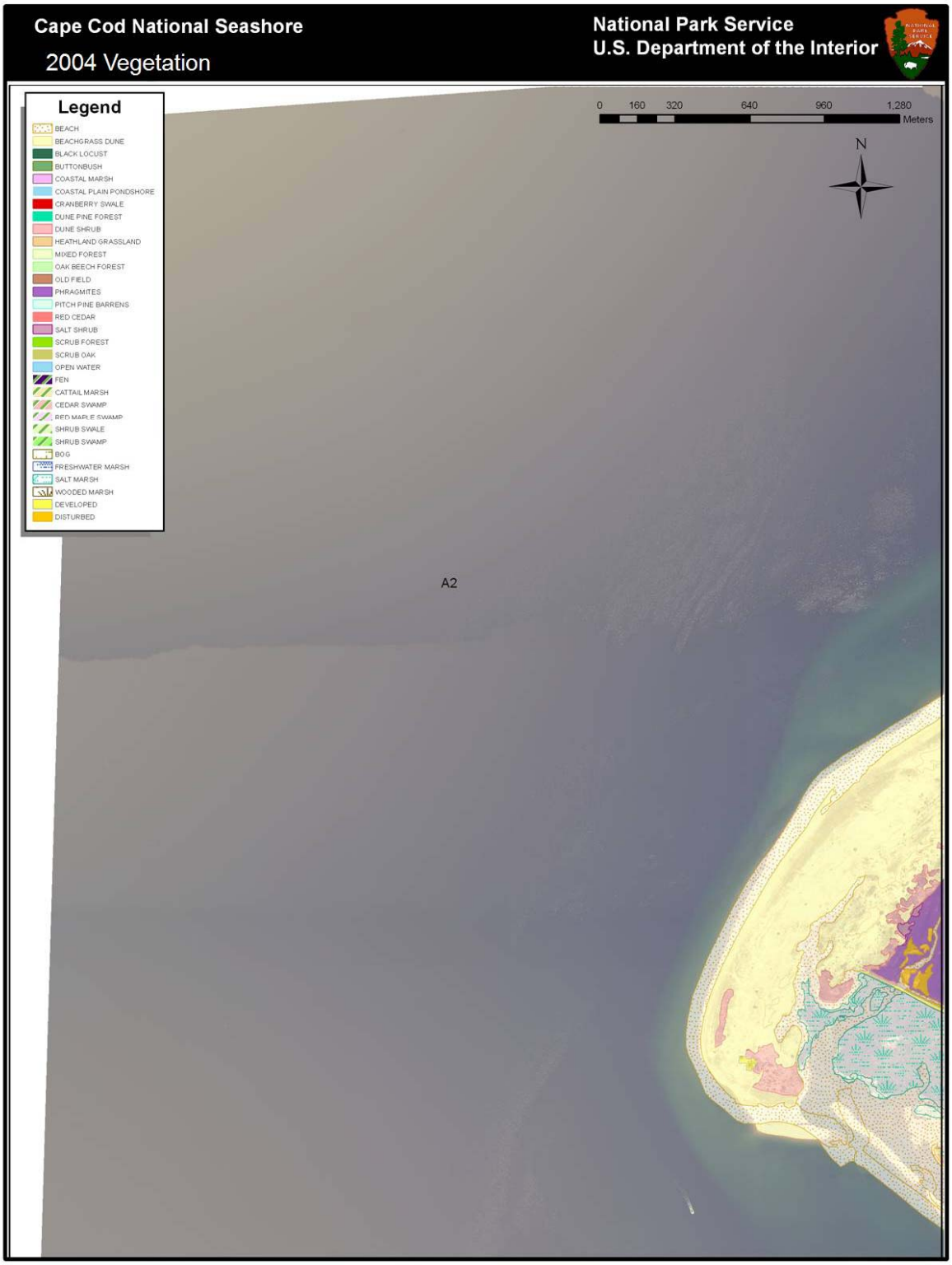
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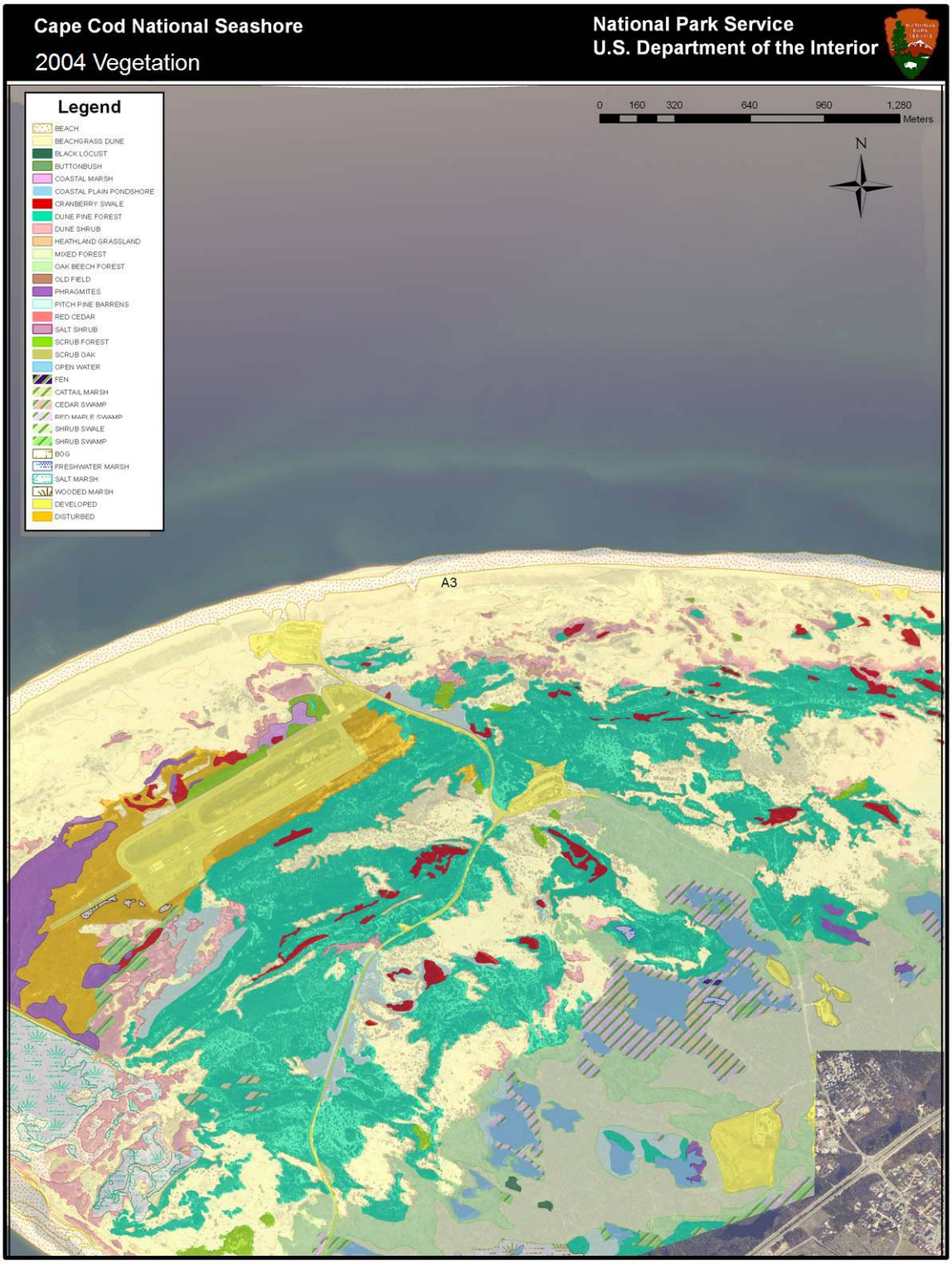
TWINSPAN sample numbers (#) and Motzkin and Foster (2002) samples (plot #)

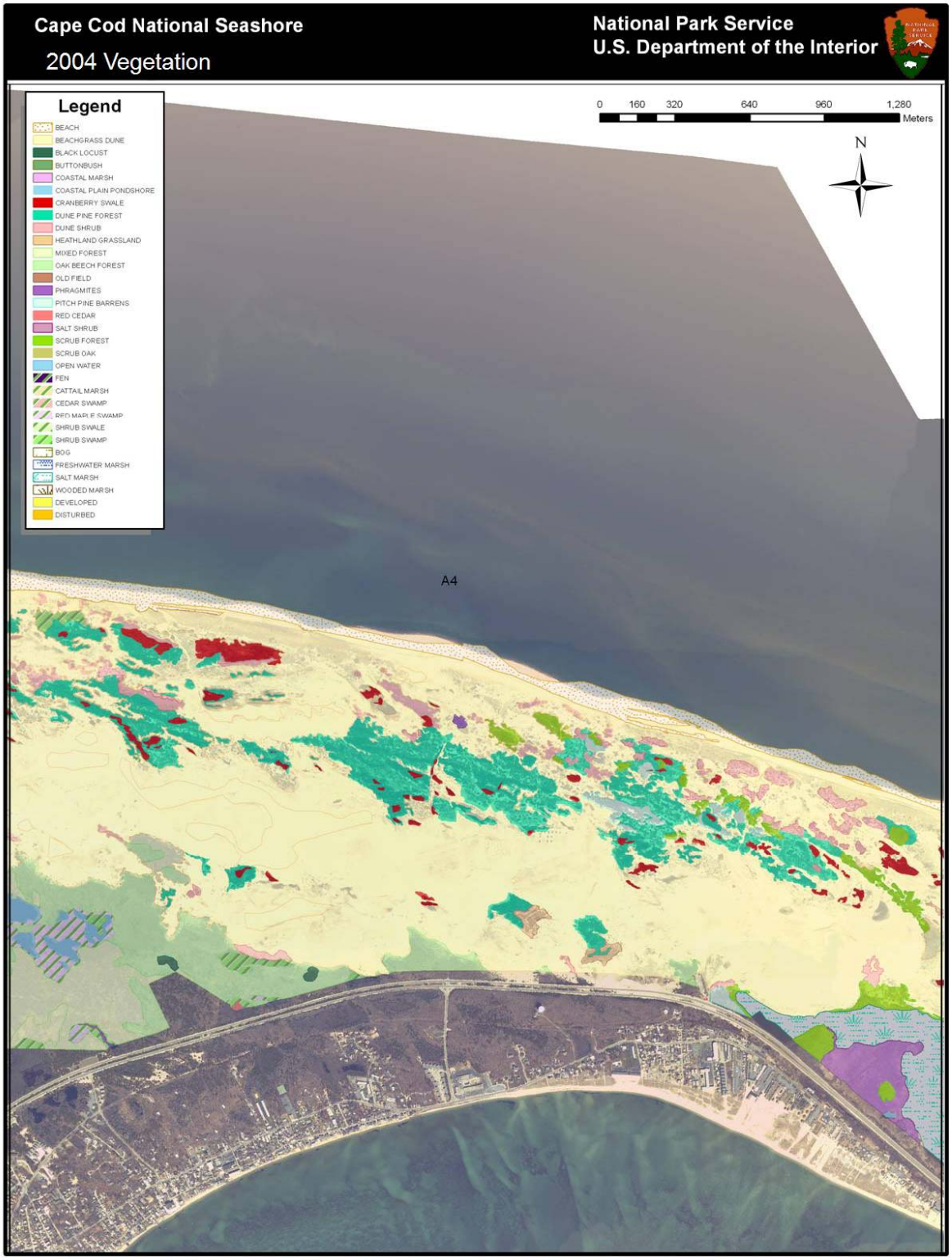
1 plot 4 | 2 plot 5 | 3 plot 6 | 4 plot 12 | 5 plot 14
6 plot 15 | 7 plot 17 | 8 plot 20 | 9 plot 22 | 10 plot 25
11 plot 26 | 12 plot 35 | 13 plot 37 | 14 plot 39 | 15 plot 40
16 plot 42 | 17 plot 44 | 18 plot 47 | 19 plot 50 | 20 plot 52
21 plot 53 | 22 plot 54 | 23 plot 56 | 24 plot 57 | 25 plot 65
26 plot 80 | 27 plot 85 | 28 plot 89 | 29 plot 92 | 30 plot 95
31 plot 101 | 32 plot 105 | 33 plot 108 | 34 plot 111 | 35 plot 112
36 plot 115 | 37 plot 117 | 38 plot 120 | 39 plot 124 | 40 plot 125
41 plot 140 | 42 plot 142 | 43 plot 143 | 44 plot 148 | 45 plot 150
46 plot 151 | 47 plot 152 | 48 plot 154 | 49 plot 174 | 50 plot 175
51 plot 176 | 52 plot 178 | 53 plot 182 | 54 plot 183 | 55 plot 188
56 plot 198 | 57 plot 200 | 58 plot 202 | 59 plot 203 | 60 plot 205
61 plot 208 | 62 plot 216 | 63 plot 218 | 64 plot 222 | 65 plot 223
66 plot 225 | 67 plot 226 | 68 plot 229 | 69 plot 236 | 70 plot 245
71 plot 251 | 72 plot 265 | 73 plot 276 | 74 plot 293 | 75 plot 298
76 plot 299 | 77 plot 300 | 78 plot 308 | 79 plot 318 | 80 plot 319
81 plot 334 | 82 plot 335 | 83 plot 445 | 84 plot 488 | 85 plot 500
86 plot 727 | 87 plot 853 |

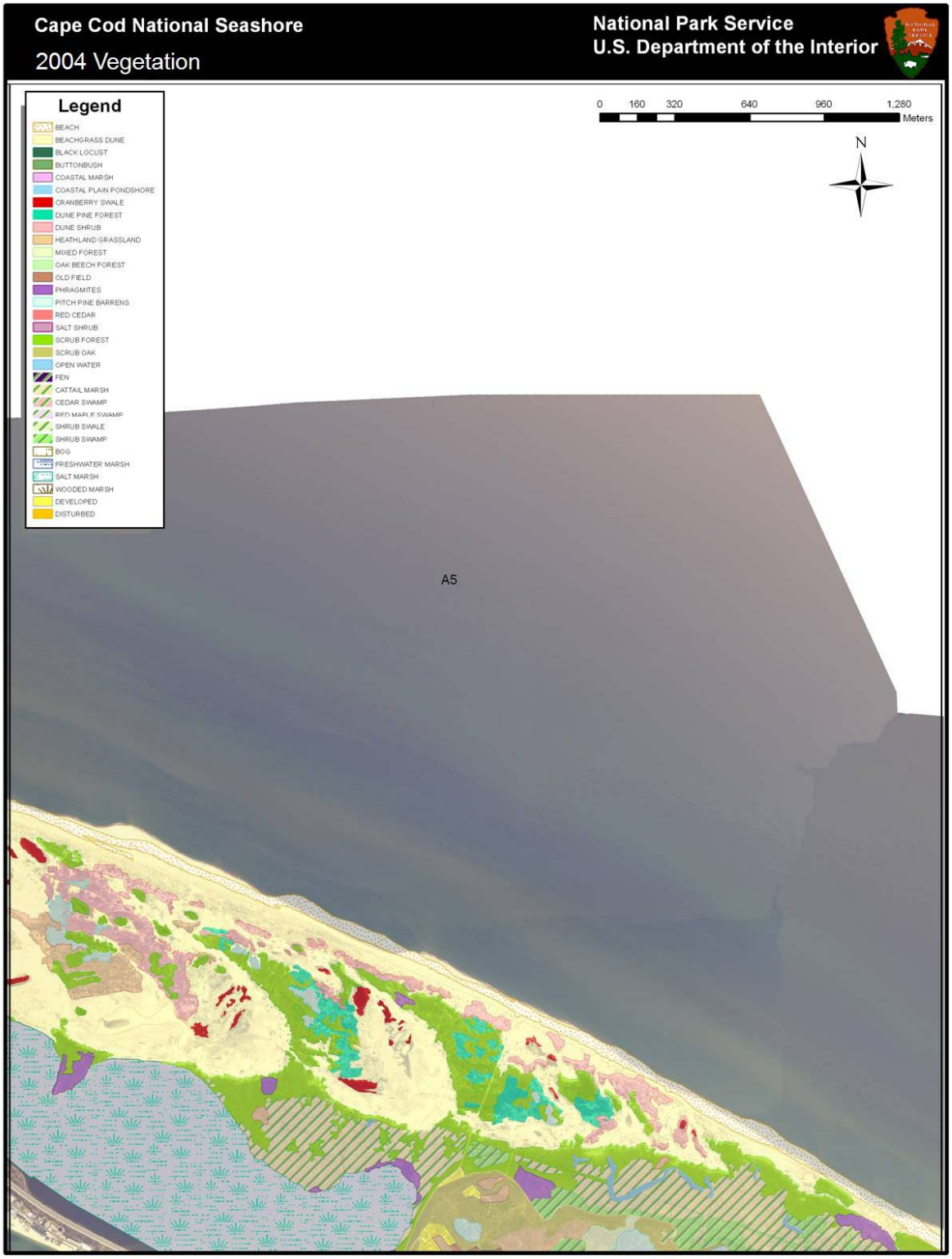
Appendix H. Detail of Cape Cod National Seashore vegetation map.

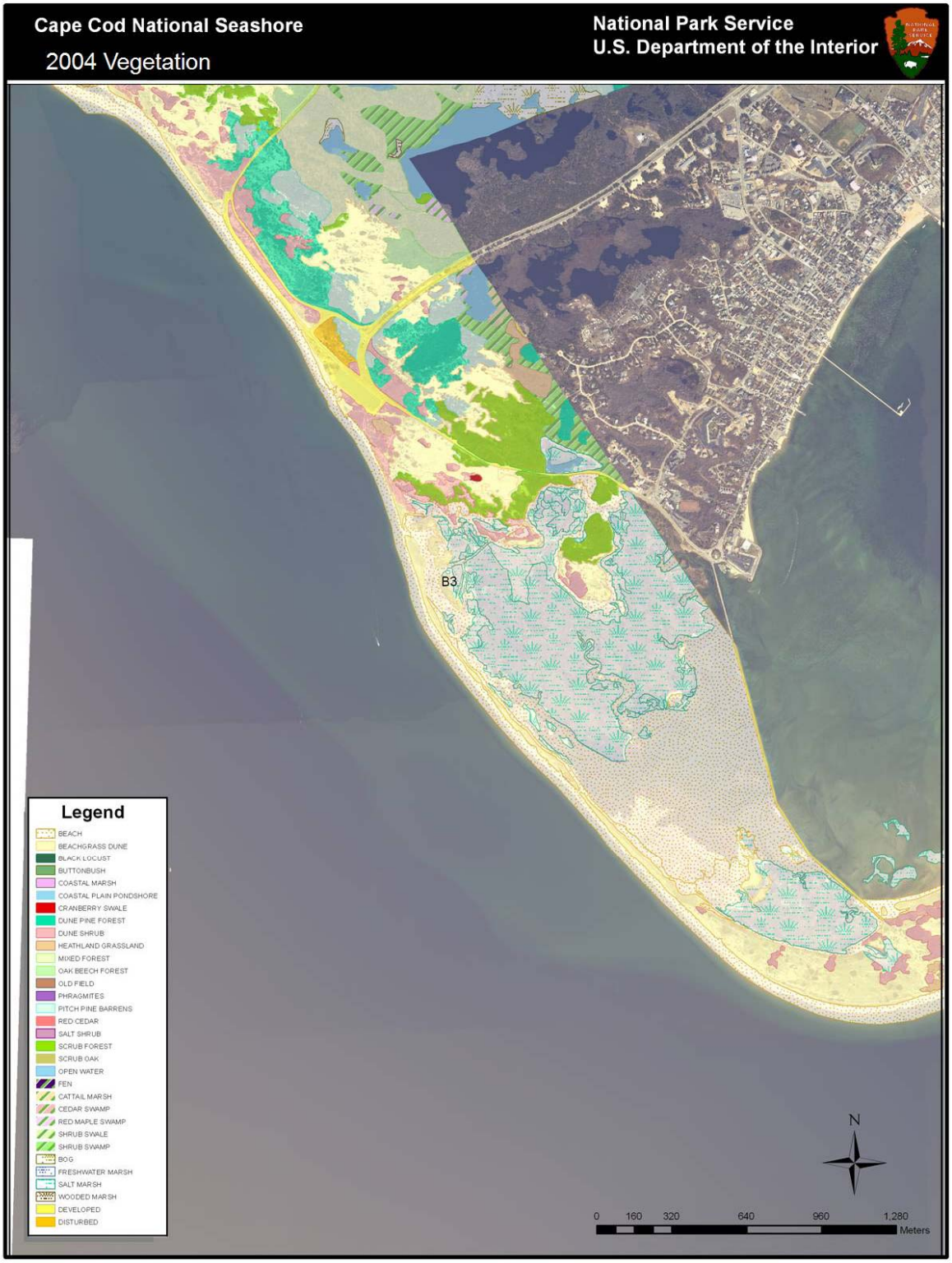


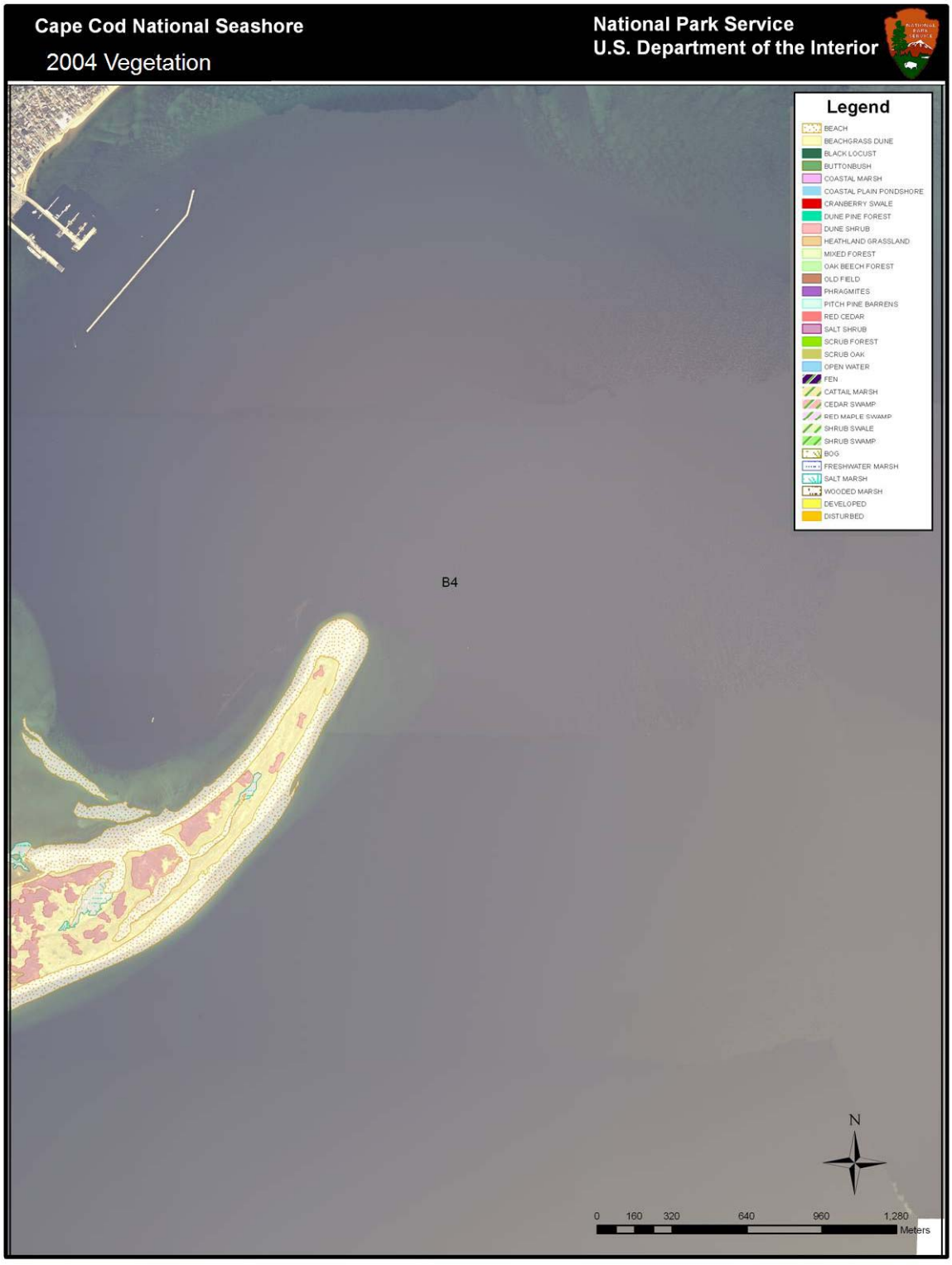

Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN PONDSHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
0 160 320 640 960 1,280
Meters
N
A2

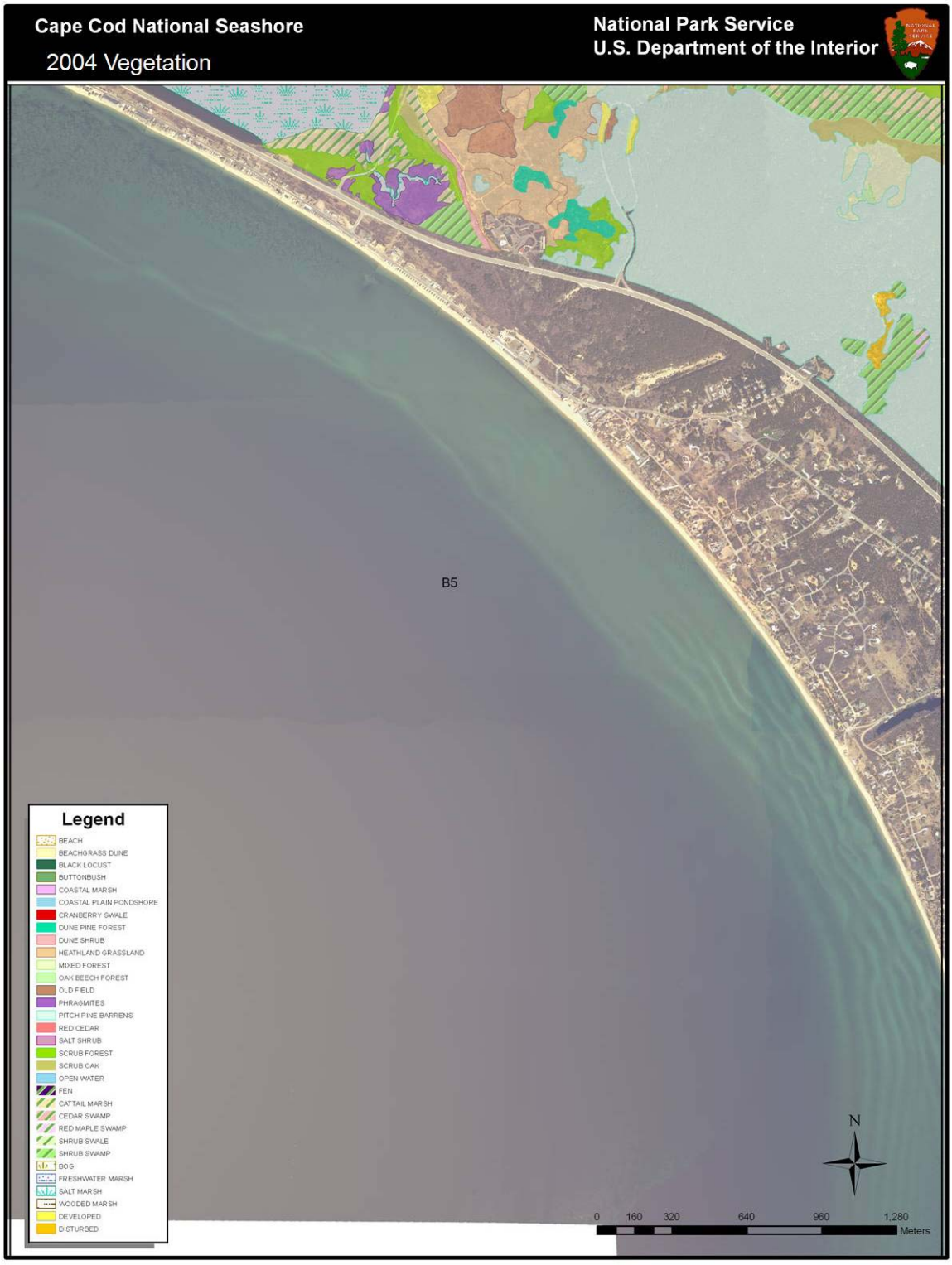

Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN PONDSHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
0 160 320 640 960 1,280
Meters
N
A3

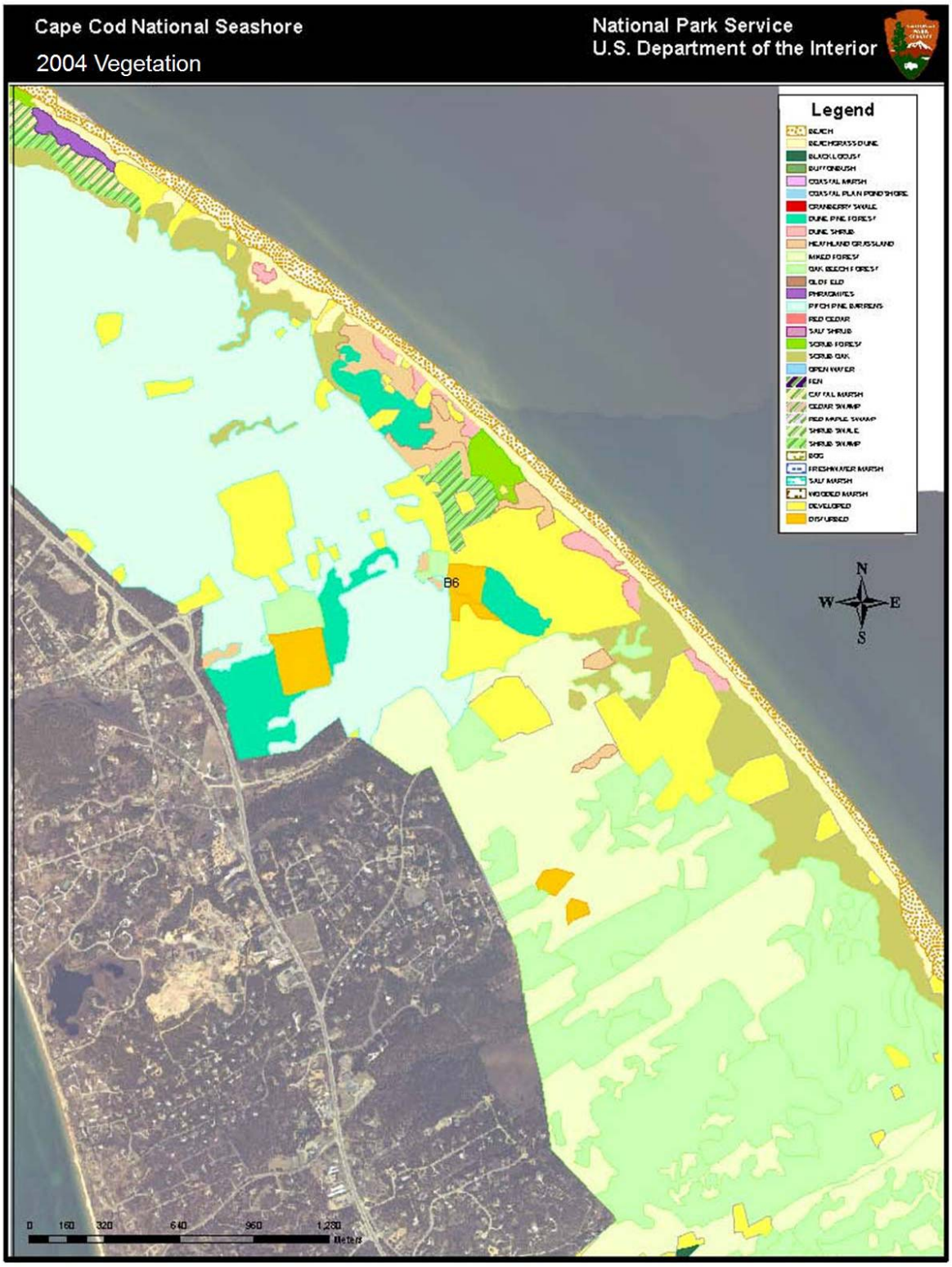

Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN PONDSHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
0 160 320 640 960 1,280
Meters
N
A4

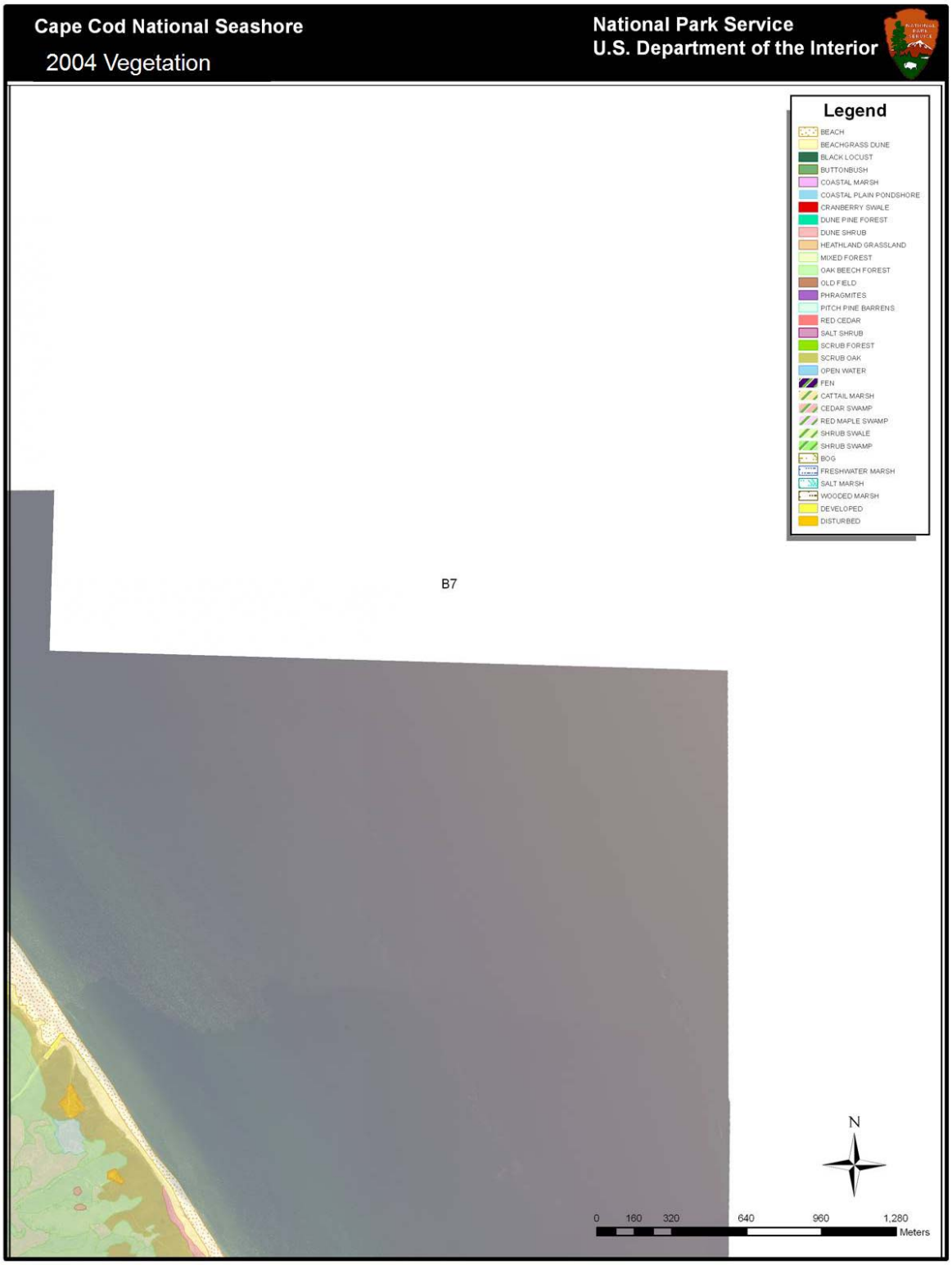

Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN PONDSHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
0 160 320 640 960 1,280
Meters
N
A5

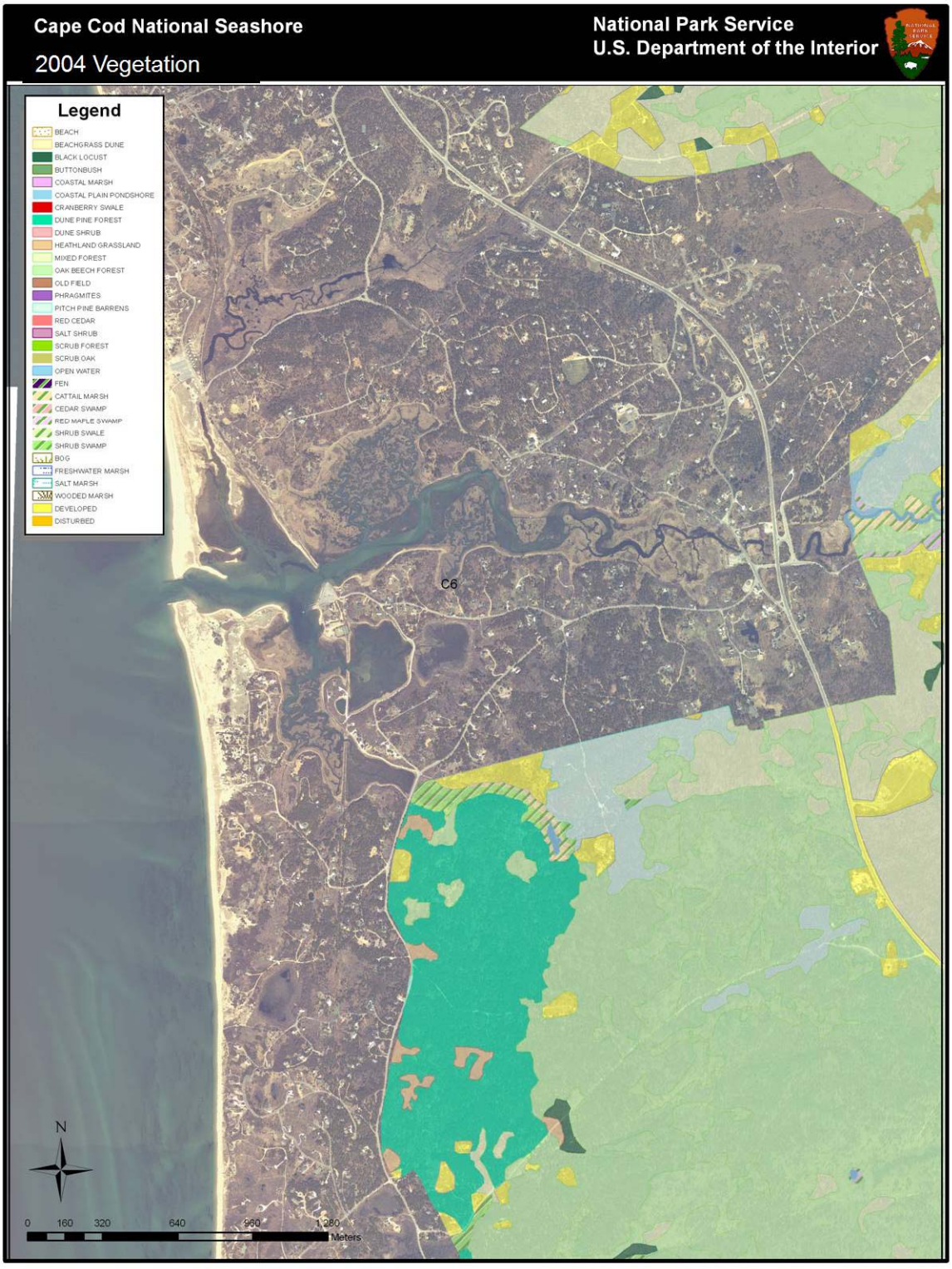

Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
B3
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN POND SHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
N
0 160 320 640 960 1,280
Meters

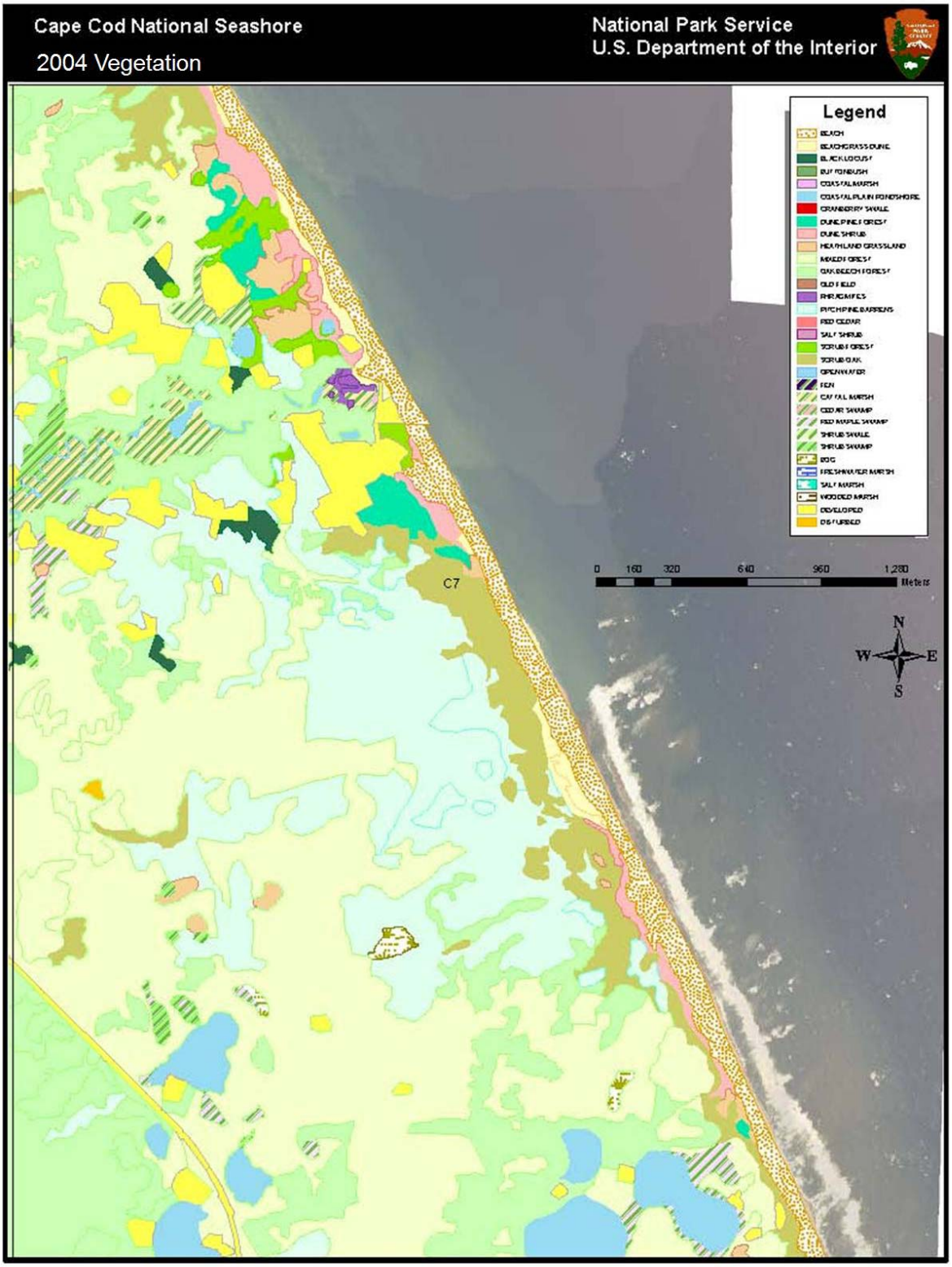

Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN PONDSHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
B4
N
0 160 320 640 960 1,280
Meters

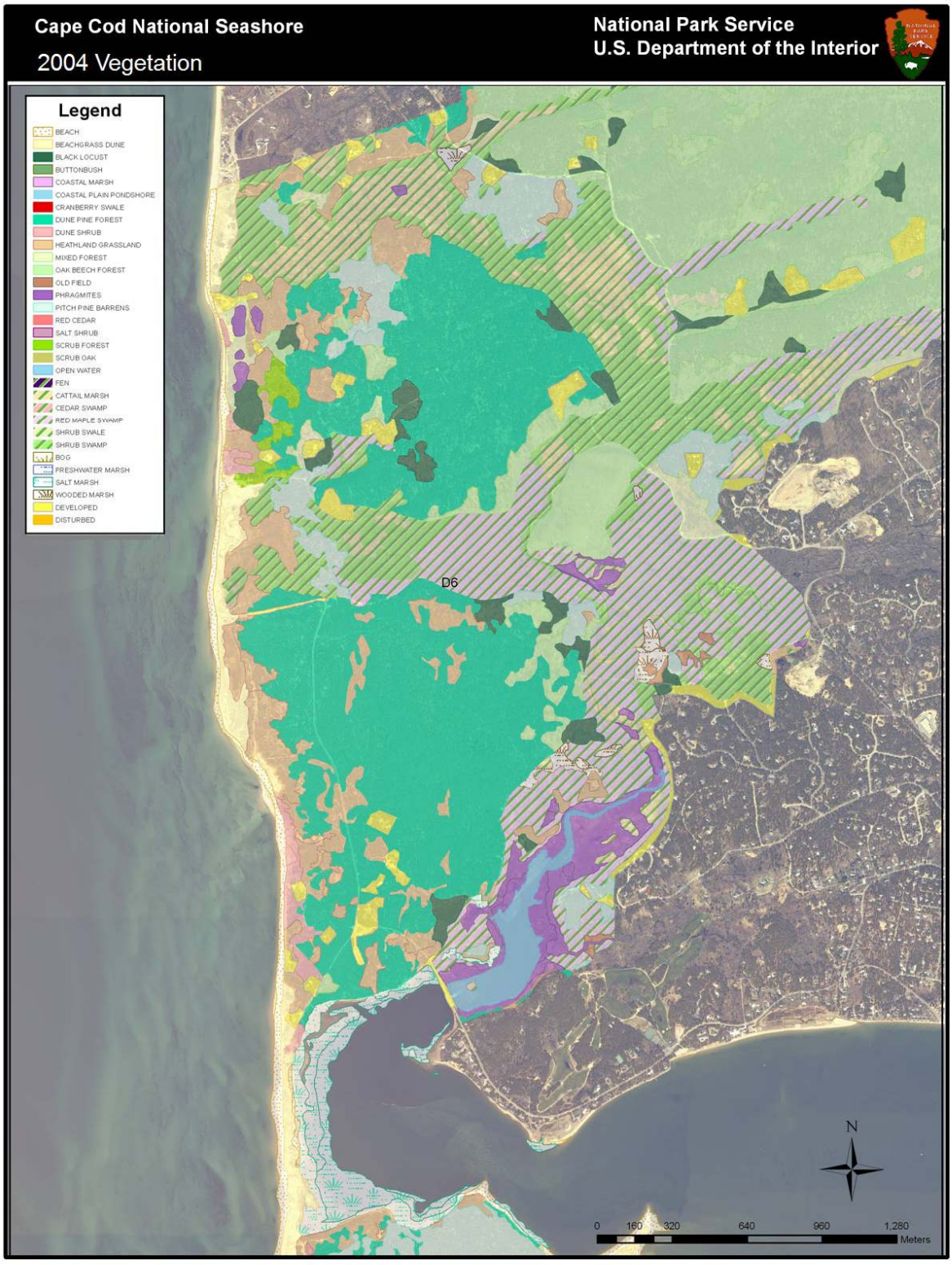

Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
B5
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN PONDSHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
N
0 160 320 640 960 1,280
Meters

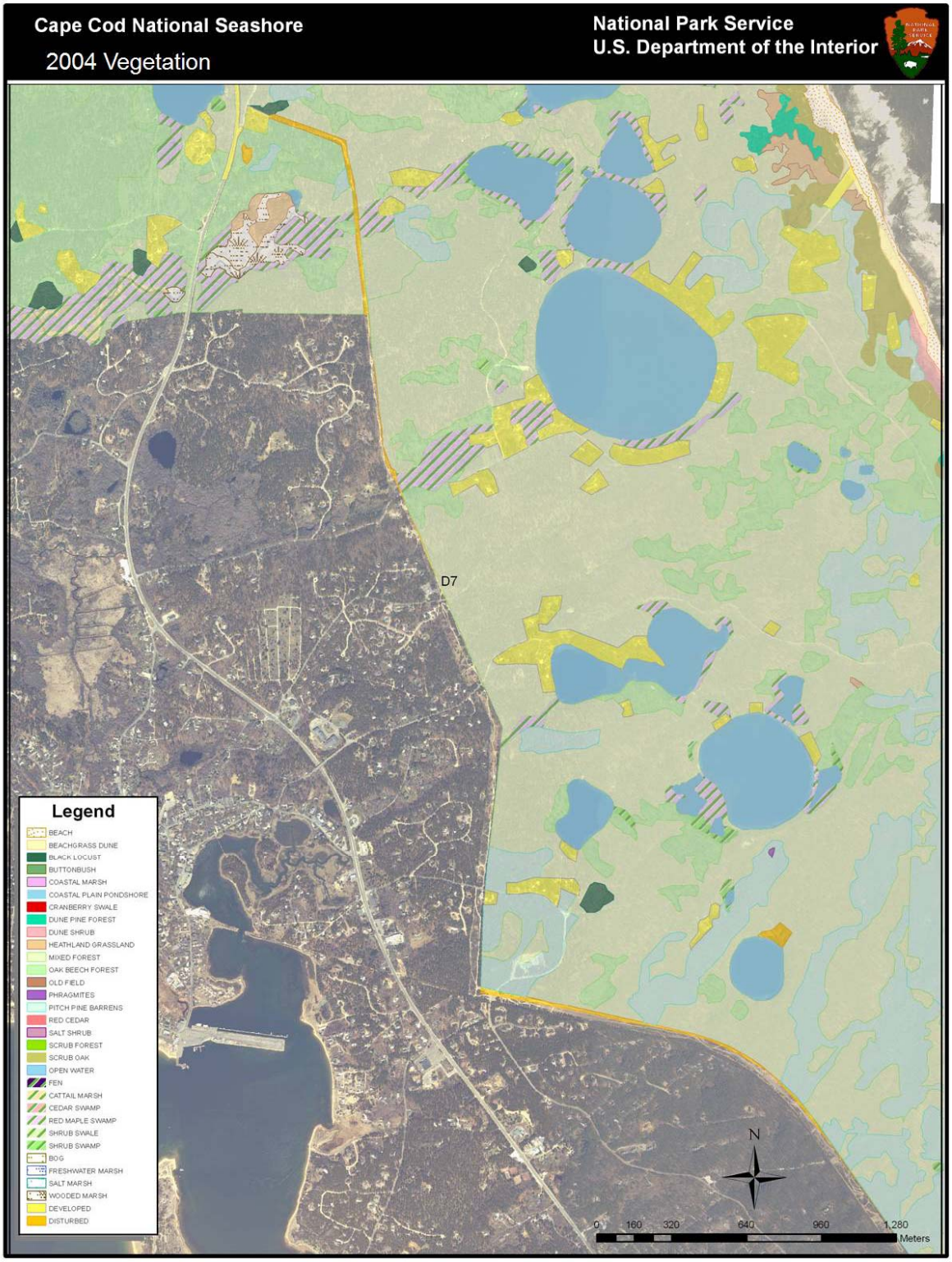

Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUFFONBUSH
COASTAL MARSH
COASTAL PLAIN POND SHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
B6
N
W
E
S
0
160
320
640
960
1,280
Meters

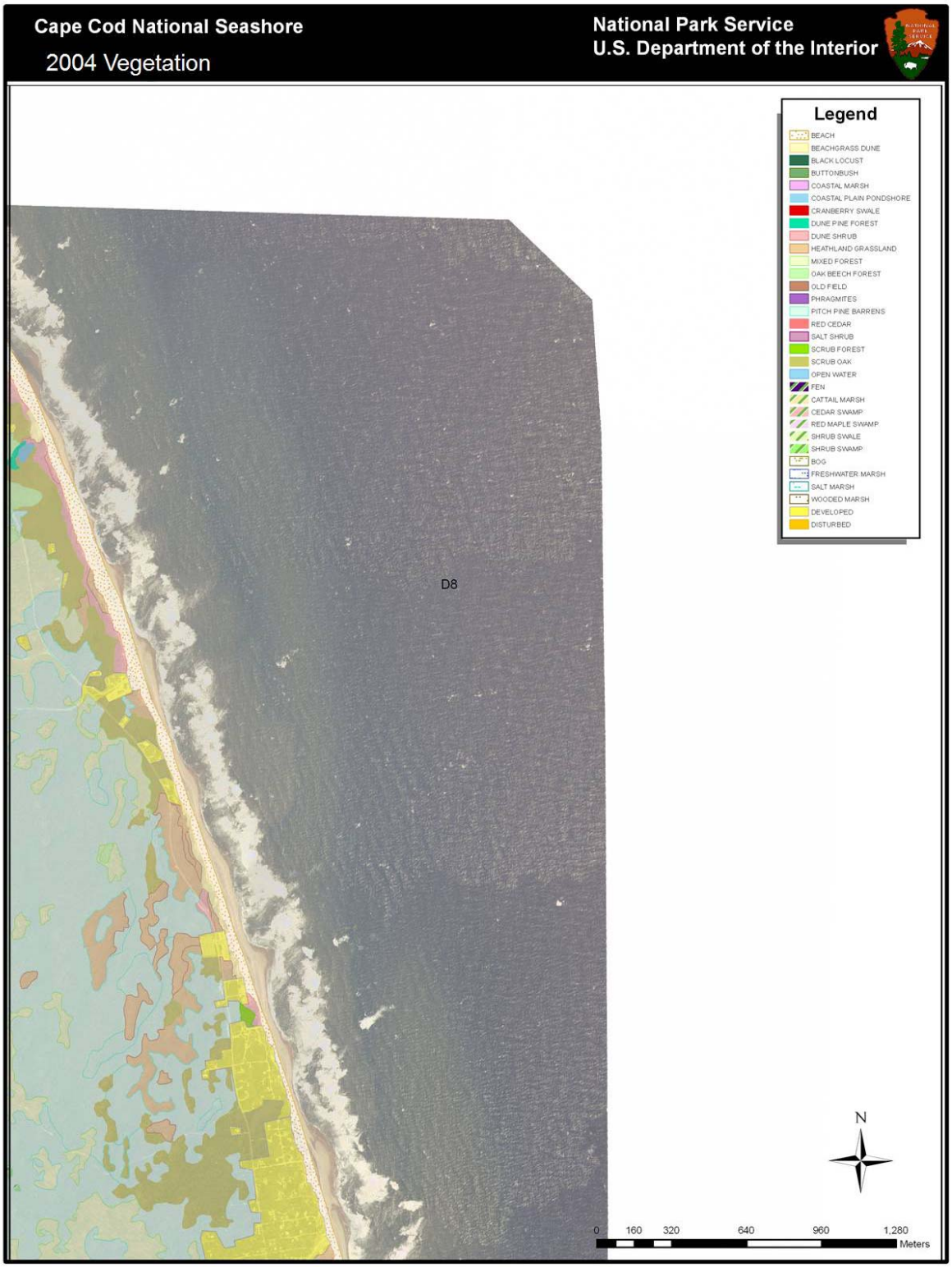

Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN POND/SHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
B7
N
0 160 320 640 960 1,280
Meters


Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN PONDSHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
C6
N
0 160 320 640 960 1,280
Meters

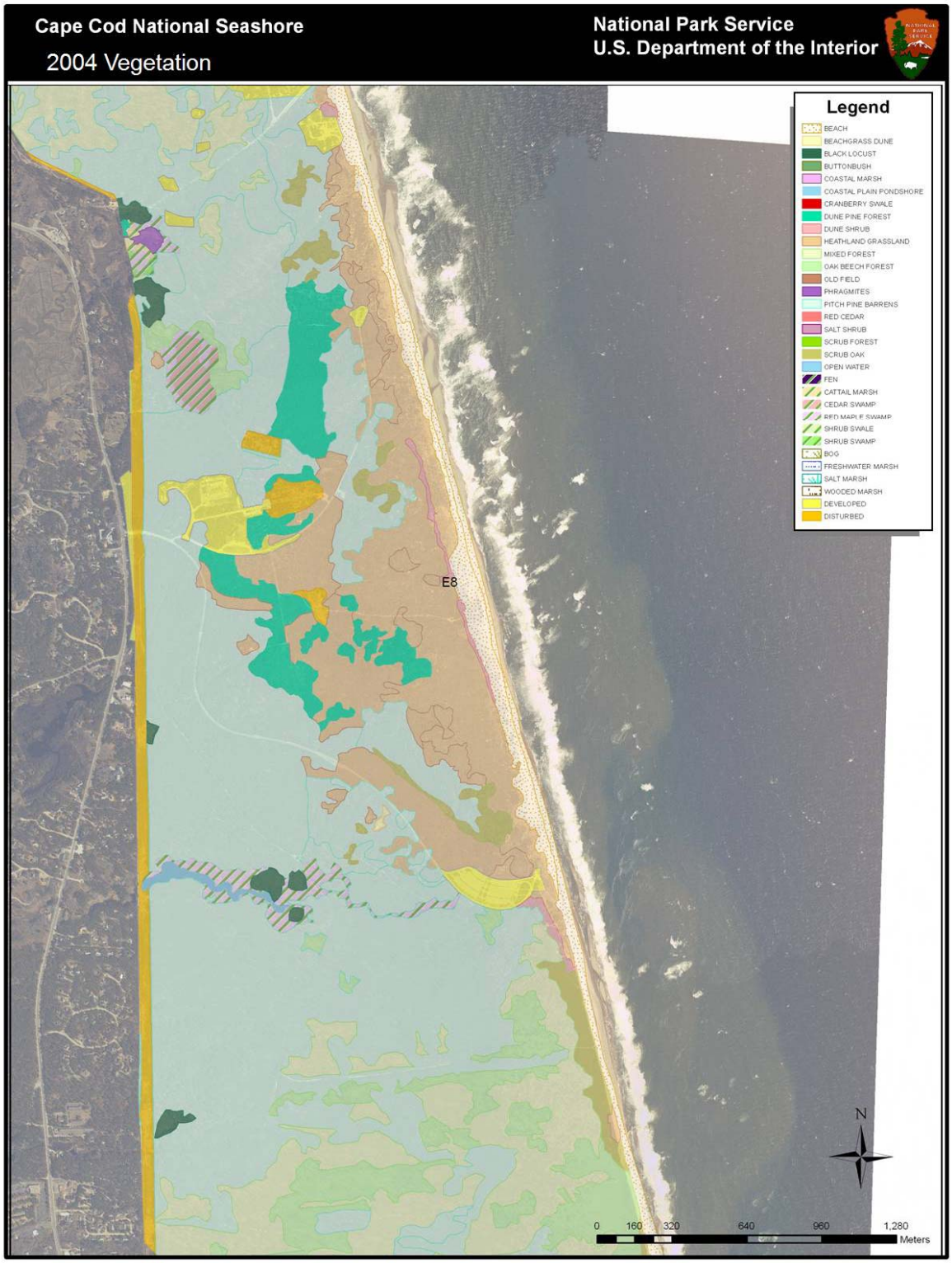

Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS-DUNE
BLACK LOCUST
BUFFONBUSH
COASTAL MARSH
COASTAL PLAIN POND SHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MAPLE FOREST
OAK-BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
0 160 320 640 960 1,280
Meters
N
W
E
S
C7

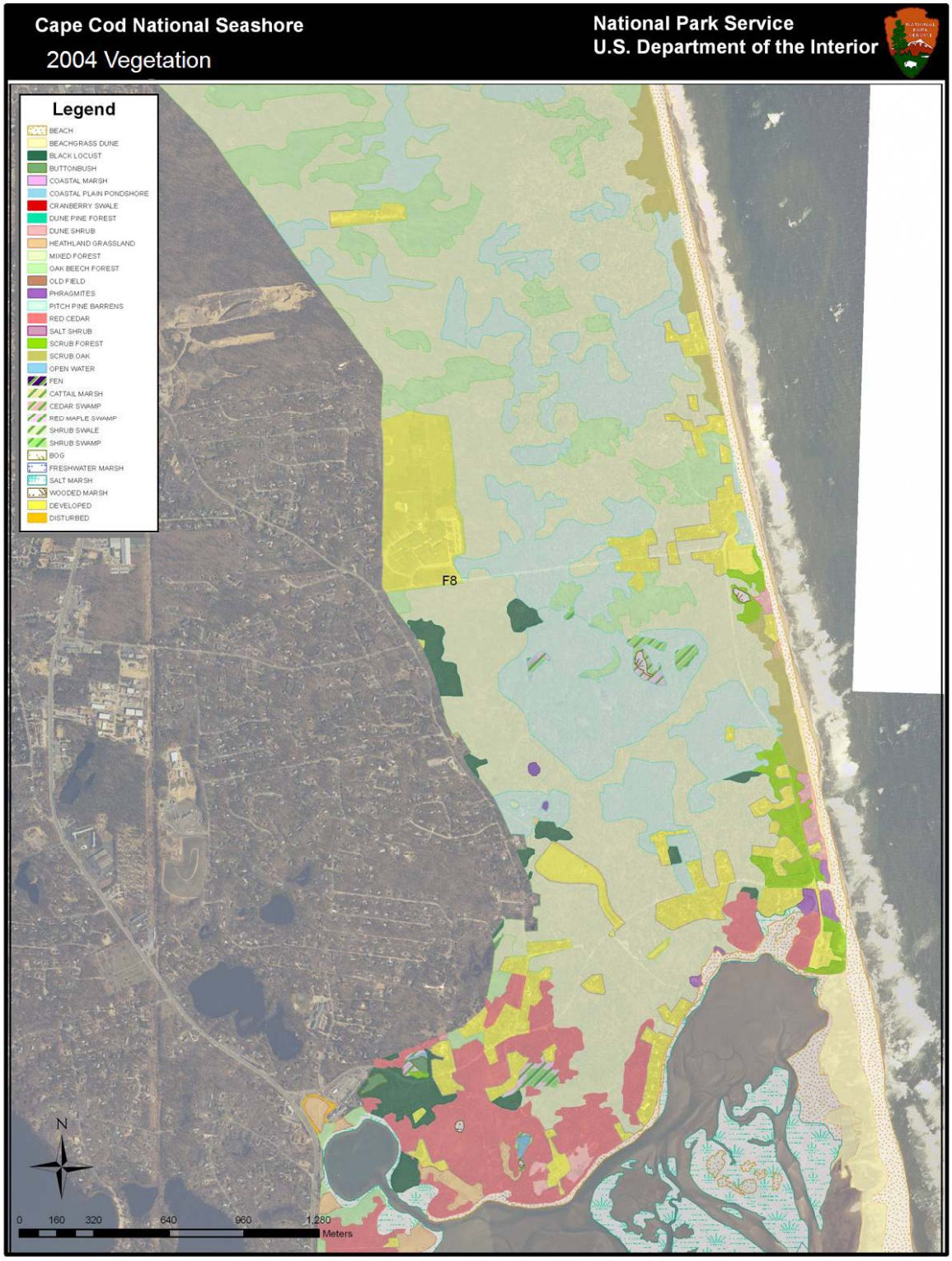

Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN PONDSHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
D6
N
0 160 320 640 960 1,280
Meters

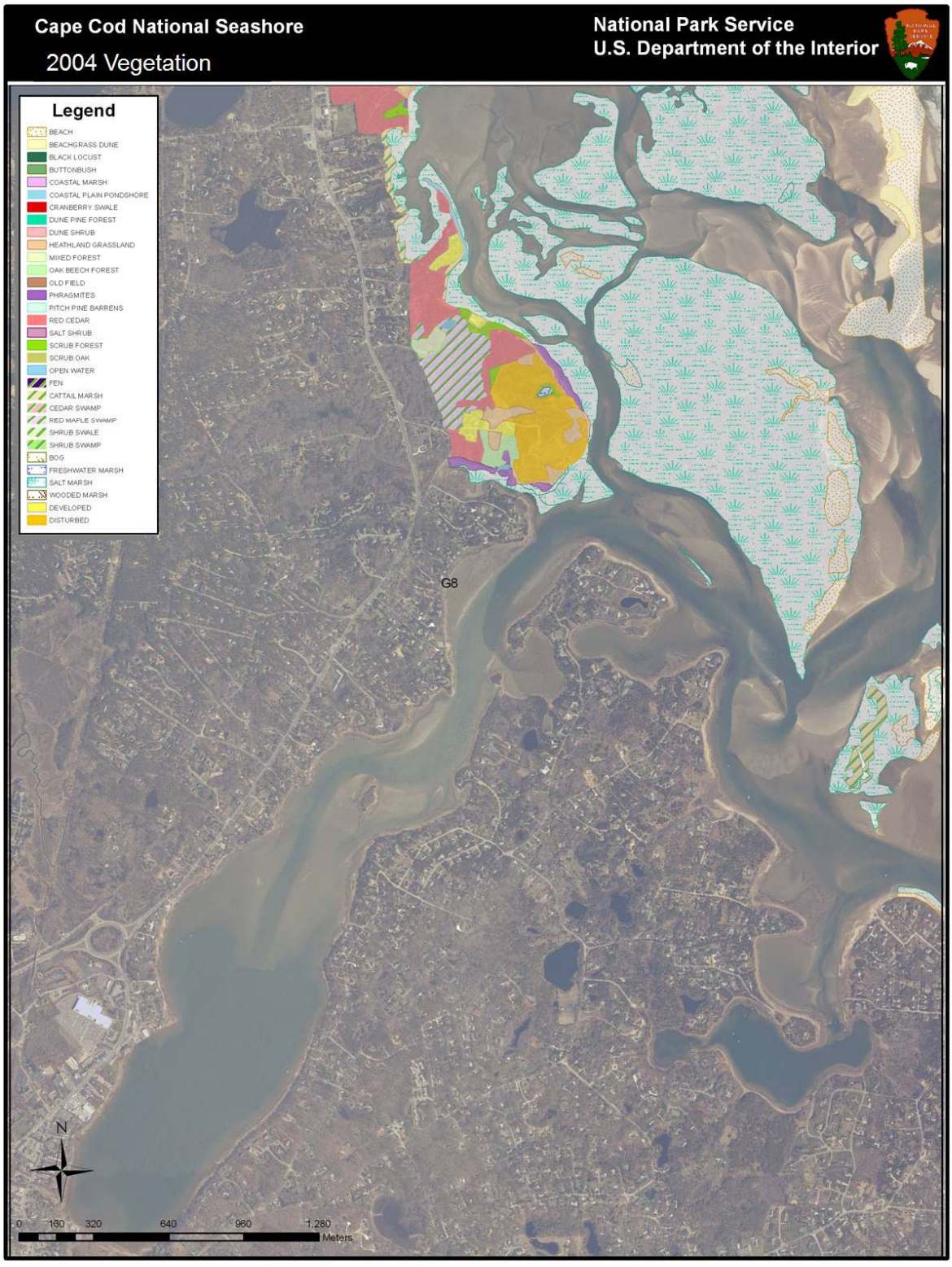

Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
D7
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN PONDSHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
N
0 160 320 640 960 1,280
Meters

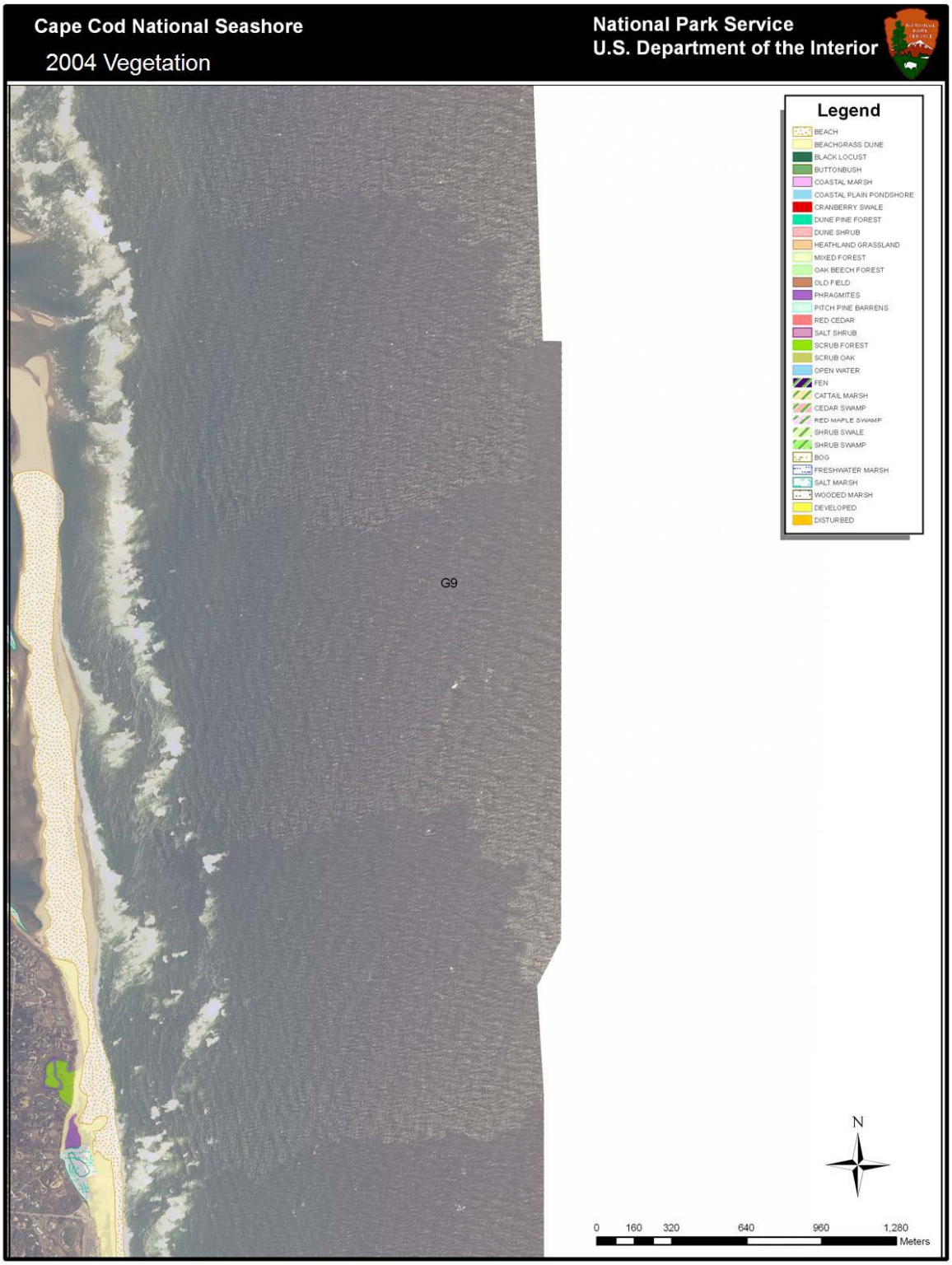

Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN PONDSHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
D8
N
0 160 320 640 960 1,280
Meters

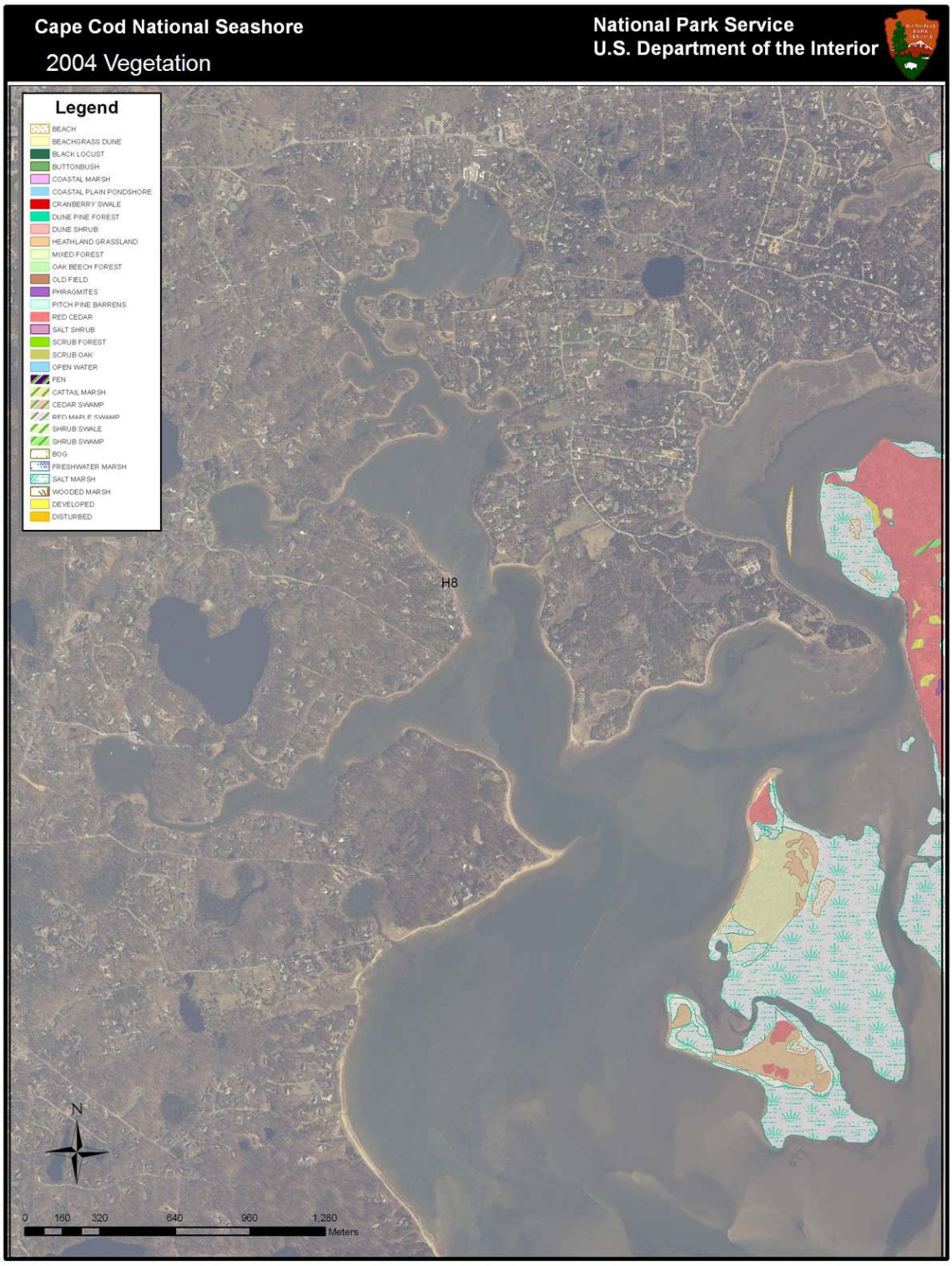

Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN PONDSHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
E6
N
0 160 320 640 960 1,280
Meters


Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN PONDSHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
E8
N
0 160 320 640 960 1,280
Meters

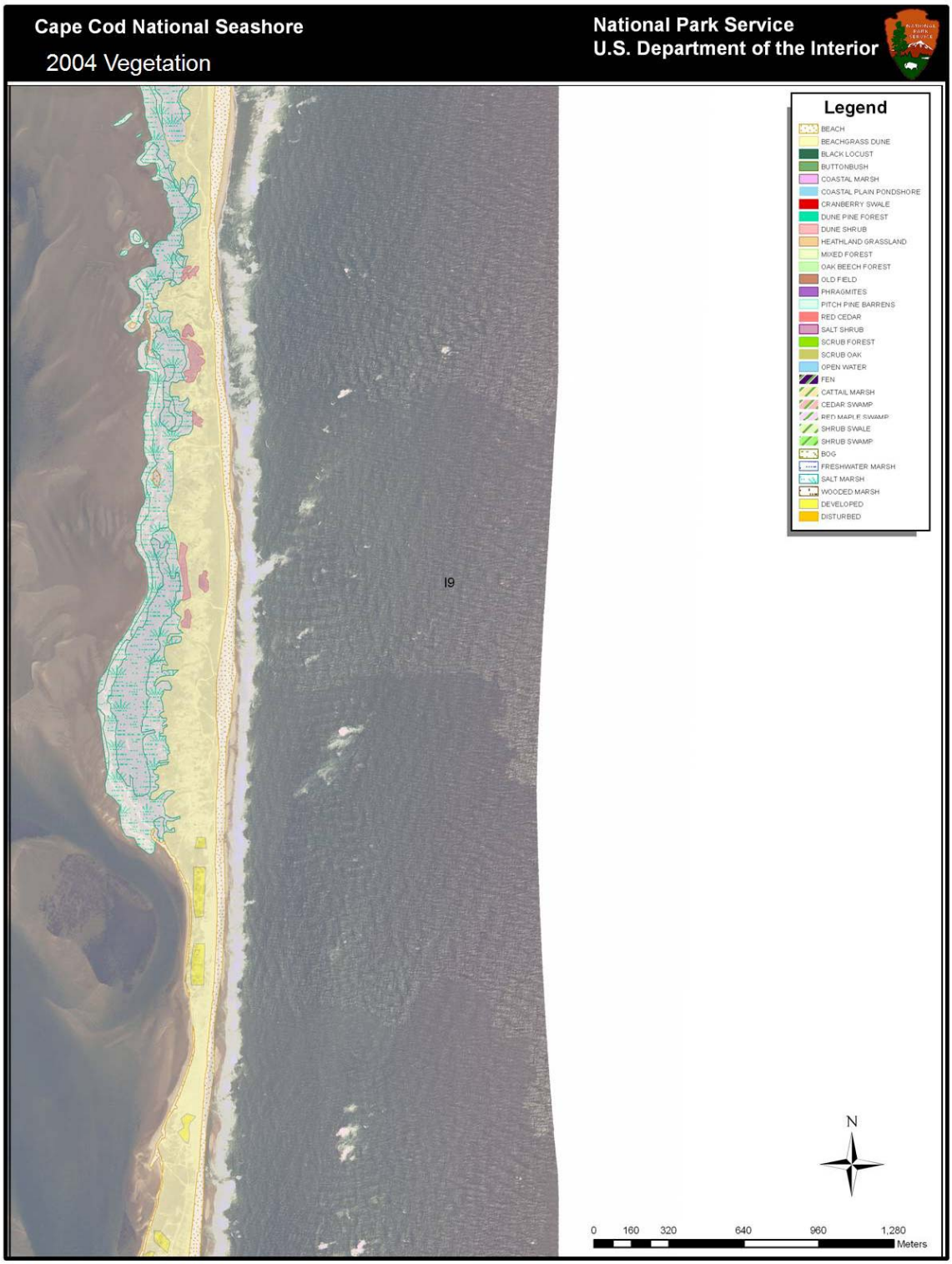

Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN PONDSHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
F8
N
0 160 320 640 960 1,280
Meters


Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN PONDSHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
G8
N
0 160 320 640 960 1,280
Meters


Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN POND SHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
G9
N
0 160 320 640 960 1,280
Meters


Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN PONDSHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
H8
N
0 160 320 640 960 1,280
Meters


Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN POND/SHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
OPEN WATER
FEN
CATTAIL MARSH
CEDAR SWAMP
RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
H9
N
0 160 320 640 960 1,280
Meters


Cape Cod National Seashore
2004 Vegetation
National Park Service
U.S. Department of the Interior
Legend
BEACH
BEACHGRASS DUNE
BLACK LOCUST
BUTTONBUSH
COASTAL MARSH
COASTAL PLAIN PONDSHORE
CRANBERRY SWALE
DUNE PINE FOREST
DUNE SHRUB
HEATHLAND GRASSLAND
MIXED FOREST
OAK BEECH FOREST
OLD FIELD
PHRAGMITES
PITCH PINE BARRENS
RED CEDAR
SALT SHRUB
SCRUB FOREST
SCRUB OAK
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FEN
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RED MAPLE SWAMP
SHRUB SWALE
SHRUB SWAMP
BOG
FRESHWATER MARSH
SALT MARSH
WOODED MARSH
DEVELOPED
DISTURBED
I9
N
0 160 320 640 960 1,280
Meters

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Appendix J. Field definitions for local and global vegetation descriptions.

Field Definitions

LOCAL DESCRIPTION

Common Name (Park-specific)
A common or colloquial name used by the park for the Association.

Environmental Description
A summary of available information on the environmental conditions associated with the Association and any other important aspects of the environment which affect this particular type within the park, including elevation ranges and, where relevant, information on large landscape context, geology and soils.

Vegetation Description
A summary of available information on the vegetation, species composition (including dominant and diagnostic taxa, as well as problematic exotic species), structure (defining strata and their heights and percent cover), and variability of the vegetation of this Association as it occurs on the park.

Species Name
Global scientific name (and common name) for each floristic component species of the community as it occurs within the park.

Characteristic Species
Component plant species that are characteristic for the community type as it occurs within the park.

Other Noteworthy Species
Other noteworthy species (i.e., species that are not necessarily diagnostic of the community, but that are worth noting for some other reasons, such as those that are rare species or exotic invasives) that are found within the community in the park.

FLORISTIC COMPOSITION

Most Abundant Species
Component plant species that are dominant (i.e., most abundant in terms of percent cover) for the community type as it occurs in the park.

Stratum
For each component plant species, the stratum (or strata) in which it occurs in the community within the park.

Categories for Stratum are

- Tree (canopy & subcanopy)
- Tree canopy
- Tree subcanopy
- Shrub/sapling (tall & short)
- Tall shrub/sapling
- Short shrub/sapling
- Herb (field)
- Nonvascular
- Floating aquatic
- Submerged aquatic

Lifeform
The lifeform of each component plant species that is present within each designated stratum of the community as it occurs within the park. Lifeform definitions are from Table 3.1, page 37, of Whittaker, R. H. 1975. Communities and ecosystems. Second edition. Macmillan Publishing Co., New York. 387 pp.

Categories for Lifeforms are

- Needle-leaved tree
- Broad-leaved deciduous tree
- Broad-leaved evergreen tree
- Thorn tree
- Evergreen schlerophyllous tree
- Succulent tree
- Palm tree
- Tree fern
- Bamboo
- Needle-leaved shrub
- Broad-leaved deciduous shrub
- Broad-leaved evergreen shrub
- Thorn shrub
- Evergreen schlerophyllous shrub
- Palm shrub
- Dwarf-shrub
- Semi-shrub
- Succulent shrub
- Ephiphyte
- Vine/Liana
- Forb
- Graminoid
- Succulent forb
- Aquatic herb (floating & submergent)
- Moss
- Alga
- Lichen
- Fern or fern ally
- Other/unknown
- Other shrub
- Other herbaceous
- Liverwort/hornwort

DISTRIBUTION

State
The two-letter postal code of the for U.S. state(s) in which the park occurs.
State Rank
The Heritage Conservation Subnational Rank that best characterizes the relative rarity or endangerment of the Association within the specified state. See **Global Rank** for equivalent values. A star (*) indicates that the Subnational Rank is for the NHP/CDC Element (nonstandard) not the IVC Association (standard) (see below).
Relationship
The **State Name** (see below) is the name that the state Natural Heritage Program applies to their community Element. The **Relationship to Standard** is a value that indicates the relationship between the NHP(**Nonstandard)** Element and the related **Standard** Association (IVC). Values for Relationship to Standard are:

= - Equivalent = NHP community is equivalent to the standard Association
B - Broader = the NHP community is more broadly classified than the standard Association
F - Finer = the NHP community is more finely classified than the standard Association
I - Intersecting = the NHP community is not clearly broader or finer than this standard Association; the standard and NHP communities are related in a way that is more complex than a simple broader/finer relationship
? - Undetermined = the relationship between the NHP community and this standard Association is unknown

State Name
If the IVC Association has been crosswalked to a state classification type and it is equivalent to the IVC type, the **State Name** is the name that the Natural Heritage Program applies to the same community. A value of [gname] indicates that the **State Name** is the same as the **Global Name**. A value of [not crosswalked] indicates that no state type representing the concept of the IVC Association has been identified. If a state type has been identified that is NOT equivalent to the IVC Association (**Standard**), then the subnational type is considered a **Nonstandard** community. In this case, the **State Name** is the name of the nonstandard community.
Reference
This is the primary reference for the Natural Heritage Program classification that contains the **State Name** and confirms the presence of the Association in the state.
Local Range
A description of the total range (including present and historic, if known) of the Association within the park.

ADDITIONAL INFORMATION

Classification Comments
Comments about classification criteria used to define the community or description of any remaining issues associated with its classification on the park.
Other Comments
Additional comments about the community within the park.
Local Description Authors
Name(s) of the person(s) primarily responsible for authorship of the current description of this community on the park.
Plots
List of plot codes for plots used in the identification and classification of the community on the park.
Inventory Notes
Information regarding the sampling of the community on the park.

GLOBAL INFORMATION
USNVC CLASSIFICATION

Physiognomic Class
Class designates the growth form and structure of the vegetation of a community.
Physiognomic Subclass
Subclass designates growth form characteristics (e.g., leaf phenology) of a community.
Physiognomic Group
Group designates the leaf type of a community, corresponding to climate.
Physiognomic Subgroup
Subgroup designates the relative human impact (natural/semi-natural or cultural) on a community.
Formation
Formation designates additional physiognomic and environmental factors, including hydrology, of a community.

Classification Code
The InterUS National Vegetation Classification (IVC) Standard Classification code for the respective level of the hierarchy. Classification codes for the different levels are comprised of the following:

Class: Roman numerals (I-VII)
Subclass: Class code plus an uppercase letter (A–Z)
Group: Subclass code plus an Arabic number
Subgroup: Group code plus either the uppercase letter N (Natural/Semi-natural) or the uppercase letter C (Planted/Cultivated)
Formation: Subgroup code plus a lowercase letter (a–z)

Alliance
The names of dominant and diagnostic species are the foundation of the **Alliance Name**. At least one species from the dominant and/or uppermost stratum is included. In rare cases where the combination of species in the upper and lower strata is strongly diagnostic, species from other strata are included in the name. Species occurring in the same stratum are separated by a hyphen (-), and those occurring in a different strata are separated by a slash (/). Species occurring in the uppermost stratum are listed first, followed successively by those in lower strata. In physiognomic types where there is a dominant herbaceous layer with a scattered woody layer, alliance names can be based on species found in the herbaceous layer and/or the woody layer, whichever is more diagnostic of the type.

Species less consistently found in all associations of the alliance may be placed in parentheses, and these parenthetical names are generally listed alphabetically. In cases where a particular genus is dominant or diagnostic, but the presence of individual species of the genus may vary among associations, only the specific epithets are placed in parentheses.

Nomenclature for vascular plant species follows a nationally standardized list (Kartesz 1999), with very few exceptions. Nomenclature for nonvascular plants follows Anderson (1990), Anderson et al. (1990), Egan (1987, 1989, 1990), Esslinger and Egan (1995), and Stotler and Crandall-Stotler (1977).

Alliance Key
A unique identifier for each Alliance that begins with the string "A." followed by a unique 3- or 4-digit number.

Alliance (English name)
A repeat of the **Alliance Name** with a translation of the scientific names using standard Central Ecology-accepted common names for the plant taxa in the name.

Association
The **Association Name** includes the scientific names of dominant and diagnostic species. Species occurring in the same stratum are separated by a hyphen (-), and those occurring in different strata are separated by a slash (/). Species occurring in the uppermost strata are listed first, followed successively by those in lower strata. Within the same stratum, the order of species names generally reflects decreasing levels of dominance, constancy, or indicator value. In physiognomic types where there is a dominant herbaceous layer with a scattered woody layer, Association names can be based on species found in either the herbaceous layer or the woody layer, whichever is more diagnostic of the type. If both layers are used, then the uppermost layer is always listed first, regardless of which may be more diagnostic.Species less consistently found

in all occurrences of the Association are placed in parentheses (). In cases where a particular genus is dominant or diagnostic, but individual species of the genus may vary among occurrences, only the specific epithets are placed in parentheses. Association names conclude with the **Class Name** in which they are classified.

In cases where diagnostic species are unknown or in question, a more general term may be used as a species placeholder (e.g., *Sphagnum* spp., Mixed Herbs, Mesic Graminoids). An environmental or geographic term, or one that is descriptive of the height of the vegetation (e.g., Dwarf Forest, Northern Shrubland), can also be used as a modifier when such a term is necessary to adequately characterize the Association. For reasons of standardization and brevity, however, this is kept to a minimum. For **Provisional** Associations, [Provisional] is added at the end of the name (ex. *Salix wolfii* Shrubland [Provisional]).

Vascular plant species nomenclature for Association and Alliance names follows the nationally standardized list of Kartesz (1999), with very few exceptions. Nomenclature for nonvascular plants follows Anderson (1990) and Anderson et al. (1990) for mosses, Egan (1987, 1989, 1990, 1991) and Esslinger and Egan (1995) for lichens, and Stotler and Crandall-Stotler (1977) for liverworts/hornworts.

Association (English name)
A repeat of the **Association Name** but with a translation of the scientific names using standard Central Ecology-accepted common names for the plant taxa used in the name. Unlike **Global Name**, names in parentheses should be fully contained within the parentheses, and [Provisional] is not added at the end of name.

Ecological System(s)
A list of the Ecological Systems (**Association Name** and **Elcode**) of which the Association is a member. Ecological Systems are groups of plant associations unified by similar ecological conditions and processes (e.g., fire, riverine flooding), underlying environmental features (e.g., shallow soils, serpentine geology), and/or environmental gradients (e.g., elevation, hydrology in coastal zones). They should form relatively robust, cohesive, and distinguishable units on the ground. In most landscapes, the Ecological System will manifest itself on the ground as a spatial aggregation at an intermediate scale (e.g., between the IVC Alliance and Formation scales).

GLOBAL DESCRIPTION

Elcode (Identifier)
For IVC ecological units, a unique identifier code. Associations have a code that begins with the string "CEGL" (Community Element GLobal) followed by a unique 6-digit number; Ecological Systems have codes that begin "CES" (Community Ecological System) followed by the 3-digit primary division code, followed by a 3-digit number.

Concept Summary
A description of the range, structure, composition, environmental setting and dynamics associated with the community. Information includes a general understanding of the type, often with some concept of its distribution; environmental setting in which the type occurs and a summary of the important disturbance regimes, successional status, and temporal dynamics for this community rangewide; community structure/physiognomy; species by strata (dominant and diagnostic taxa); and key diagnostic characteristics that distinguishes it from similar types.

Environmental Description
A summary of available information on the environmental conditions of the Association rangewide and any other important aspects of the environment which affect this particular type, including elevation ranges and, where relevant, information on large landscape context, geology and soils.

Vegetation Description
A summary of available information on the leaf type and phenology, species composition (including dominant and diagnostic taxa, as well as problematic exotic species), structure (defining strata and their heights and percent cover), and variability of the vegetation of this Association rangewide and any additional comments relating to the vegetation.

FLORISTIC COMPOSITION

Most Abundant Species
Component plant species that are dominant (i.e., most abundant in terms of percent cover) for the community type as it occurs rangewide.

Stratum
For each component plant species, the stratum (or strata) in which it occurs in the community rangewide.

Categories for Stratum are

- Tree (canopy & subcanopy)
- Tree canopy
- Tree subcanopy
- Shrub/sapling (tall & short)
- Tall shrub/sapling
- Short shrub/sapling
- Herb (field)
- Nonvascular
- Floating aquatic
- Submerged aquatic

Lifeform
The lifeform of each component plant species that is present within each designated stratum of the community as it occurs rangewide. Lifeform definitions are from Table 3.1, page 37, of Whittaker, R. H. 1975. Communities and ecosystems. Second edition. Macmillan Publishing Co., New York. 387 pp.

Categories for Lifeforms are

- Needle-leaved tree
- Broad-leaved deciduous tree
- Broad-leaved evergreen tree
- Thorn tree
- Evergreen schlerophyllous tree
- Succulent tree
- Palm tree
- Palm shrub
- Dwarf-shrub
- Semi-shrub
- Succulent shrub
- Tree fern
- Bamboo
- Needle-leaved shrub
- Broad-leaved deciduous shrub
- Broad-leaved evergreen shrub
- Thorn shrub
- Evergreen schlerophyllous shrub
- Ephiphyte
- Vine/Liana
- Forb
- Graminoid

Succulent forb	Aquatic herb (floating & submergent)
Moss	Alga
Lichen	Fern or fern ally
Other/unknown	Other shrub
Other herbaceous	Liverwort/hornwort

Species Name
Global scientific name (and common name) for each floristic component species of the community as it occurs rangewide.
Characteristic Species
Component plant species that are characteristic for the community type as it occurs rangewide.
Other Noteworthy Species
Other noteworthy species (i.e., species that are not necessarily diagnostic of the community, but that are worth noting for some other reasons, such as those that are rare species or exotic invasives) that are found within the community rangewide.
USFWS Wetland System
Systems developed for the classification of wetlands by the U.S. Fish and Wildlife Service to classify. System refers to a complex of wetlands and deepwater habitats that share the influence of similar hydrologic, geomorphic, chemical, or biological factors. As defined in Cowardin et al. (1979), the values are:

Marine - consists of open ocean overlying the continental shelf and its associated high-energy coastline.

Estuarine - consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land.

Riverine - includes all wetlands and deepwater habitats contained with a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5%.

Lacustrine - includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30% areal coverage; and (3) total area exceeds 8 ha (20 acres).

Palustrine - includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5%.

DISTRIBUTION

Range
A description of the total range (present and historic, if known) of the Association rangewide, using names of nations, subnations or states, ecoregions, etc.
States/Provinces
The two-letter postal codes for U.S. states and Canadian provinces in which the Association occurs. Mexican two-letter state abbreviations are preceded by "MX". When the occurrence of the Association in a state/province is uncertain, a ? is appended. The state code may be followed by the **State Rank** when known.

Federal Lands

List of federal lands where the Association occurs or is believed to occur. Names used are shortened versions of the official name of the Federal land unit with "National Park, National Forest," etc. dropped from the name. A ? indicates that presence is uncertain.
Federal Agency Abbreviations are:

BIA = Bureau of Indian Affairs
BLM = Bureau of Land Management
COE = U.S. Army Corps of Engineers
DOD = Department of Defense
DOE = Department of Energy
NPS = National Park Service
PC = Parks Canada
TVA = Tennessee Valley Authority
USFS = U.S. Forest Service
USFWS = U.S. Fish and Wildlife Service

CONSERVATION STATUS

Global Rank

The Heritage Conservation Status **Global Rank** which best characterizes the relative rarity or endangerment of the Association worldwide. Values for Global Rank are:

G1 = Critically imperiled globally = Generally 5 or fewer occurrences and/or very few remaining acres or very vulnerable to elimination throughout its range due to other factor(s)
G2 = Imperiled globally = Generally 6–20 occurrences and/or few remaining acres or very vulnerable to elimination throughout its range due to other factor(s)
G3 = Rare or uncommon = Generally 21–100 occurrences; either very rare and local throughout its range or found locally, even abundantly, within a restricted range or vulnerable to elimination throughout its range due to specific factor(s)
G4 = Widespread, abundant, and apparently secure, but with cause for long-term concern = Uncommon but not rare (although it may be quite rare in parts of its range, especially at the periphery); apparently not vulnerable in most of its range
G5 = Demonstrably widespread, abundant and secure = Common, widespread, and abundant (although it may be quite rare in parts of its range, especially at the periphery); not vulnerable in most of its range
G#G# = Numeric range rank (range no greater than 2) = Greater uncertainty about a rank is expressed by indicating the full range of ranks which may be appropriate; for example, a G1G3 rank indicates the rank could be G1, G2, or G3
GNR = Not yet ranked = Status has not yet been assessed
GNA = Rank not applicable
GH = Historical = Presumed eliminated throughout its range, with no or virtually no likelihood that it will be rediscovered, but with potential for restoration (e.g., *Castanea dentata* Forest)
GX = Extirpated = Eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species
GU = Unrankable = Status cannot be determined at this time

Qualifiers:
? = Inexact numeric rank = A question mark added to a rank expresses an uncertainty about the rank in the range of 1 in either way on the 1–5 scale; for example, a G2? rank indicates that the rank is thought to be G2, but could be G1 or G3 (Note: G1? and G5? are both valid ranks)
Q = Questionable taxonomy = A "Q" added to a rank denotes questionable taxonomy; it modifies the degree of imperilment and is only used in cases where the type would have a less imperiled rank if it were not recognized as a valid type (i.e., if it were combined with a more
common type); a GUQ rank often indicates that the type is unrankable because of daunting taxonomic questions.

For non-natural types, a **Global Rank** of **GNA** = **Rank not applicable** is assigned. They are further identified as one from the following:

Cultural - indicates that the Association is cultivated. Planted/cultivated areas are defined as being dominated by vegetation that has been planted in its current location by humans and/or is treated with annual tillage, a modified conservation tillage, or other intensive management or manipulation. The majority of these areas are planted and/or maintained for the production of food, feed, fiber, or seed.

Ruderal - indicates that the Association is considered ruderal. Ruderal communities are vegetation resulting from succession following anthropogenic disturbance of an area. They are generally characterized by unnatural combinations of species (primarily native species, though they often contain slight to substantial numbers and amounts of species alien to the region as well). In many landscapes, ruderal communities occupy large areas - sometimes more than any other category of communities - and can provide important biodiversity functions.

Modified/Managed - indicates that the Association is modified or managed. Modified/managed communities are vegetation resulting from the management or modification of natural/near-natural vegetation, but producing a structural and floristic combination not clearly known to have a natural analogue. Modified vegetation may be easily restorable by either management, time, or restoration of ecological processes. It is not yet clear how to deal with these communities in the IVC.

Invasive - indicates that the Association is weedy and invasive. Invasive communities are dominated by invasive alien species. Although these communities are often casually considered as "planted/cultivated," they are spontaneous, self-perpetuating, and not the (immediate) result of planting, cultivation, or human maintenance. Land occupied by invasive communities is generally permanently altered (converted) unless restoration efforts are undertaken. It is also important to recognize that these communities are novel; they are not merely a community "transplanted" from the native range of the dominant species. *Melaleuca* in south Florida, kudzu in the southeastern United States, tamarisk in the western United States, and red mangrove in Hawaii all form communities which have no equivalent in the native range of the dominant species (associated species, processes, landscape context, fauna, etc. are all significantly different).

Global Rank Date
The date the **Global Rank** was last ***reviewed*** (regardless of whether the rank was changed).
Global Rank Reasons
Reasons that the Heritage Conservation Status **Global Rank** for the Association was assigned, including key ranking variables and other considerations used.

CLASSIFICATION INFORMATION

Classification Status
The status of the Association in relation to the standard IVC.
Categories for Classification Status are:

Standard – the Association has been formally recognized, described, and accepted by NatureServe Central Ecology as a standard Association in the IVC.

Nonstandard – the Association has not been accepted by NatureServe Central Ecology as a standard Association (i.e., it does not follow the standard classification).

Provisional* – the Association is a candidate for acceptance into the standard classification but has not yet been comprehensively reviewed by Central Ecology.

Circumscription Confidence
The degree of confidence associated with the classification of the Association. This confidence is based on the quality and type of data used in the analysis, as well as the extent to which the entire (or potential) range of the Association was considered. Values for Circumscription Confidence are:

1 – Strong: Classification is based on quantitative analysis of verifiable, high-quality field data (species lists and associated environmental information) from plots that are published in full or are archived in a publicly accessible database. A sufficient number of high-quality plots covering the expected geographic distribution and habitat variability of the vegetation type, as well as plots from related types across the region, have been used in the analysis.

2 – Moderate: Classification is based either on quantitative analysis of a limited data set of high-quality, published/accessible plots and/or plots from only part of the geographic range, or on a more qualitative assessment of published/accessible field data of sufficient quantity and quality.

3 – Weak: Classification is based on limited, or unpublished/inaccessible plot data or insufficient analysis, anecdotal information, or community descriptions that are not accompanied by plot data. These types have often been identified by local experts. Although there is a high level of confidence that these types represent recognized vegetation entities, it is not known whether they would meet national standards for floristic types in concept or in classification approach if sufficient data were available.

Classification Comments
Comments about classification criteria used to define the Association, or to describe any remaining issues associated with the classification. Any potentially confusing relationships with other existing Associations should be indicated if there is a potential that further scrutiny may result in a change in the classification of the Association. Discussion of any atypical occurrences and why they are included in this Associationconcept may also be addressed. In addition, rationale for choosing nominal species that are not dominant and other comments about nominal species pertaining to the classification of the community should be included. Comments may explain confusion about the similarity between types that may not be distinguishable.

Similar Associations
The **Global Name** and **Elcode** of any closely related or apparently similar IVC association(s) which may be mistaken for this Association. They may be in the same or different Formation or Alliance. This includes only types whose classification is not at issue (e.g., two types have similar sounding names but are differentiated by the degree of canopy closure and lower frequency of associated light-requiring species). **Notes** regarding the relationship and/or distinction of each particular Similar Association may follow.

Related Concepts
Name used by agencies or other published or unpublished classification systems to describe community types that may be related to this Association. These might include Society of American Foresters (SAF) cover types, Kuchler PNV types, U.S. Fish and Wildlife Service (USFWS) wetland types, or other local or regional vegetation classifications. The **Other Community Name** is followed by the associated **Reference** and **Relationship**. The **Related Concept Reference** is the source reference for the **Related Concept**. **Relationship** indicates whether the type designated in **Other Community Name** is more, less, or equally inclusive of the IVC Association concept. Values for Relationship are:

B – Broader: the concept of the Other Community is broader than the Association concept
F – Finer: the concept of the Other Community is finer (more narrow) than the Association concept
I – Intersects: the concepts of the Other Community and the Association overlap (i.e., neither fully includes the other) and are related in a way that is more complex than a simple "broader/finer" relationship
= - Equivalent: concept designated in Other Community Name is equivalent to the Association concept
? – Unknown: the relationship of the Other Community to the Association has not been determined

SOURCES

Description Authors
Name(s) of the person(s) primarily responsible for authorship of the current version of the Association's *description* and *characterization* including descriptions in **Environment, Vegetation**, and **Dynamics**. The abbreviation mod. before a name indicates that modifications were subsequently made to the original description by the person(s) listed.

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Short citations of all references used in documenting the classification/concept and characterization of this Association.

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