National Park Service
U.S. Department of the Interior

Northeast Region
Philadelphia, Pennsylvania

# Vegetation Classification and Mapping at Colonial National Historical Park, Virginia

Technical Report NPS/NER/NRTR—2008/129



**ON THE COVER**
Upper left: Tidal Mesohaline and Polyhaline Marsh; photograph by Karen D. Patterson. Upper right: Tidal Bald Cypress Forest / Woodland. Lower left: Coastal Plain Loblolly Pine – Oak Forest. Lower right: Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash – Red Maple Type). Photographs by Gary P. Fleming.

# Vegetation Classification and Mapping at Colonial National Historical Park, Virginia

Technical Report NPS/NER/NRTR—2008/129

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June 2008

U.S. Department of the Interior
National Park Service
Northeast Region
Philadelphia, Pennsylvania

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## Summary

Accurate and up-to-date vegetation maps are recognized by the National Park Service (NPS) Inventory and Monitoring Program as one of twelve basic data sets for every national park with significant natural resources. The National Park Service (NPS) and the U.S. Geological Survey (USGS) have put forth standards and protocols for classification and mapping of vegetation communities on NPS lands. The USGS-NPS Vegetation Mapping Program recognizes the United States National Vegetation Classification (USNVC) as the standard vegetation classification to be used in these mapping projects.

Vegetation data collected from seven national parks in Virginia were combined with over 2,000 existing plot samples from throughout the Mid-Atlantic Piedmont and Coastal Plain and used to refine the USNVC for the mid-Atlantic region. This classification was used to map and describe the vegetation at the seven national parks in Virginia.

This report documents the classification and mapping of vegetation at Colonial National Historical Park. Forty map classes representing 31 USNVC associations, seven nonstandard, park-specific vegetation classes, and seven Anderson Level II land-use categories were used to map the 3,452-ha (8,529-ac) park. Vegetation map classes were determined through extensive field reconnaissance, data collection, and analysis. Leaf-off aerial photography from 2002 served as the base map, and field sampling was conducted from 2003–2005. Spatial data were digitized onscreen over digital orthophoto mosaics created from scanned color infrared, stereo pair 1:6,000 scale aerial photography using a 0.5 hectare minimum mapping unit.

The vegetation map for Colonial National Historical Park covers 3498 ha (8644 ac) in and around the park. Transitional vegetation covers 37.4% of the land in the park (1,308.4 ha [3,233.0 ac]). Cultural map classes cover 19.3% (676.6 ha [1671.9 ac]) of the park and include the Anderson land-use categories and other man-made or maintained areas in the park. Tidal wetlands account for approximately 16.3% (568.5 ha [1404.7 ac]) of the park, and nontidal wetlands cover 4.9% (171.9 ha [424.7 ac]). Open water accounts for 2% of the area on the vegetation map. The remaining 20.1% (702.5 ha [1,736.0 ac]) of the park land is mapped as later successional, upland forests.

A vegetation map of Colonial National Historical Park was created following the USGS-NPS Vegetation Mapping Program protocols. Vegetation map classes were crosswalked to the Natural Communities of Virginia and to the USNVC in order to provide a regional and global context for the park's vegetation. One hundred and eighty-three randomly selected accuracy assessment sampling points were collected throughout the park and used to assess the thematic accuracy of the map. The Kappa Index for the final vegetation map was 83.8 ± 4.7%, with an overall accuracy of 84.7%.

A field key to the vegetation classes, and detailed descriptions for map classes, or associations within a map class, were developed to assist with field recognition and classification. Additional products associated with this project include leaf-on and leaf-off orthophoto mosaics, a database of vegetation plot data and accuracy assessment data, digital photos of vegetation associations,

and spatial data files for the vegetation map, plot sample points, and accuracy assessment sample points with associated Federal Geographic Data Committee (FGDC)-compliant metadata.

Products for Colonial National Historical Park and similar national park vegetation mapping projects can be accessed at the USGS-NPS Vegetation Mapping Program website: http://biology.usgs.gov/npsveg/.

Keywords: vegetation association, vegetation classification, vegetation mapping, Colonial National Historical Park.

# Introduction

## General Background

Effective management of natural resources in our national parks depends on park managers having access to comprehensive, scientifically credible information on species and habitats found in their parks. Accurate and up-to-date vegetation maps can form the foundation for resource management activities in the national parks and are recognized by the National Park Service (NPS) Inventory and Monitoring Program as one of twelve basic data sets for every park with significant natural resources (NPS 2003). Activities as diverse as park planning, fire management, wildlife research, habitat conservation/restoration, and visitor interpretation all can be informed by current maps of vegetation distribution. Additionally, a vegetation map attributed to a standard, nationally used classification system provides a way to assess how an individual park's biodiversity fits into the context of the entire region.

Since the early 1990's, the National Park Service and the U.S. Geological Survey (USGS) have worked cooperatively to classify, describe, and map vegetation communities in more than 250 national parks across the United States. At its inception, the USGS-NPS Vegetation Mapping Program (USGS-NPS VMP) put forth standards and protocols for classification and mapping of vegetation communities on NPS lands. These standards are outlined in four documents written by The Nature Conservancy and Environmental Systems Research Institute (TNC and ESRI 1994a, b, c, d) and available at http://biology.usgs.gov/npsveg/standards.html.

Products produced as part of the USGS-NPS VMP must meet Federal Geographic Data Committee (FGDC) standards for vegetation classification and metadata, and national standards for spatial accuracy and data transfer. Standard spatial data products include aerial photography, map classification, a spatial database of vegetation communities, hardcopy maps of vegetation communities, metadata for spatial databases, and a 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. Mapping standards include a minimum mapping unit of 0.5 hectares (ha) and classification accuracy of 80% for each map class. The spatial databases are required to have a horizontal positional accuracy that meets National Map Accuracy Standards at the 1:24,000 scale. This means that each well-defined object in the spatial database will be within 1/50 of an inch of its actual location on the map or 12.2 m (40 ft) on the ground.

The FGDC standard for vegetation classification is the United States National Vegetation Classification (USNVC). Over the past twenty years, the USNVC has been developed and implemented by The Nature Conservancy (TNC), the network of Natural Heritage Programs, and more recently, NatureServe. The USNVC is a subset of the larger International Vegetation Classification (IVC). In North America, the IVC consists of the U.S. National Vegetation Classification (USNVC) and the Canadian National Vegetation Classification (CNVC). The IVC has also been developed for the Caribbean region. Further developments are under way through various Latin American projects.

The USNVC is currently maintained and updated by NatureServe. Additional support has come from federal agencies, the FGDC, and the Ecological Society of America. Refinements to the classification occur in the process of application, leading to ongoing proposed revisions that are reviewed both locally and nationally. A two volume publication (Grossman et al. 1998) presenting the standardized classification, and providing a thorough introduction to the classification, its structure, and the list of vegetation types found across the United States as of April 1997 can be found on the Internet at: http://www.NatureServe.org/publications/library.jsp. Volume II of this publication (the classification listing) has been superceded by the online database server, NatureServe Explorer®, http://www.NatureServe.org/explorer[1], which provides regular updates to ecological communities in the United States and Canada.

The USNVC is a hierarchical system that classifies vegetation using physiognomic (structural) 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 perspectives (The Nature Conservancy and Environmental Systems Research Institute 1994a; 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 (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, forestry plantations, 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 (Table 1). The basic 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 physiognomic portion of the classification is based upon the United Nations Educational, Scientific, and Cultural Organization world physiognomic classification of vegetation, which was modified to provide greater consistency at all hierarchical levels and to include additional types (UNESCO 1973).

The floristic levels include alliances and associations. The alliance is a physiognomically uniform group of plant associations that share dominant or diagnostic species, usually found in the uppermost strata of the vegetation. The association is the finest level of the USNVC. An association is defined as a plant community type that is relatively homogeneous in composition and structure and occurs in a uniform habitat. For example, Mid-Atlantic Mesic Mixed Hardwood Forest (*Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / (Ilex opaca* var. *opaca) / Polystichum acrostichoides* Forest) is a common forest type on well drained, acidic midslopes in the Piedmont and Coastal Plain of Virginia. Associations are also assigned global rarity ranks that indicate their conservation status and relative risk of extirpation (Grossman et al. 1998). Associations from the USNVC are cross-referenced to communities in

[1] As of this writing, cultural, early successional / ruderal, and exotic (i.e. nonnative plot species) dominated vegetation units defined in the USNVC are not served on NatureServe Explorer. Additional information on these types can be obtained from a NatureServe regional or national vegetation ecologist.

Table 1. United States National Vegetation Classification System physiognomic-floristic hierarchy for terrestrial vegetation (from Grossman et al. 1998).

| Level | Primary Basis For Classification | Example |
|---|---|---|
| Class | Growth form and structure of vegetation | Forest |
| Subclass | Growth form characteristics (e.g., leaf phenology) | Deciduous forest |
| Group | Leaf types, corresponding to climate | Cold-deciduous forest |
| Subgroup | Relative human impact (natural/semi-natural or cultural) | Natural/semi-natural |
| Formation | Additional physiognomic and environmental factors, including hydrology | Lowland or submontane cold-deciduous forest |
| Alliance | Dominant/diagnostic species of uppermost or dominant stratum | White Oak - (Northern Red Oak, Hickory species) Forest Alliance |
| Association | Additional dominant/diagnostic species from any strata | Northern Red Oak / Umbrella Magnolia - Eastern Redbud / Black Cohosh - Heartleaf Foamflower Forest |

state-specific vegetation classifications such as the Natural Communities of Virginia (Fleming et al. 2006), as well as to other regional and national classification systems.

In 2001, the Northeast Region of NPS contracted separately with the Virginia Department of Conservation and Recreation, Division of Natural Heritage (VADNH), NatureServe, and North Carolina State University's Center for Earth Observation (NCSU-CEO) to apply the USGS-NPS VMP standards to the vegetation in seven NPS units in Virginia. These parks are within two NPS Inventory and Monitoring networks: the Mid-Atlantic Network and the Northeast Coastal and Barrier Network.

The goal of the study was to accurately map and classify, at least to the alliance level of the USNVC, the vegetation in Appomattox Court House National Historical Park, Booker T. Washington National Monument, Colonial National Historical Park, Fredericksburg and Spotsylvania National Military Park, George Washington Birthplace National Monument, Petersburg National Battlefield, and Richmond National Battlefield Park. The classification used to map these parks was developed regionally, using quantitative data that was collected from all seven parks and combined with existing data from throughout the Mid-Atlantic Piedmont and Coastal Plain.

The goal of the mapping effort at Colonial National Historical Park was to produce an up-to-date digital geospatial vegetation database for the park and to provide a plant species list, a dichotomous key to the vegetation, and descriptions of the vegetation communities in the park. Baseline information on plant community composition and rarity is critical to developing desired conditions and park management goals relating to native plant communities, nonnative plant and insect species, and effects of deer browse and other disturbances. Identification and description of plant communities also provide habitat information important to understanding associated

organisms, including animals, protozoa, bacteria, and fungi. A vegetation map can also allow inferences about the location and abundance of species that are characteristic of each community. This report also describes the park's vegetation in the context of a national and regional vegetation classification, the USNVC. Having the park's vegetation mapped and attributed to this standard will facilitate the comparison of vegetation types among other NPS units in the region and throughout the United States.

The success of this study depended on cooperative efforts of several government and private entities. VADNH and NatureServe worked cooperatively to develop the vegetation classification, the vegetation descriptions, and field keys to the vegetation classes, and to ensure that the vegetation units were properly crosswalked to the USNVC. NCSU-CEO produced the photo mosaics, assessed their positional accuracy, and developed preliminary vegetation maps. VADNH took lead responsibility for field validation of the preliminary maps, editing the vegetation maps and labeling features with USNVC units, vegetation data collection and analysis, thematic accuracy assessment, and writing the final reports. The Northeast Region of NPS funded the project and provided technical specifications and guidance.

Park-specific Information

Colonial National Historical Park is located in eastern Virginia, between the James and York rivers, 72 km (45 mi) southeast of the City of Richmond. The 3452 ha (8529 ac) park is spread out over three counties and the City of Williamsburg (Figure 1). Established in 1930, Colonial National Historical Park preserves the historic resources of Yorktown Battlefield, scene of the culminating battle of the American Revolution in 1781, and Jamestown Island, the site of the first permanent English settlement in North America. The Colonial Parkway, a 24 mile scenic road, links Yorktown Battlefield with Jamestown Island, passing through the City of Williamsburg. Along the Colonial Parkway are park holdings such as picnic areas (many have been closed to visitor use) and overlook sites. In addition, the park maintains two land holdings not directly connected to the Colonial Parkway. Green Springs is about 4.6 km (3 mi) northwest of Jamestown Island in James City County. Swanns Point is located across the James River about 2.4 km (1.5 mi) southwest of Jamestown Island in Surry County. Colonial National Historical Park provides a resource for interpretation of history from pre-colonial settlement through the American Civil War, as well as numerous opportunities for outdoor recreation. In 2007 over 3.3 million people visited Colonial National Historical Park.

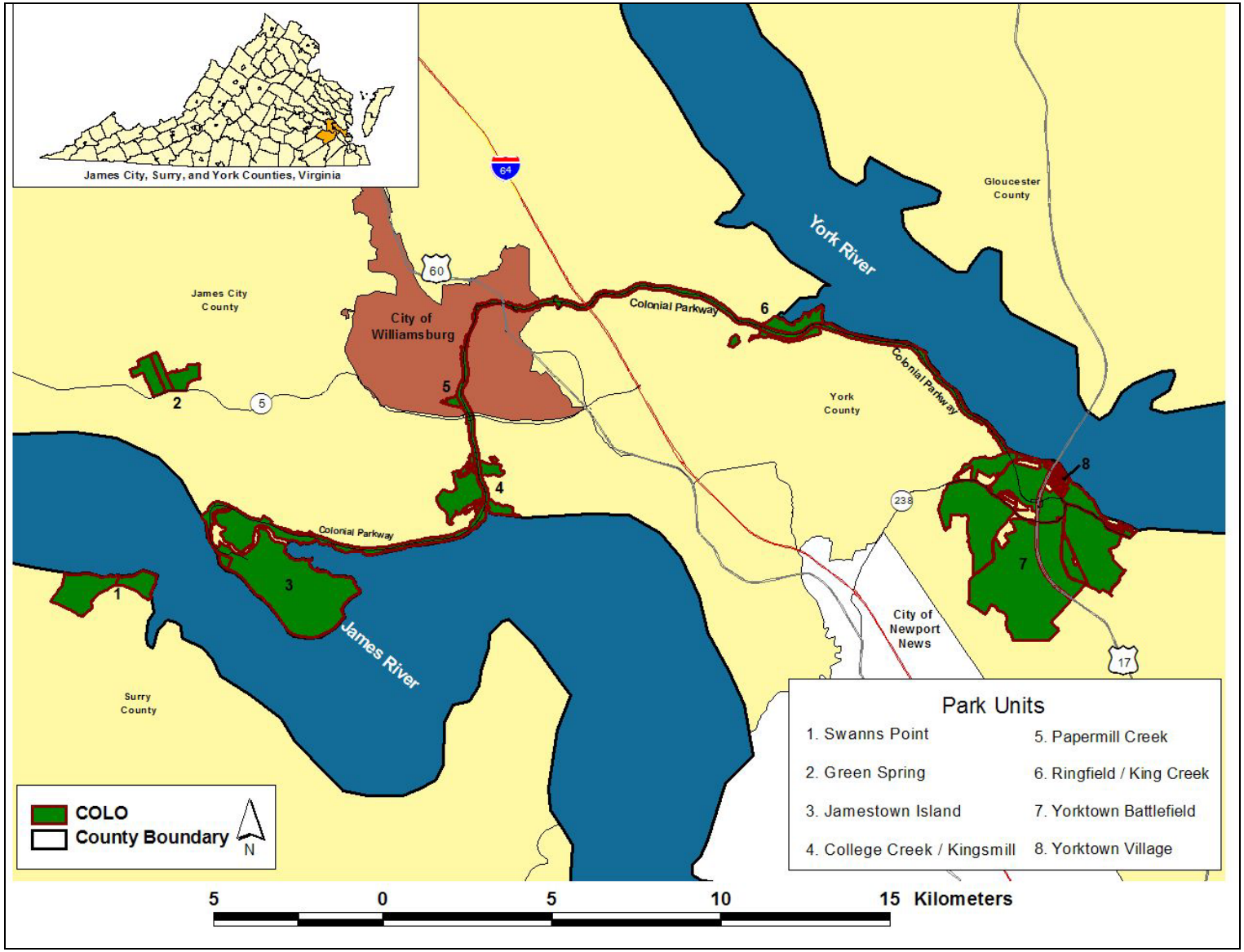



Figure 1. Location of Colonial National Historical Park (COLO), Virginia.

# Project Area

## Location and Regional Setting

Colonial National Historical Park is located in the middle of Virginia's Coastal Plain (Figure 2). This region is also known as the "The Peninsula" or the "Lower Peninsula", one of three prominent peninsulas formed as four large tidal rivers dissect the Coastal Plain, draining into the Chesapeake Bay. The Lower Peninsula is bounded by the York River to the north, the Chesapeake Bay to the east, and the James River to the south. The park boundaries fall within seven USGS quadrangle maps: Clay Bank, Hog Island, Norge, Poquoson West, Surry, Williamsburg, and Yorktown (Figure 3). The majority of the park is in a portion of the Coastal Plain known as the Atlantic Southern Loam Hills subsection that is characterized by smooth plains ranging from 30 to 91 m (100 to 300 ft) (Keys et al. 1995). Jamestown Island is in the Chesapeake Bay subsection of the Atlantic Coastal Flatwoods section, and the eastern portion of Yorktown is in the Tidal Area subsection of the Atlantic Coastal Flatwoods section, an area of flat plains with elevations ranging from 0–30 m (0–100 ft) (Keys et al. 1995.) Historical climate data from Williamsburg, Virginia (37°18'N / 76°42'W) from the years 1948 through 2007 report the mean monthly minimum temperature as 8.6º C (47.5º F), and the mean monthly maximum temperature is 21.0º C (69.9º F). The mean January minimum temperature is –2.0º C (28.3º F), and the mean July maximum temperature is 31.4º C (88.5º F). Annual precipitation averages 102.9 cm (47.63 in), with snowfall of 18.3 cm (7.2 in) (Southeast Regional Climate Center 2008).

The upland forests that originally covered much of Virginia's Coastal Plain have been extensively cleared or altered, so that it is now difficult to determine which species and natural communities were historically prevalent. Much of the contemporary forest consists of successional or silvicultural stands of loblolly pine (*Pinus taeda*) and secondary pine-hardwood forests that have developed after repeated cutting or agricultural abandonment. The most mature remnant stands on mesic uplands are characterized by associations of American beech (*Fagus grandifolia*), several oaks (*Quercus* spp.), and American holly (*Ilex opaca* var. *opaca*), representing what once was the common, matrix-forming forest type in region. Patches of drier oak-dominated forest and steep bluffs with forests of chestnut oak (*Quercus prinus*), American beech, and dense mountain laurel (*Kalmia latifolia*) are fairly common in the dissected inner Coastal Plain, especially north of the James River. South of the James River, fire-maintained forests and woodlands dominated by longleaf pine (*Pinus palustris*) may have been prevalent prior to European settlement (Frost 1995), but little trace of these now remain. The Coastal Plain also supports terrestrial communities that are restricted to special habitats on ravine slopes and estuarine-fronting bluffs that have down-cut into Tertiary shell deposits or limesands. Soils of these forests and woodlands have extraordinarily high levels of calcium and support a number of inland, calciphilic species that are disjunct from the mountains. Wetlands of the Coastal Plain are extensive and have fared somewhat better than the province's upland forests, supporting a great variety of natural communities. The diversity of wetlands in this region spans a range of freshwater to saline, lunar-tidal estuaries; tidal and palustrine swamps; nonriverine, groundwater-saturated flats; seasonally flooded ponds and depressions; seepage slope wetlands; and various tidal and non-tidal aquatic habitats.

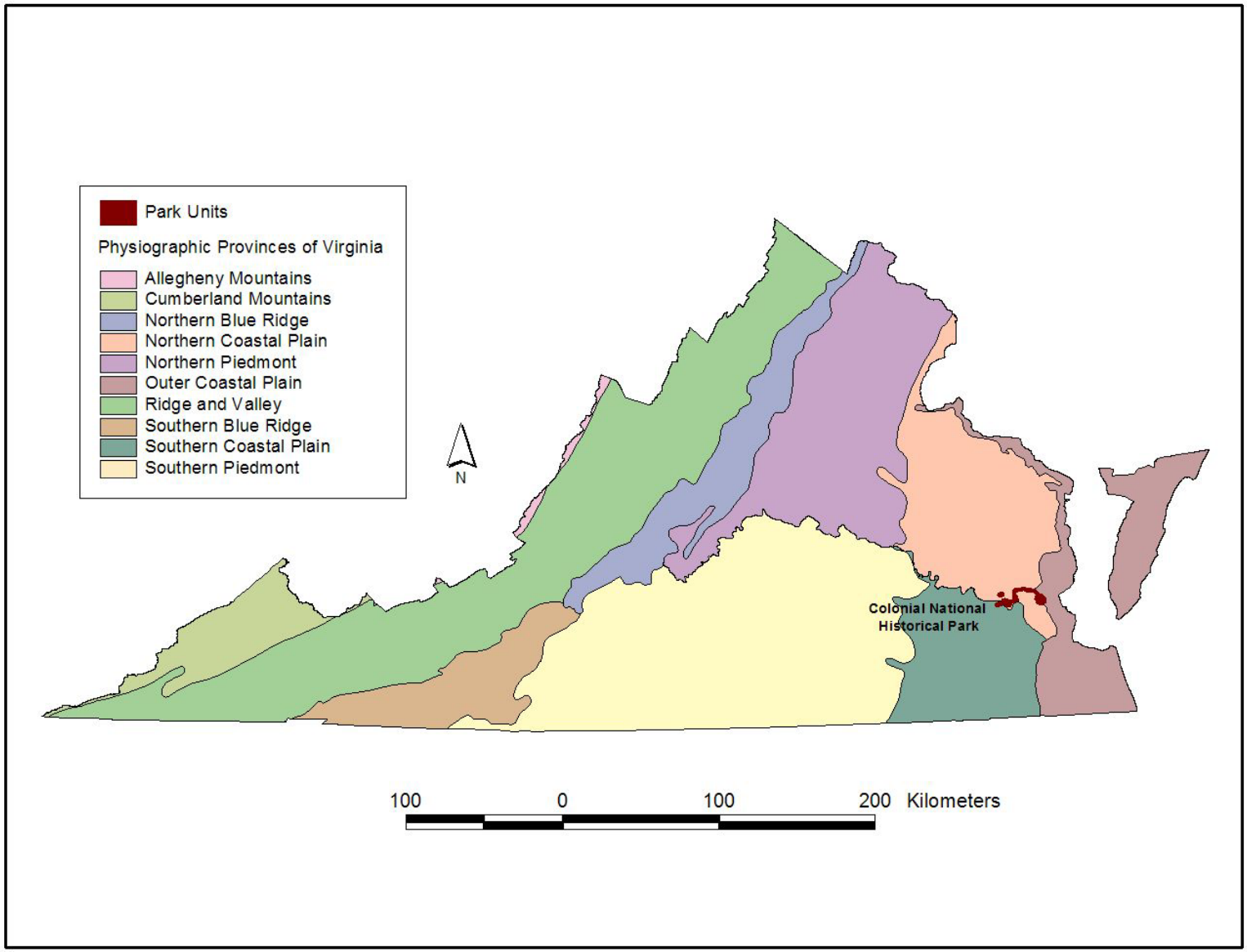



Figure 2. Physiographic provinces of Virginia showing the location of Colonial National Historical Park.

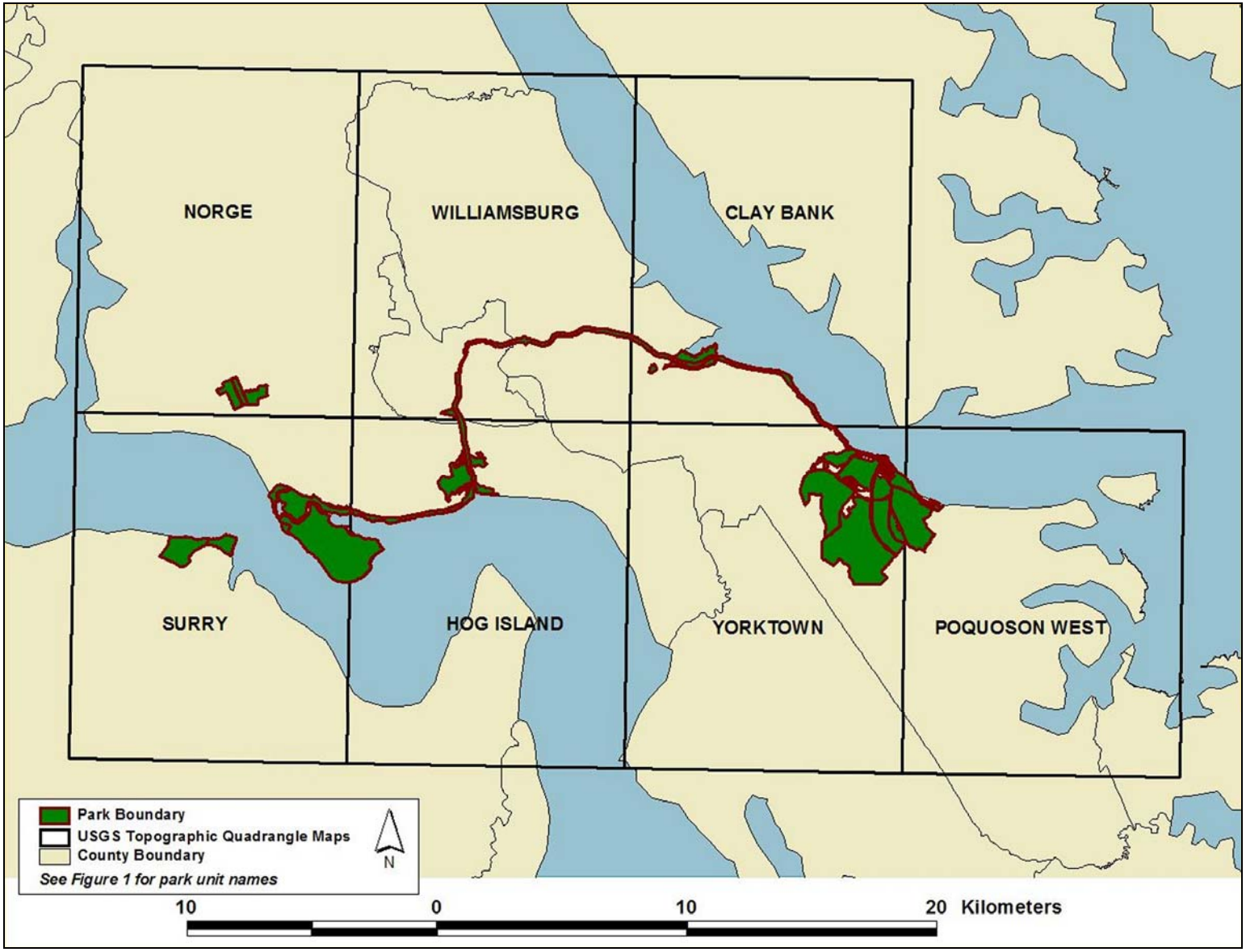



Figure 3. Location of Colonial National Historical Park (COLO), Virginia, on seven 1:24000 USGS topographic quadrangle maps.

## Park Environmental Attributes

Many environmental factors, such as geology, soils, hydrology and topography, affect the types and distribution of vegetation within Colonial National Historical Park. The majority of the park is underlain by six geologic units representing ancient marine and fluvial-estuarine deposits of sands, silts, and clays: Bacons Castle Formation, Chesapeake Group, Chuckatuck Formation, Shirley Formation, Tabb Formation (Sedgefield member), and the Winsor Formation (Virginia Division of Mineral Resources 1993). Some marine formations contain strata rich in fossilized shells, which are locally exposed on the park's steep slopes and have a pronounced influence on soil chemistry and vegetation composition.

Two different soil surveys cover Colonial National Historical Park. The Soil Survey Geographic (SSURGO) databases for James City and York counties and the City of Williamsburg, Virginia (USDA, NRCS 2007a), and for Surry County, Virginia (USDA, NRCS 2007b) map 37 unique soil series within the boundary of Colonial National Historical Park.

The soils in the park are primarily ultisols (57%), entisols (25%), and inceptisols (13%), with small areas mapped as alfisols and histosols. The upland soils of the park are deep, well-drained to moderately well-drained soils that formed in interbedded layers of loamy and clayey fluvial or marine Coastal Plain sediments. These soils are typically very strongly to extremely acid in reaction (pH values less than 5.0). Common soils on upland terraces, ridges, and side slopes in the park include the series Emporia, Craven, Slagle, and Uchee, or complexes of these soil series (all ultisols). Thirteen soil series are mapped on well-drained to somewhat poorly drained stream terraces in the park; the most common of these are State, Tetotum, Peawick, Dogue, Newflat (all ultisols), and Pamunkey (an alfisol). These soils are not considered hydric, but are found on low-lying stream terraces often associated with wetland vegetation. Hydric soils are mapped on 18% of the park. Hydric soil is a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper portion. Soils along creeks and rivers in tidal marshes that are inundated twice daily by saline, brackish, or freshwater are very poorly drained entisols of the series Axis, Bohicket, Lawnes, and Levey. Poorly drained to very poorly drained soils of non-tidal floodplains, swamps, and bottomlands are mapped as Chickahominy (ultisol), Johnston (inceptisol), Nawney (entisol), and Matten (histosol) series. The Bethera series (an ultisol) is mapped on wet upland flats and depressions not associated with streams. Alluvial beach deposits occur along the James and York rivers.

Colonial National Historical Park lies within the James River drainage basin, except for the very northern portion of Yorktown Battlefield and the Colonial Parkway from Yorktown to Williamsburg, which lie in the Lower York River watershed. More than 48 km (30 mi) of shoreline along the James and York rivers bounds Colonial National Historical Park and approximately 38 km (24 mi) of perennial streams and 48 km (30 mi) of intermittent streams flow through the park. The entire park has a direct hydrological link to the Chesapeake Bay. Numerous streams, creeks, and ponds with major portions of their drainage basin upstream and outside of park boundaries flow through the park and feed directly into the York River or James River. As freshwater tributaries flow through the park and approach the James and York rivers, they become tidally influenced, estuarine waters, and many support large estuarine wetlands. Major tributaries that flow through the park into the York River include Felgates Creek, Indian

Field Creek, King Creek, West Branch Wormley, and Yorktown Creek. Tributaries that flow through the park into the James River include Baptist Run Creek, Beaver Dam Creek, Black Duck Gut, College Creek, Great Run Creek, Half-Way Creek, Passamore Creek, and Powhatan Creek. The park has several large freshwater and brackish ponds formed by impoundments, including Bracken's Pond, Jones Mill Pond, and Wormley Pond. A freshwater spring and a small creek are found at Green Spring and a series of springs and seeps originate on Yorktown Battlefield. Numerous sinkholes that hold water for a portion of the year occur in the Yorktown Battlefield and along the Colonial Parkway between Yorktown and College creeks. These features have formed over the past several hundred thousand years due to the dissolution of the underlying carbonate-rich shell marl deposits.

Topographic relief in the park is typical for the Coastal Plain, where broad uplands are gently dissected by streams. Locally, the relief can be quite rugged where short, high gradient streams have incised steep ravine systems. Elevations range from sea level along the York and James rivers and along tidal tributaries, to 27 m (90 ft) at Swanns Point on the south slopes over the James River.

# Methods

## Project Scoping and Planning

In early 2001, the Northeast Region of the National Park Service approached VADNH to help develop a vegetation classification and maps for seven NPS units in the Piedmont and Coastal Plain of Virginia (Appomattox Court House National Historical Park, Booker T. Washington National Monument, Colonial National Historical Park, Fredericksburg and Spotsylvania National Military Park, George Washington Birthplace National Monument, Petersburg National Battlefield, and Richmond National Battlefield Park). Later that year a meeting was convened with representatives from the NPS Northeast Region Inventory and Monitoring Program, NatureServe (then the Association of Biodiversity Information), NCSU-CEO, and VADNH to identify the scope of the project and clarify roles and responsibilities.

The three entities and the NPS worked cooperatively to develop accurate vegetation maps and a regional vegetation classification to apply to the vegetation of all seven parks. Ecologists at VADNH took the primary role in field data collection, data analysis, regional classification development, map editing, and accuracy assessment. They developed the local association descriptions, finalized the field key to vegetation classes, and wrote the final reports. NatureServe reviewed the vegetation classification developed by VADNH and ensured that the USNVC standard was followed. They also took responsibility for entering all new information into the USNVC databases and completed global association descriptions. They developed the draft field key to the vegetation classes, and provided in-the-field consultation on problematic vegetation types. Researchers at NCSU-CEO were responsible for aerial photography acquisition and processing, and preliminary photo interpretation. They also wrote the corresponding sections of the final reports.

## Preliminary Data Collection and Review of Existing Information

Previous studies conducted at Colonial National Historical Park were reviewed for information pertinent to the park's vegetation. These studies included a series of tidal marsh inventories by the Virginia Institute of Marine Sciences (Silberhorn 1974, Moore 1980, Moore 1981) and various inventories by VADNH (Ludwig et al. 1993, VanAlstine et al. 2001, Weber and Coulling 2002). Existing aerial photography (Virginia Geographic Information Network 2002), topographic maps, digital raster graphics (DRGs), National Wetland Inventory maps, the soil surveys for James City, Surry, and York counties, Virginia, and digital soil survey data (SSURGO) were gathered for use in planning fieldwork and to use as ancillary data layers. Additional spatial data was acquired from the park including a layer depicting an exotic species inventory (Gounaris and Grubbs 2000), locations of sinkhole ponds, and a vegetation coverage for Jamestown Island (Weber and Coulling 2002). Vegetation plot data collected during previous VADNH inventories in the park were reviewed prior to planning fieldwork. A preliminary classification of vegetation in Virginia's Piedmont and inner Coastal Plain (Fleming 2001) was used to develop a list of vegetation associations likely to occur in the park. Lists of the USNVC formations and alliances likely to occur in the park were generated from NatureServe databases.

## Aerial Photography Acquisition and Processing

Two sets of digital orthophoto mosaics, leaf-on (fall) and leaf-off (spring), were created for Colonial National Historical Park. To achieve manageable file sizes, each set is made up of five files that, together, cover the entire geographic extent of the park. Kucera International acquired color infrared, stereo pair 1:6,000 scale aerial photography for the leaf-on mosaics on October 26, 2001 and, for the leaf-off mosaics on March 1, 2002. The photography was delivered to the National Park Service (NPS), quality checked, accepted as provided, and sent to NCSU-CEO. Upon receipt at NCSU-CEO, the air photos were counted to make sure that none were missing, scanned and saved in .tif format, and placed in the air photo archive maintained at NCSU-CEO for the NPS Northeast Region Inventory and Monitoring Program. Associated data and information provided by Kucera International, and also stored in the air photo archive, include the airborne global positioning system (GPS) and inertial mapping unit (IMU) data files, the camera calibration certificates for the cameras, and the hardcopy flight reports for the photography that crosswalk the airborne GPS and IMU data to the photo frame numbers.

The leaf-on and leaf-off mosaics were produced from 328 and 280 color infrared air photos, respectively, scanned at 600 dpi with 24-bit color depth. For each of the ten mosaics (five leaf-on and five leaf-off), scanned .tif images of the relevant air photos were imported into ERDAS Imagine (.img) format where a photo block was created using airborne GPS and IMU data that Kucera International supplied with the aerial photography. Each photo block was manipulated until it could be triangulated with a root mean square error of less than 1. At this point, single frame orthophotos (one for each air photo) were generated within Imagine and exported to Imagine .lan format. Then the .lan files were imported into ER Mapper's native (.ers) format, and an ER Mapper algorithm was created which contains the color balancing information and the cutlines created for each of the final mosaics. In ER Mapper, band interleaved by line (.bil) image and header files for each mosaic were generated, the .bil images were imported into Imagine .img format, and, finally, the .img images were compressed using MrSID software with a 20:1 compression ratio. The final mosaics, in both .img and MrSID formats, are stored in the NCSU-CEO data archive.

## Preliminary Photointerpretation

A preliminary vegetation dataset for Colonial National Historical Park was created by interpreting the digital orthophoto mosaics to delineate vegetation polygons to the formation level defined in the USNVC (FGDC 1997, Grossman, et al. 1998). To create the formation level vegetation database, a photo interpreter, viewing the leaf-off and leaf-on mosaics in two dimensions, delineated visible areas of homogenous vegetation, land cover, and land use using ArcMap's onscreen digitizing tools. The minimum mapping unit was 0.5 hectares (1.25 acres); however, the photo interpreter was able to delineate polygons as small as 0.2 hectares (0.5 acres). After polygons were delineated for the entire park area, the photo interpreter created and populated three fields in the attribute table, entering a unique polygon identification number, the formation-level vegetation class or land use/land cover code, and notes if the interpreter was unsure of the appropriate code or could not assign a code. In accordance with USGS-NPS VMP protocols, the Level II land use and land cover classification system developed by Anderson, et al. (1976) was used to attribute urban and water dominated land covers (USGS 1994). In addition, user-defined codes were used to attribute agricultural and beach areas. Next, the photo

interpreter examined each polygon in three dimensions using ERDAS Imagine's Stereo Analyst software, checked the vegetation class code entered in the attribute table, and entered a corrected vegetation class code if appropriate. The final formation-level vegetation database is archived in ESRI shapefile and geodatabase formats in the NCSU-CEO data archive.

Field Data Collection

Leaf-on and leaf-off photomosaics and the formation-level line work were obtained from NCSU-CEO in May 2004. Ecologists from VADNH conducted field data collection in Colonial National Historical Park in May and June 2003, June through September 2004, and April and May 2005. The objectives of the fieldwork were to evaluate the formation-level line work and to collect information to help attribute and edit the line work to reflect the alliance level of the USNVC. Additionally, detailed quantitative data from the least disturbed areas of the park were needed to augment data available for a regional vegetation classification.

The evaluation and editing of the line work required extensive field reconnaissance throughout the park. Ecologists navigated to vegetation polygons represented on the formation-level map using a GarminMap76S GPS. Once within the target polygon, qualitative observations were made that described any variation of vegetation or environment within the polygon. The dominant vegetation class and any inclusion communities were noted following Fleming (2001). Dominant and characteristic vascular plant species were listed by strata with an indication of their prevalence in the stand (i.e. dominant, common, or rare). When possible, the entire polygon was traversed and additional GPS points were collected to mark significant vegetation change within a polygon. Only areas within the park boundary were surveyed.

Additional detailed quantitative data were collected only in the highest quality stands of floristically and structurally homogeneous vegetation. These were middle-to-late successional stands with a composition of mostly native species and with a consistent environmental setting. Within these areas, specific plot locations were chosen subjectively in order to distribute plots across a range of site conditions and to capture vegetation types that were relatively dominant, homogenous, and covered at least the minimum mapping unit area of 0.5 ha (1.24 ac). An attempt was made to find at least one undisturbed sampling location for each mid-to-late successional community type in the park. Early-successional forests and heavily disturbed areas within the park were not sampled using quantitative methods. These areas are spatially, temporally, and compositionally dynamic. Since their floristics are often in flux and subject to stochastic factors, groups of plots of heavily modified vegetation (even groups dominated by the same species) usually lack the compositional consistency to allow for ecologically meaningful patterns to be found using quantitative data analysis. Thus, sample plots from these types often perform as statistical outliers in quantitative analyses and frequently fail to aggregate into convincing groups by accepted statistical standards. Instead, qualitative data collected from vegetation polygons were used to describe and map early-successional forests and heavily disturbed areas within the park.

In order to be maximally compatible with existing regional plot data, plots were sampled using the relevé method (sensu Peet et al. 1998), following standard procedures employed by VADNH and modified slightly to accommodate entry into the PLOTS database (NatureServe 2004). As a rule, 100 $m^2$ plots with 10 x 10 m, or 5 x 20 m configurations were used to sample shrubland or

herbaceous vegetation and 400 $m^2$ plots were used to sample forested vegetation. The configuration of the plot was flexible (e.g. 20 x 20 m, 16 x 25m, 13.33 x 30 m, 10 x 40 m) to accommodate special site conditions and vegetation pattern. If a forest had particularly large diameter trees or a diverse canopy composition, a 1000 $m^2$ plot (20 x 50m) was used to fully capture tree species composition.

Within each plot, the percent cover of each vascular plant taxon was visually estimated as a vertical projection of above-ground biomass onto the full plot area and assigned to one of nine numerical cover classes (Table 2). In addition to this total cover value, cover was estimated for each species in the following height/lifeform classes:

- herb (field) layer (all herbaceous plants, woody plants <0.5 m)
- short shrub layer (woody plants 0.5 to 1 m)
- tall shrub layer, >1 to 6 m
- tree layer, >6 to 10 m
- tree layer, >10 to 20 m
- tree layer, >20 to 35 m
- tree layer, >35 m

The overall cover of mosses, lichens, and liverworts was estimated, but the individual cover of non-vascular taxa was not estimated. The cover of vines climbing into the canopy or subcanopy was recorded in the maximum height stratum attained by the plant. Vascular plants thought to be characteristic of the sampled community, but located outside the plot, were recorded parenthetically if visible from the boundary, and assigned a cover class of 1.

Additional vegetation information collected included the estimated height and total vegetative coverage of each stratum, the leaf type and leaf phenology of each stratum, and the physiognomic class represented by the stand. The maximum canopy height was measured using a clinometer.

Table 2. Cover-class scores used in field sampling and data analysis.

| Cover Class | Percent Cover Range | Area of Coverage for a 400 $m^2$ plot | Cover Class Percent Cover Midpoint |
|---|---|---|---|
| 1 | <0.1% | <20 $cm^2$ | 0.05% |
| 2 | 0.1–1% | 20 $cm^2$–4 $m^2$ | 0.55% |
| 3 | 1–2% | 4–8 $m^2$ | 1.50% |
| 4 | 2–5% | 8–20 $m^2$ | 3.50% |
| 5 | 5–10% | 20–40 $m^2$ | 7.50% |
| 6 | 10–25% | 40–100 $m^2$ | 17.50% |
| 7 | 25–50% | 100–200 $m^2$ | 37.50% |
| 8 | 50–75% | 200–300 $m^2$ | 62.50% |
| 9 | 75–100% | 300–400 $m^2$ | 87.50% |

A standard set of environmental data was measured or estimated at each plot (Table 3). Slope inclination was measured with a clinometer, and slope direction (aspect) was evaluated using a compass. Both measurements were taken to the nearest degree from the plot center. In plots with variable microtopography, slope was measured at several points and averaged. The percent cover of different surface substrates was estimated visually, with precision varying such that values sum to 100%. Topographic position, slope shape (both horizontally and vertically), soil drainage class, soil moisture regime, and inundation were assessed using scalar values. Landform was assessed at the landscape level using a topographic map and assigned to values from a standard landform classification (Driscoll et al. 1984). When conditions permitted, a digital photo was taken of each sampling location. Each vegetation sample was georeferenced using a GarminMap76s global positioning system (GPS), when possible. If a satellite reading could not be obtained, UTM coordinates were derived from the estimated position on a topographic quadrangle map. Elevation was also derived from the position on a topographic quadrangle map.

When possible, soil samples were collected from the top 10 cm (4 in) of mineral soil (below the surficial litter and humus). Depth of surface duff, soil color, and texture were evaluated in the field and recorded on the plot forms.

Evidence of any past or ongoing vegetation disturbance was carefully recorded at each sampling site. Other information was recorded in the form of a narrative qualitative assessment and notes. This narrative could include information concerning landscape context, estimated size of stand, hydrologic condition, approximate distance and direction to proximate water sources, spatial variation of vegetation pattern, or any other unusual features of the vegetation.

The plot survey form used to collect quantitative vegetation samples is provided in Appendix A.

All field data for quantitative vegetation samples were entered into the PLOTS database version 2.0 (NatureServe 2004) and are provided as a supplement to this report. Plot data collected in the park as part of previous studies from May 1997 through October 2001, using the same field methodology as in the current study, were also entered into the PLOTS database. Nomenclature follows the PLANTS 3.5 Database developed by the Natural Resource Conservation Service in cooperation with the Biota of North America Program (United States Department of Agriculture, National Resources Conservation Service 2004).

In the context of this report, a nonnative species (sometimes referred to as an exotic or alien species) is a species that is not thought to be a native component of Virginia's flora (Townsend 2007). Native species are those that occur in the region in which they evolved, changing over time in response to physical and biotic processes characteristic of a region. Plants that exhibit invasive tendencies and threaten rare native plants and natural communities are referred to as invasive. For this report, invasive nonnative plant species include those on the VADNH list of Invasive Exotic Plant Species in Virginia (Heffernan et al. 2001, VADCR 2003).

Table 3. Topographic / hydrologic environmental data recorded at each plot sample location.

| | |
|---|---|
| **Topographic Position:**<br>crest<br>upper slope<br>middle slope<br>lower slope<br>toe slope<br>plain/level/bottom<br>basin/depression | **Soil Drainage Class:**<br>very poorly drained<br>poorly drained<br>somewhat poorly drained<br>moderately well drained<br>well drained<br>rapidly drained |
| **Surface Substrate (% cover):**<br>bedrock<br>boulders and stones<br>gravel and cobbles<br>litter / organic matter<br>decaying wood<br>water<br>mineral soil / sand<br>other | **Inundation:**<br>never<br>infrequently<br>regularly; for < 6 months<br>regularly; for > 6 months<br>always submerged by shallow water (< 30cm)<br>always submerged by deep water (>30 cm) |
| **Measured Aspect (degrees)** | **Soil Moisture Regime:**<br>very xeric (moist for negligible time after precipitation)<br>xeric (moist for brief time)<br>somewhat xeric (moist for short time)<br>submesic (moist for moderately short time)<br>mesic (moist for significant time)<br>subhygric (wet for significant part of growing season; mottle <20cm)<br>hygric (wet for most of growing season; permanent seepage/mottling)<br>subhydric (water table at or near surface for most of the year)<br>hydric (water table at or above surface year round) |
| **Measured Slope (degrees)** | |
| **Slope Shape:**<br>vertical<br>concave<br>convex<br>straight<br>horizontal<br>concave<br>convex<br>straight<br>hummock and hollow microtopography<br>irregular craggy/bouldery microtopography | |
| **Hydrologic Regime:**<br>terrestrial (i.e. not a wetland)<br>non-tidal<br>permanently flooded<br>semipermanently flooded<br>seasonally flooded<br>intermittently flooded<br>temporarily flooded<br>saturated<br>tidal<br>irregularly exposed (< diurnally)<br>regularly flooded ( diurnally)<br>irregularly flooded (< diurnally)<br>wind tidally flooded<br>unknown hydrology | |

## Vegetation Classification and Characterization

The vegetation classification used to map seven mid-Atlantic NPS units in Virginia was developed through successive approximations. The initial classification from 2001 (Fleming 2001) was improved upon by two additional analyses, in 2003 and in 2006, each progressively using a larger regional dataset, with the objective of producing a more robust classification.

All plot data collected in mid-Atlantic national parks as of November 2002 were combined into a regional data set of 1342 plots from throughout the Virginia Piedmont and Coastal Plain and from selected NPS units in Maryland and the District of Columbia. The resulting preliminary vegetation classification was reviewed by NPS ecologists and Natural Heritage Program ecologists from Virginia, Maryland, and West Virginia. In December 2006, with the addition of plot data collected since 2002 from Virginia, Maryland, and West Virginia, a regional dataset of 2,250 plots was used to develop the final vegetation classification for the project.

All data were examined using a combination of cluster analysis, ordination, and tabular (statistical) analysis. In general, the analytical process was designed to progressively fragment the large datasets into more workable subsets, using cluster analysis to identify groups, statistical analysis to validate those groups, and lastly ordination studies to examine compositional gradients between groups and correlations with important environmental gradients. In practice, the process was iterative as increasingly finer groups were identified and analyzed.

The general steps included 1) data preparation and transformation, 2) numerical classification (cluster analysis), 3) summary statistics, 4) gradient analysis (ordination), and 5) assignment of classification units to the standard (crosswalking to USNVC). Each of these steps is outlined below.

### Data Preparation and Transformation

Plot data collected during field work were combined with existing data from throughout the Mid-Atlantic Coastal Plain and Piedmont using databases created with Microsoft Access 2000. The final dataset consisted of 2,250 plots (1,452 upland and palustrine wetland plots; plus 798 tidal plots).

Since individual plant taxa are not always identified to the same taxonomic level in plot sampling, botanical nomenclature for the whole analysis dataset was reviewed and standardized. As a rule, taxa were treated at the highest level of resolution possible, but treatment at the subspecific level was not always possible and a few groups of species had to be merged into "pseudospecies." For example, various plots had *Polygonatum biflorum*, *Polygonatum biflorum* var. *biflorum*, or *Polygonatum biflorum* var. *commutatum*; these were merged at the species level. Species richness was calculated for each plot using all taxa (including unidentified species) rooted within plot boundaries. However, taxa identified only at generic or higher levels (e.g., "*Carex* sp." or "unidentified woody seedling") were deleted from the dataset prior to analysis to eliminate "noise" and potentially erroneous correlations between generic entities.

Prior to analysis, most environmental variables were transformed, either to normalize frequency distributions or to assign numeric values to categorical variables. Topographic position and slope were converted to ordinal variables (Table 4). Aspect was transformed using the cosine method of Beers et al. (1966), using the formula A' = cos (45º - A) + 1, where A' = transformed aspect and A = aspect in degrees. The Beers transformation is a commonly used formula for the conversion of the circular measure of slope aspect in degrees into linear values that can be used in correlation and regression analysis. Beers transformation yields values between 0 and 2 that are used to relate aspect to topographic moisture and solar exposure. Drier, solar exposed slopes (SW, 225$^{o}$) have the lowest values and moist, sheltered slopes (NE, 45$^{o}$) the highest transformed values. Surface substrate values were converted to decimals and arcsine transformed to normalize their distributions.

A synthetic Topographic Relative Moisture Index (TRMI) was calculated for each plot using a procedure modified from Parker (1982). TRMI is a scalar index ranging from 0 (lowest moisture potential) to 50 (highest moisture potential) and is computed by combining three topographic variables that potentially influence water runoff, evapotranspiration, and soil moisture retention:

- Slope inclination (10-point scale; per Parker [1982])
- Aspect (20-point scale) = Beers-transformed aspect X 10
- Topographic position (20-point scale; per Parker [1982])

Normally slope shape would be included as an additional 10-point scale but, unfortunately, data on slope shape were not consistently collected from the plots in this study. Because of this omission, as well as assumptions of the formula that may not apply as well to Piedmont and Coastal Plain topography as to montane topography, TRMI as calculated for this study, should be regarded as strictly experimental.

Soil samples collected from plots were oven-dried, sieved (2 mm), and analyzed for pH, estimated nitrogen release (ENR), phosphorus (P), soluble sulfur (S), exchangeable cations (calcium [Ca], magnesium [Mg], potassium [K], and sodium [Na] in ppm), extractable micronutrients (boron [B], iron [Fe], manganese [Mn], copper [Cu], zinc [Zn], and aluminum [Al], in ppm), cation exchange capacity (CEC; m.e.q./100g), total base saturation (%TBS), and percent organic matter (%OM). Chemical analyses were conducted by Brookside Laboratories,

Table 4. Ordinal values for topographic position and slope inclination used in data analysis.

| Topographic Position | Slope Inclination |
|---|---|
| basin/depression = -1<br>plain/level/bottom = 0<br>toe slopes = 1<br>lower slope = 2<br>middle slope = 3<br>upper slope = 4<br>crest = 5 | 0–3º = 1 (flat)<br>4–6º = 2 (gentle / undulating)<br>7–13º = 3 (sloping / rolling)<br>14–20º = 4 (moderate / hilly)<br>21–40º = 5 (steep)<br>41º+ = 6 (very steep) |

Inc., New Knoxville, Ohio. Extractions were carried out using the Mehlich III method (Mehlich 1984) and percent organic matter was determined by loss on ignition. Values for all soil variables except pH were natural log-transformed to normalize their distributions and make the values more biologically interpretable (Palmer 1993). A calcium:magnesium ratio and a synthetic fertility index ([cation exchange capacity X total base saturation] / 100) were also calculated for each plot.

Cluster Analysis

In order to identify groups of compositionally similar plots samples, a hierarchical, agglomerative, polythetic, cluster analysis was implemented using the software program PC-ORD (version 5.0; McCune and Mefford 1999). In this type of numerical classification, sample units (plots) are compared and joined into clusters based on their relative similarity. This type of cluster analysis results in a treelike diagram called a "dendrogram" that depicts the progressive joining of individual plots into larger and larger clusters. Ecologists can use the dendrogram to identify classes (subsets of plots) to subject to further analyses. In the context of this type of analysis, hierarchical means that large clusters are composed of smaller clusters. Agglomerative means that the analysis proceeds by joining clusters rather than by dividing clusters. Polythetic means that many attributes of the items are used to decide the optimum way to combine or divide clusters (McCune and Grace 2002).

Plot by species matrices for cluster analysis were constructed using raw species cover class scores. The Lance-Williams Flexible-Beta linkage method (Lance and Williams 1966, 1967) and either the Bray-Curtis (Sorensen) dissimilarity measure (Bray and Curtis 1957) or Relative Euclidian distance were used to identify compositionally similar groups of plots. The Flexible-Beta method is a generalized sorting strategy, the performance of which varies with user-specified emphasis (beta) on different measures of between-group distance. In general, beta settings ranging from the default of –0.25 to –0.5 produce optimal results with vegetation data, performing very similarly to minimum-variance clustering, i.e., Ward's method (Ward 1963). The Bray-Curtis coefficient (also known as the Sorensen coefficient) has been used with demonstrable success in a wide range of ecological studies (Beals 1984). Among available measures of ecological "distance," represented as a mathematical dissimilarity between samples, the Bray-Curtis coefficient is a balanced measure that places some emphasis on dominant (i.e., high-cover) species while still giving minor (i.e., low-cover) species considerable weight in the analysis (Gauch 1982). Relative Euclidian distance is conceptually similar, except that abundance values are relativized such that the total abundances for all plots are equal.

Using these procedures, the 2,250-plot dataset was progressively fragmented by identifying one or more homogeneous subsets at each iteration, removing those subsets, and re-clustering the remaining plots. These data subsets were then subjected to more comprehensive cluster, statistical, and ordination analyses.

Summary Statistics

Summary tables of compositional statistics were calculated to evaluate the adequacy of groups recognized in cluster analysis and ultimately to assist in naming and describing the community types. Total mean cover and total frequency across all plots were determined for every taxon. To compute mean cover, cover class scores were converted to the midpoints of their respective percent ranges, the midpoints were averaged, and resulting values were back-transformed to cover class scores. For each taxon in each group under consideration, the following summary statistics were then calculated:

- Frequency – the number of samples in a group in which a species occurs.

- Mean Cover – back-transformed cover class value corresponding to mean percent cover calculated from midpoint values of cover class ranges. All samples assigned to a group were considered when calculating mean cover, not just those in which a taxon was present; absences were assigned a cover value of 0.

- Relative Cover – the arithmetic difference between mean cover (for a given group of samples) and total mean cover (for the entire data set) (= Mean Cover – Total Mean Cover). Expressed by plus or minus symbols, this value provides a *relative* approximation of how much more, or less, abundant a particular species is in a community type compared to the overall data set.

- Constancy – the proportion of samples in a group in which a species occurs, expressed as a percentage (= [Frequency / Number of samples in group]×100).

- Fidelity – the degree to which a species is restricted to a group, expressed as proportion of total frequency that frequency in a given group constitutes (= [Frequency / Total Frequency] × 100). An accidental or nonnative species can have maximal (100) fidelity to a type if it occurs in only one sample in the entire data set. As a result, fidelity alone can perform poorly as a criterion for identifying characteristic species and distinguishing among types.

- Diagnostic Value (DV) (= [Constancy × Fidelity] / 100). A synthetic value indicating species that are both frequent within and relatively restricted to a group of plots.

- Diagnostic Value Adjusted by Cover, Scaled (Adj DV [scaled]) (= [Diagnostic Value × Mean Cover] / 9). By dividing DV x Mean Cover by 9, the maximum possible cover value, this statistic synthesizes information about frequency, diagnostic value, and mean abundance. A species entirely restricted to a particular community type, occurring in every sample of that type, and attaining maximum mean cover will have a Scaled Adjusted DV of 100 for that type. Empirically, taxa most characteristic of a type will have a much lower Adjusted DV, although the exact range of values in any given type or data set may vary considerably.

- Diagnostic Value Adjusted by Cover, Unscaled (Adj DV [unscaled]) (=Diagnostic Value X $2^{\text{relative cover}}$). An alternative, unscaled synthetic measure of adjusted DV, using relative cover as the modifier of DV. Since cover classes form a logarithmic, rather than linear scale of values, Unscaled Adjusted DV is a statistically more legitimate means of incorporating

information on cover, and has the advantage of not favoring only dominant species and better identifying species that are considerably more abundant within a given type than in the data set as a whole. This statistic is sensitive, however, to vegetation types containing few samples and to species with low overall frequency. Additionally, the following statistics were generated for each group:

- Mean Species Richness – the average number of species present per plot; only species rooted inside plot boundaries were included in this calculation.

- Homoteneity – the average constancy of the S-most constant species, where S = mean species richness for the type. This value (*sensu* Curtis 1959) can be considered an index of the relative uniformity of a group of plots; higher values for homoteneity indicate greater uniformity in species composition among plots. Although homoteneity is not independent of group size, often increasing as the number of group members decreases, it can be used to evaluate whether community types have been defined at an appropriate level.

Environmental Summary Statistics

Mean values for continuous and ordinal environmental variables were calculated for each group to aid in describing the units and identifying the differences between them. These calculations were performed with raw (untransformed) values, which were averaged across all plots representing a given group. Environmental variables were summarized only for groups with at least half the plots containing data. Mean aspect was calculated as the average position along an arc defined by the range of aspect values.

Ordination

The ordination method of non-metric multidimensional scaling (NMDS; Kruskal 1964) was used to examine classified units in a multidimensional space, detect compositional variation and trends that are obscured in cluster analysis, and aid in identifying the environmental gradients along which vegetation classes and community types are distributed. NMDS is a type of indirect gradient analysis that assigns samples to coordinates in ordination space in a way that maximizes, to the extent possible, the rank-order (i.e., non-parametric) correlation between inter-sample distance in ordination space and inter-sample dissimilarity (i.e., ecological distance; Minchin 1987). A detailed discussion of NMDS and other ordination techniques can be found in McCune and Grace (2002).

Ordination studies were conducted for each major compositional group identified in cluster analysis, as well as for selected smaller groups of closely related community types. The software program PC-ORD (version 5.0; McCune and Mefford 1999) was used to implement NMDS ordination analysis. The Bray-Curtis coefficient (Sorensen) or Relative Euclidean, the same measure used in cluster analysis, was used to calculate dissimilarity and VARIMAX rotation was employed to optimize axis placement in all ordination runs. Each ordination was computed using 100 random starting configurations, and configurations with the lowest stress levels were used for interpretation. Prior to running ordination analysis, outlier plots that would have undesirable effects on the ordination results were identified and removed using the outlier analysis function in PC-ORD.

Based on preliminary plots of stress vs. dimensionality, most ordinations were extracted in three dimensions (some were in two dimensions). Pearson's $r^2$ correlations between environmental variables and ordination axes were calculated, and significant correlations were displayed through joint plot overlays. A joint plot is a diagram that shows the relationship of a set of variables and ordination scores. Radiating lines (vectors) representing environmental variables are depicted within ordination space. The angles and lengths of the radiating lines indicate the direction and strength of the relationship between the variable and the ordination scores. The 19 soil variables and 10 topographic variables used in ordination analyses are listed in Table 5.

Table 5. Environmental variables used in ordination joint plots. Only variables correlated with plot ordination scores are shown in the joint plot diagrams.

| Topographic variables and percentage substrate | |
|---|---|
| Beers Aspect | transformed aspect (Beers et al. 1966) |
| Slope Value | ordinal value for slope |
| Topo position | ordinal value for topographic position |
| TRMI | Topographic Relative Moisture Index |
| Bedrock | percentage cover by bedrock in plot |
| Boulders and Stones | percentage cover by rocks > 10 cm in plot |
| Gravel and Cobbles | percentage cover by rocks 0.2 - 10 cm in plot |
| Decaying Wood | percentage cover by dead wood in plot |
| Water | percentage cover by water in plot |
| Mineral Soil_Sand | percentage cover by bare sand or mineral soil in plot |
| | |
| Soil chemistry variables | |
| Al | extractable aluminum (in parts-per-million) |
| B | extractable boron (in parts-per-million) |
| Base Saturation (%TBS) | percent total base saturation |
| Ca | exchangeable calcium (in parts-per-million) |
| CaMgRatio | calcium:magnesium ratio |
| CEC | cation exchange capacity (m.e.q. / 100 g) |
| Cu | extractable copper (in parts-per-million) |
| Fe | extractable iron (in parts-per-million) |
| Fertility | synthetic fertility index (= CEC X Base Saturation / 100) |
| K | exchangeable potassium (in parts-per-million) |
| Mg | exchangeable magnesium (in parts-per-million) |
| Mn | extractable manganese (in parts-per-million) |
| N | estimated nitrogen release (in lbs-per-acre) |
| Na | exchangeable sodium (in parts-per-million) |
| OM | % organic matter (by loss on ignition) |
| P | phosphorus (in parts-per-million) |
| pH | measure of acidity based on the activity of hydrogen |
| S | soluble sulpher (in parts-per-million) |
| Zn | extractable zinc (in parts-per-million) |

Crosswalking classification units to the USNVC

Vegetation classes developed through quantitative analysis were compared to existing units of the USNVC. All quantitatively-derived types were either assigned to a conceptually similar USNVC association, or used as the basis for a new USNVC association. In selecting nominals for new USNVC associations, high-constancy species (especially those with relatively high mean cover and high diagnostic value, if available) were favored to facilitate identification of the type in the field. A "constant" species was generally considered to be a species occurring in > 67% of plot samples within a classified association. In a few cases, species that were less constant in a type but had high mean cover and diagnostic value were selected as parenthetical nominals. The global USNVC descriptions for existing associations were edited, and global descriptions for new associations were drafted. All classifications, crosswalks, and new USNVC associations were reviewed by Natural Heritage Ecologists from Virginia, Maryland, North Carolina, West Virginia and NatureServe.

In addition to the vegetation classes derived from quantitative analysis, other vegetation classes used to describe the vegetation in the seven parks were developed from qualitative observations in the parks. Some of these qualitatively-derived units were crosswalked to the USNVC association level, while others (i.e. cultural or disturbed vegetation) were not appropriate for inclusion in the USNVC, and were described as nonstandard, park-specific vegetation classes.

Characterization of Vegetation

Once the regional vegetation classification was complete, vegetation classes across all seven parks were assigned a common name based on the Natural Communities of Virginia (Fleming et al. 2006) or, if no appropriate name existed in Fleming et al. (2006), the USNVC association common name was used, or a park-specific common name was assigned. Park-specific descriptions for all vegetation classes occurring at Colonial National Historical Park were drafted using data from field observation points and quantitative plots. A dichotomous key to the vegetation classes occurring in the park was created for use by park natural resource managers and others. A dichotomous key is a tool for identifying unknown entities, in this case, vegetation classes. It is structured by a series of couplets, two statements that describe different, mutually exclusive characteristics of the vegetation. Choosing the statement that best fits the vegetation in question leads the user to the correct vegetation class. The dichotomous key should be used in conjunction with the detailed vegetation class descriptions to confirm that the class selected with the key is appropriate.

Vegetation Map Preparation

Spatial data from field observation points and quantitative plots were used to edit the formation-level maps of Colonial National Historical Park to better reflect vegetation classes. Using ArcView 3.3, polygon boundaries were revised onscreen over leaf-off photography. Units used to label polygons on the map (i.e. map classes) are equivalent to one or more vegetation classes from the regional vegetation classification, or to a land-use class from the Anderson (Anderson et al. 1976) Level II classification system. Each polygon on the Colonial National Historical Park map was assigned to one of forty map classes based on plot data, field observations, aerial photography signatures, and topographic maps. The mapping boundary was based on park

boundary data obtained Colonial National Historical Park in May 2003. The mapping boundary includes lands under a scenic easement at Swanns Point and it excludes the Cheatham Annex, an area that returned to US Navy ownership in February 2004. The vegetation map was clipped at the park boundary because areas outside the park were not surveyed or included in the accuracy assessment.

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 due to mapping error. The USGS-NPS VMP protocols (The Nature Conservancy and Environmental Systems Research Institute 1994c) were followed to assess the horizontal positional accuracy of the digital photo mosaics (leaf-on and leaf-off) and the thematic accuracy of the vegetation map.

Positional Accuracy Assessment

The horizontal positional accuracy of the leaf-on and leaf-off mosaics was assessed using guidelines of the USGS-NPS VMP (The Nature Conservancy and Environmental Systems Research Institute 1994c). For purposes of accuracy assessment, each set of mosaics (leaf-on and leaf-off) was treated as a single entity because the photography for each was acquired in a single flight, with the same camera, and with one set of airborne GPS and IMU data. Well-defined positional accuracy ground control points were placed throughout all quadrants of each set of mosaics in ArcMap. Ground control points and zoomed-in screenshots of each point were plotted on hard copy maps with the mosaic as a background. These maps and plots were used to locate the ground control points in the field. For each plotted ground control point, field staff noted any alterations to the locations in the field, and then recorded the coordinates with a Trimble Pro XR/XRS or GeoXT. Mapped ground control points that were physically inaccessible were also noted. The field crew correctly located and collected accuracy assessment data at 62 ground control points for the leaf-on mosaics and at 69 ground control points for the leaf-off mosaics. The coordinate data were collected with real time GPS and post processed with differential correction using Pathfinder Office software. Prior to calculating accuracy, five ground control points for the leaf-on mosaics and four ground control points for the leaf-off mosaics were identified as outliers with SAS's JMP program and removed. The field-collected "true" or "reference" GPS coordinates for the remaining 57 points for the leaf-on mosaics and 65 points for the leaf-off mosaics were compared to the coordinates obtained from each mosaic viewed in ArcMap. Both pairs of coordinates for each point were entered into a spreadsheet in order to calculate horizontal accuracy (in meters). The accuracy calculation formula is based on root mean square error (FGDC 1998b; Minnesota Governor's Council on Geographic Information and Minnesota Land Management Information Center 1999). Figures 4 and 5 show the distribution of the ground control points for the leaf-on and leaf-off mosaics, respectively.

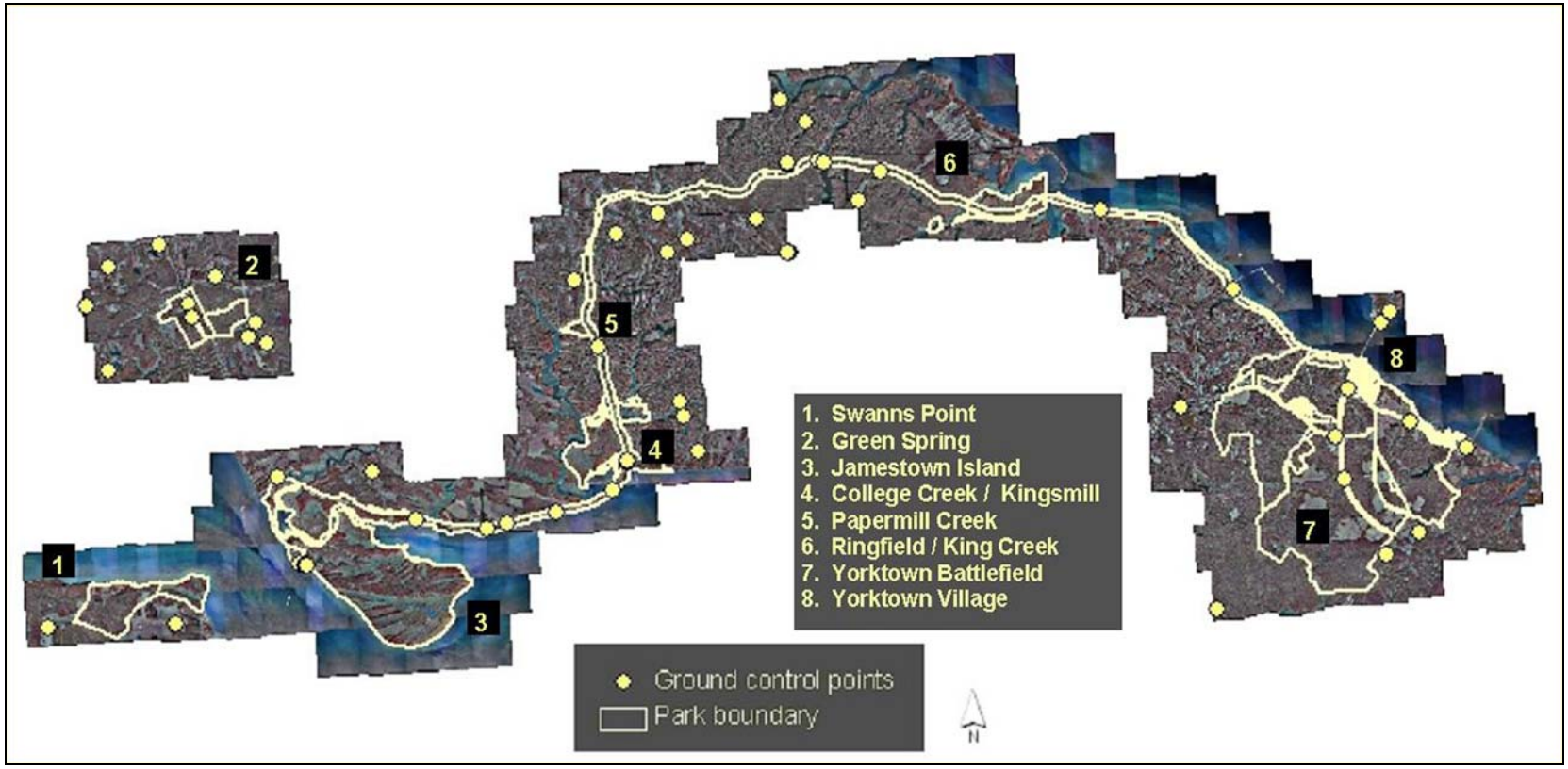



Figure 4. Ground control points used to calculate horizontal positional accuracy of the Colonial National Historical Park leaf-on (fall) mosaics.

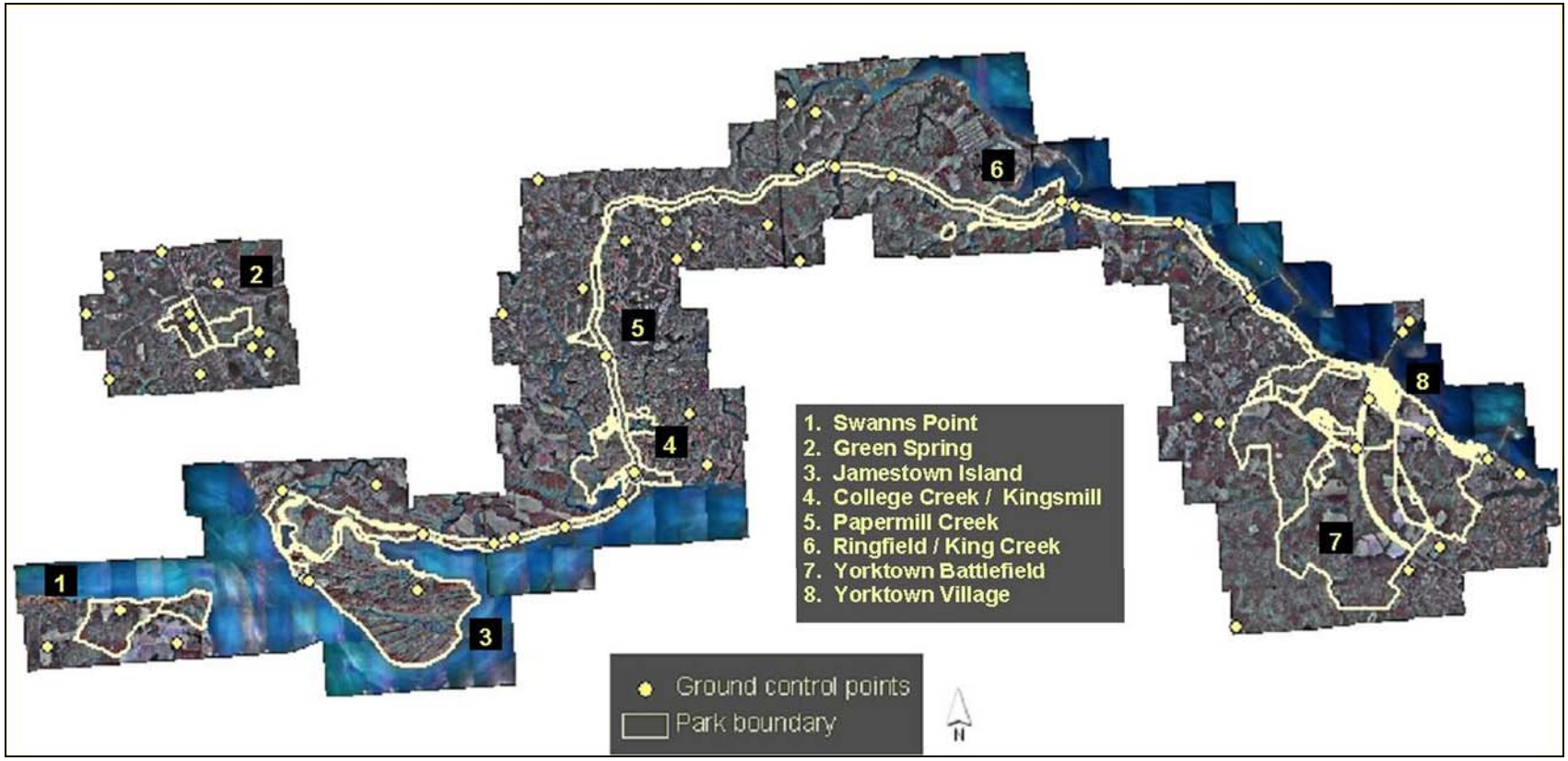



Figure 5. Ground control points used to calculate horizontal positional accuracy of the Colonial National Historical Park leaf-off (spring) mosaics.

Thematic Accuracy Assessment

The Virginia Natural Heritage Program assessed the thematic accuracy of the vegetation map. A stratified random sampling approach was used, proportionally stratifying the samples among map classes representing natural or semi-natural vegetation. All polygons less then the minimum mapping unit (0.5 ha, 1.2 ac) were excluded from the sampling design. Sample size for each class was determined by class abundance and frequency as recommended in section 4.4.2 of the USGS-NPS VMP standards, with one "regional modification" (Table 6). Due to the fragmented nature of cultural parks, most map classes are rare and a modification of Scenario B was needed to accommodate the vegetation pattern seen in these parks. Polygons representing seven Anderson land-use classes were not included in the sample design: Beaches; Industrial and Commercial Complexes; Mixed Urban or Built-up Land; Other Urban or Built-up Land; Residential; Transportation, Communications, and Utilities; and Water. Four classes of cultural vegetation, Cultural Meadow, Dense Hardwood Regeneration, Mixed Successional Scrub, and Semipermanent Impoundment were also excluded from the accuracy assessment. These classes represent very distinct, intensively managed features that were easily delinated from aerial photography, or a few, very small polygons that were completely surveyed on-the-ground during the mapping phase of the project. Additionally, five map classes that naturally occur in small patches and were mapped through chance encounters in the field rather than by photo interpretation, were excluded from the sampling design: Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type), Coastal Plain Depression Wetland (Swamp Tupelo Type), Coastal Plain Dry Calcareous Forest, Piedmont / Low Elevation Mixed Oak / Heath Forest, and Successional Sweetgum Forest. These map classes had very few (1-8) polygons, and the polygons were mostly below minimum mapping unit (0.5 ha) and were completely surveyed on-the-ground during the mapping phase of the project. Since these map classes were mapped only through chance encounters it is unlikely they are mapped consistantly

Table 6. Recommended sample size for accuracy assessment points based on the stratified random sampling process (TNC and ESRI 1994c). Modification for Virginia cultural parks shown as senario B2.

| Scenario | Description | Polygons in class | Area occupied by class | Recommended number of samples in class |
|---|---|---|---|---|
| A | Abundant. Map class has many polygons that cover a large area. | ≥30 | ≥50 ha | 30 |
| B | Relatively abundant. Map class has few polygons that cover a large area. | <30 | ≥50 ha | 20 |
| B2 | Regional modification to Senario B | >5, ≤20 | ≥50 ha | 10 |
| C | Relatively rare. Map class has many polygons, but covers a small area. | >30 | <50 ha | 20 |
| D | Rare. Map class has few polygons; most or all polygons are small. | ≥5, ≤30 | <50 ha | 5 |
| E | Very rare. Map class has too few polygons to permit statistical assessment. | <5 | <50 ha | Visit all and confirm |

across the landscape and thus the errors of omission could be high. However, since polygons were surveyed completely on-the-ground there is a high probability that they are mapped correctly and comission errors would be low. Three map classes were created to indicate vegetation that may have formerly represented natural communities, but is now too altered to assign to a natural community classification. The polygons in these classes were mapped only due to chance encounters, were surveyed completely during the mapping phase of the project, and thus were excluded from the accuracy assessment: Disturbed Calcareous Forest, Disturbed Depressional Wetland, Disturbed Seepage Swamp. Table 7 summarizes the thematic accuracy assessment sampling strategy, showing the allocation of the 183 accuracy assessment points among the map classes.

Prior to selecting sampling locations, all points surveyed during the mapping phase of the project (qualitative observation points and quantitative plots) were buffered by 40 m (131 ft) and excluded from the sampling universe, effectively excluding all areas that had already been observed and classified. The ArcView 3.3 extension, Random Point Generator v. 1.3 (Jenness 2005), was used to randomly select polygons within each map class, then to randomly select points within those polygons. This extension generates random points within a specified distance for a set of input theme features (e.g. polygons), producing a new ArcView shapefile and/or a results table. Where possible, accuracy assessment points were generated so that they were at least 40 m (131 ft) from polygon edges. The size and linearity of some polygons, however, made it impossible to meet these criteria for all polygons. Decreasing edge buffer distances 30 m, 20 m, or 10 m (98 ft, 66 ft, or 33 ft) were used as necessary based on polygon size and shape. Using these methods, three sets of 183 random points (primary, secondary, and tertiary) were generated for each the random polygon in each map class. Primary points were reviewed over aerial photos and topographic maps, and secondary or tertiary points were substituted when there where access limitations or if the point fell on a road or outside the park boundary.

Field staff were provided with maps showing the boundaries of the target polygons and the location of accuracy assessment points, as well as a GPS unit preloaded with all the accuracy assessment point locations. During August through October 2005, each accuracy assessment point was located in the field using a Garmin Map76 WAAS enabled GPS. A john boat was used to access remote marsh locations. Field staff determined the map class at the accuracy assessment point using a dichotomous key and detailed vegetation descriptions. Dominant and characteristic vascular plant species were listed by strata with an indication of their prevalence in the stand (i.e. dominant, common, or rare). Qualitative observations were made that described any variation of vegetation or environment within the polygon, such as the inclusion of more than one class in a polygon. Field staff also estimated the percentage of the target polygon observed and any problems using the key or interpreting the vegetation type in the polygon. The minimum area of observation around the sampling point was 0.5 ha (1.2 ac) or a circle with a radius of approximately 40 m (131 ft). The accuracy assessment data form used in this study is shown in Appendix B. Figures 6 and 7 show the locations of the 183 accuracy assessment points. Accuracy assessment data collected from these 183 points were entered into the PLOTS database version 2.0 (NatureServe 2004) and are provided as a supplement to this report.

Table 7. Thematic accuracy assessment (AA) strategy for Colonial National Historical Park, showing number of polygons, mapped hectares, and number of AA points sampled for each vegetation-map class.

| Map class | number of polygons | number of polygons > 0.5 ha | mapped hectares | number of AA points sampled |
|---|---|---|---|---|
| Acidic Oak - Hickory Forest | 11 | 8 | 17.9 | 5 |
| Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type) | 3 | 3 | 50.0 | 3 |
| Coastal Plain / Piedmont Small-Stream Floodplain Forest | 6 | 6 | 72.7 | 6 |
| Coastal Plain Calcareous Seepage Swamp | 11 | 8 | 19.5 | 5 |
| Coastal Plain Loblolly Pine - Oak Forest | 31 | 26 | 325.6 | 20 |
| Coastal Plain Mesic Calcareous Ravine Forest | 9 | 4 | 20.4 | 4 |
| Disturbed Tidal Hardwood Swamp | 3 | 3 | 4.6 | 3 |
| Golden Bamboo Shrubland | 3 | 2 | 2.1 | 2 |
| Loblolly Pine Plantation | 13 | 13 | 51.4 | 5 |
| Mesic Mixed Hardwood Forest | 58 | 49 | 351.6 | 30 |
| Non-Riverine Saturated Forest | 4 | 4 | 24.9 | 4 |
| Piedmont / Coastal Plain Oak - Beech / Heath Forest | 9 | 5 | 5.4 | 5 |
| Salt Scrub | 10 | 5 | 8.0 | 5 |
| Successional Black Walnut Forest | 5 | 4 | 5.6 | 4 |
| Successional Tree-of-Heaven Forest | 1 | 1 | 5.2 | 1 |
| Successional Tuliptree - Loblolly Pine Forest | 92 | 81 | 1228.0 | 30 |
| Tidal Bald Cypress Forest / Woodland | 7 | 5 | 10.8 | 5 |
| Tidal Freshwater Marsh | 17 | 15 | 124.8 | 10 |
| Tidal Mesohaline and Polyhaline Marsh | 18 | 6 | 10.3 | 5 |
| Tidal Oligohaline Marsh | 49 | 34 | 398.7 | 30 |
| Tidal Shrub Swamp (Wax Myrtle Type) | 5 | 1 | 4.2 | 1 |
| Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type) | 5 | 2 | 1.8 | 0 |
| Coastal Plain Depression Wetland (Swamp Tupelo Type) | 1 | 0 | 0.3 | 0 |
| Coastal Plain Dry Calcareous Forest | 8 | 3 | 5.3 | 0 |
| Disturbed Calcareous Forest | 6 | 6 | 8.8 | 0 |
| Disturbed Depressional Wetland | 1 | 0 | 1.5 | 0 |
| Disturbed Seepage Swamp | 6 | 4 | 5.9 | 0 |
| Piedmont / Low Elevation Mixed Oak / Heath Forest | 1 | 1 | 0.9 | 0 |
| Successional Sweetgum Forest | 3 | 1 | 2.9 | 0 |
| Beaches | 25 | 3 | 11.4 | 0 |
| Cultural Meadow | 71 | 66 | 363.0 | 0 |
| Dense Hardwood Regeneration | 2 | 2 | 10.9 | 0 |
| Industrial and Commercial Complexes | 1 | 1 | 3.8 | 0 |
| Successional Mixed Scrub | 7 | 5 | 11.6 | 0 |
| Mixed Urban or Built-up Land | 3 | 3 | 109.7 | 0 |
| Other Urban or Built-up Land | 24 | 12 | 38.8 | 0 |
| Residential | 4 | 3 | 3.4 | 0 |
| Semipermanent Impoundment | 8 | 6 | 12.9 | 0 |
| Transportation, Communications, and Utilities | 14 | 10 | 93.5 | 0 |
| Water | 59 | 17 | 70.6 | 0 |
| TOTAL | | | 3,498.3 | 183 |

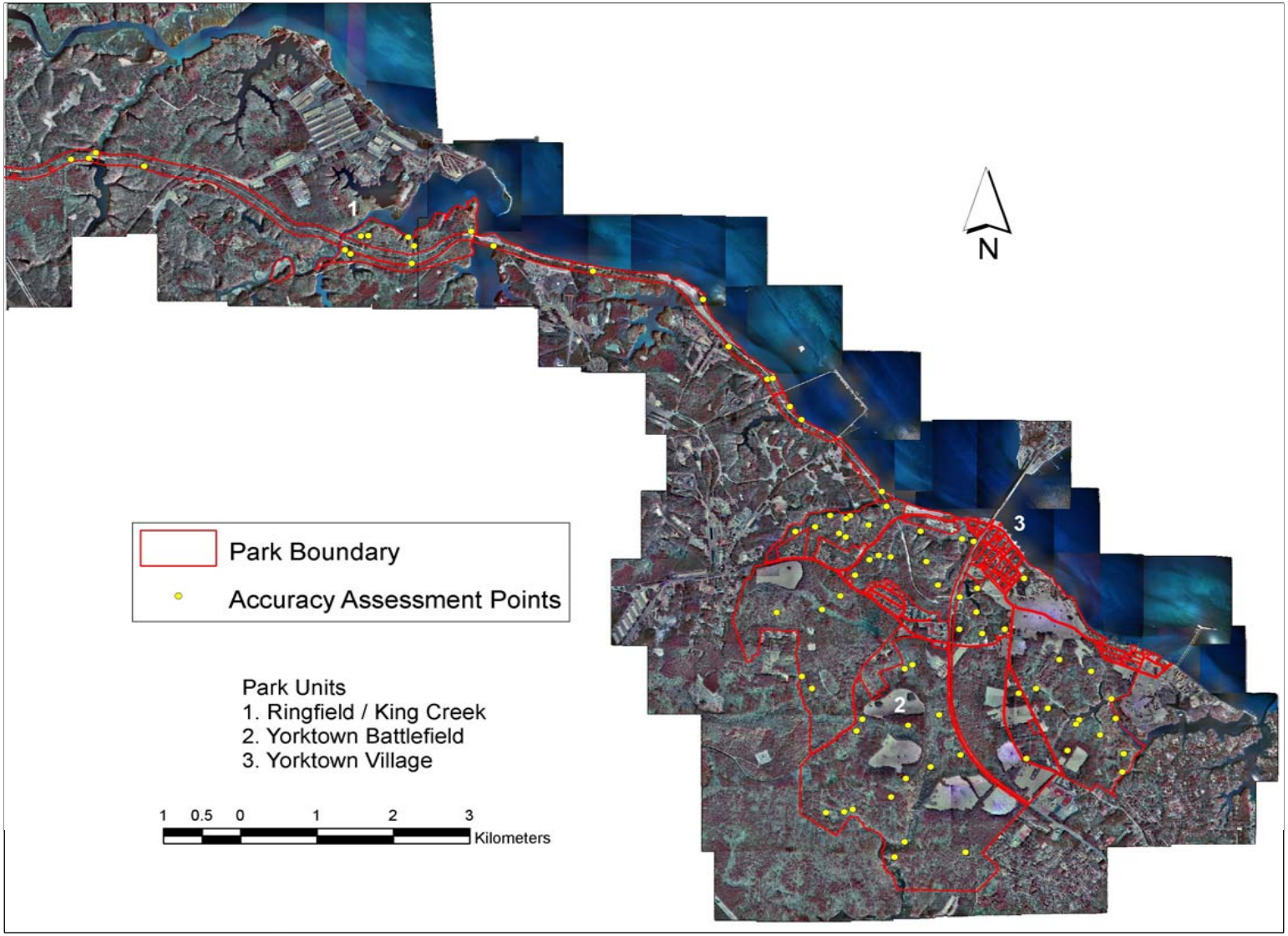



Figure 6. Locations of thematic accuracy assessment sampling points in the eastern half of Colonial National Historical Park.

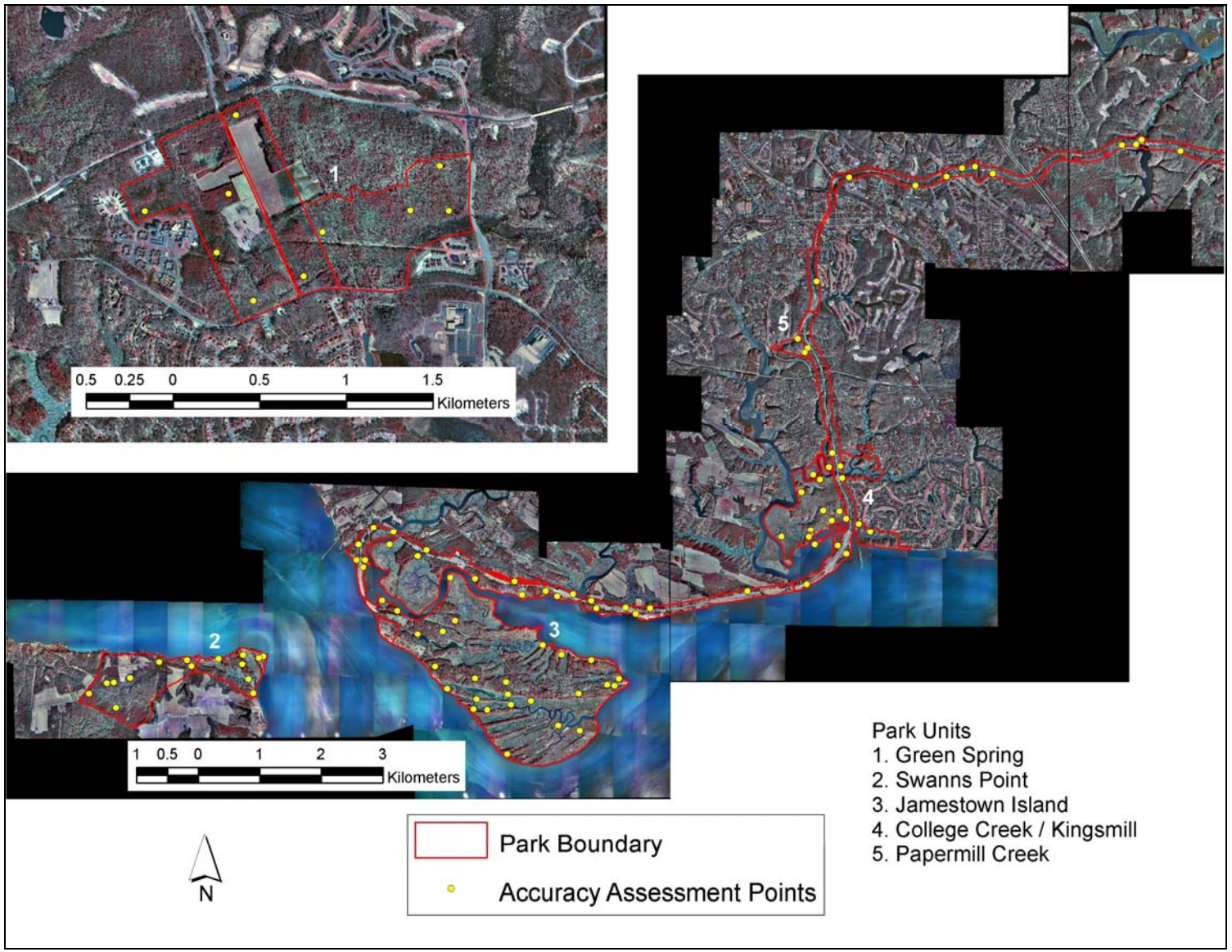



Figure 7. Locations of thematic accuracy assessment sampling points in the western half of Colonial National Historical Park.

Data from 183 accuracy assessment points were entered into an Excel spreadsheet listing accuracy assessment point ID, vegetation map polygon ID, vegetation map class, and first and second (if available) map class determination from accuracy assessment field observations. The thematic accuracy of the vegetation map was then tabulated using a contingency matrix that compares the map class observed on the ground (accuracy assessment observation) with the map class mapped at the same location on the final vegetation map (reference data). The contingency table lists reference data values in the columns and accuracy assessment observation values in the rows. The number of each reference data and accuracy assessment observation pair for all sampling locations is indicated at each row/column intersection in the matrix. Correct mappings are indicated on the table where the row and column values are the same and typically occur on the diagonal on the matrix. Overall percent accuracy and Kappa index were calculated for the map using equations from the USGS-NPS VMP accuracy assessment guidelines (The Nature Conservancy and Environmental Systems Research Institute 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 VMP protocol requires that the Kappa index of vegetation maps exceed 80% (The Nature Conservancy and Environmental Systems Research Institute 1994c). To calculate the probability that a reference data observation has been correctly classified (producer's accuracy or omission error), the number of reference data points correctly classified is divided by the total number of reference data points in that map class. To calculate the probability that the mapped vegetation classes represent the vegetation actually found on the ground (user's accuracy or commission error), the number of correctly classified reference samples was divided by the total number of samples classified or mapped to that vegetation class. The errors of omission and errors of commission for mapped vegetation classes should exceed 80%, according to the USGS-NPS VMP protocol (The Nature Conservancy and Environmental Systems Research Institute 1994c).

Metadata Preparation

All map products are accompanied by detailed Federal Geographic Data Committee (FGDC) compliant metadata (FGDC 1998a). Metadata are data about data. They describe the content, quality, condition, and other characteristics of the data. Metadata are critical elements of each spatial dataset, allowing future users of the data to understand how the dataset was developed, its appropriate uses, and to locate specific information within the spatial dataset. Metadata records were prepared for each mosaic, for the vegetation map, and for the all georeferenced plot data and accuracy assessment point data.

A metadata record for each set of mosaics was prepared in accordance with the current Federal Geographic Data Committee standards (FGDC 1998a). Metadata were produced in notepad and parsed using the USGS metadata compiler (USGS 2004). After all errors and omissions identified by the parser were corrected, the metadata compiler was used to generate final TXT, HTML, and XML versions of each metadata record which are stored in the data archive. Key information for the leaf-on (fall) and leaf-off (spring) mosaics and for the formation-level vegetation dataset is summarized in Tables 8 and 9, respectively.

Table 8. Summary of key information for Colonial National Historical Park leaf-on (fall) mosaics.

| | |
|---|---|
| Title of metadata record: | Colonial National Historical Park Color Infrared Orthorectified Photomosaic - Leaf-on (ERDAS IMAGINE .img and MrSID formats) |
| Publication date of mosaics (from metadata): | March 1, 2003 |
| Date aerial photography was acquired: | October 26, 2001 |
| Vendor that provided aerial photography: | Kucera International |
| Scale of photography: | 1:6,000 |
| Type of photography: | Color infrared, stereo pairs |
| Number of air photos delivered: | 328 |
| Archive location of air photos, airborne GPS and IMU files, and camera calibration certificate: | North Carolina State University, Center for Earth Observation |
| Scanning specifications: | 600 dpi, 24-bit color depth |
| Horizontal positional accuracy of mosaics: | 1.047 meters, meets Class 1 National MapAccuracy Standard |
| Number of ground control points upon which estimated accuracy is based: | 57 |
| Method of calculating positional accuracy: | Root mean square error (RMSE) |
| Archive location of mosaics and metadata: | North Carolina State University, Center for Earth Observation |
| Formats of archived mosaics: | .img (uncompressed) and MrSID (20:1 compression) |

Metadata records for the vegetation map and for all georeferenced plot and accuracy assessment point data were created using a combination of the NPS Metadata Tools and Editor Version 1.1 and NPS Database Metadata Extractor MS Access Add-in Version 1.0 (NPS 2006). Each file was parsed using the USGS metadata compiler Metaparser (MP) v. 2.8.25 (Schweitzer 1995) and the Federal Geographic Data Committee (FGDC) configuration file. This process ensures that all elements required by the FGDC standard are included in the metadata files. All errors and omissions identified by the parser were corrected.

Table 9. Summary of key information for Colonial National Historical Park leaf-off (spring) mosaics.

| | |
|---|---|
| Title of metadata record: | Colonial National Historical Park Color Infrared Orthorectified Photomosaic-Leaf-off (ERDAS IMAGINE .img and MrSID formats) |
| Publication date of mosaics (from metadata): | March 1, 2003 |
| Date aerial photography was acquired: | March 1, 2002 |
| Vendor that provided aerial photography: | Kucera International |
| Scale of photography: | 1:6,000 |
| Type of photography: | Color infrared, stereo pairs |
| Number of air photos delivered: | 280 |
| Archive location of air photos, airborne GPS and IMU files, and camera calibration certificate: | North Carolina State University, Center for Earth Observation |
| Scanning specifications: | 600 dpi, 24-bit color depth |
| Horizontal positional accuracy of mosaics: | 0.943 meters, meets Class 1 National Map Accuracy Standard |
| Number of ground control points upon which estimated accuracy is based: | 65 |
| Method of calculating positional accuracy: | Root mean square error (RMSE) |
| Archive location of mosaics and metadata: | North Carolina State University, Center for Earth Observation |
| Formats of archived mosaics: | .img (uncompressed) and<br>MrSID (20:1 compression) |

# Results

## Field Surveys

Field work was completed in Colonial National Historical Park in 2005. Data were collected from 48 quantitative vegetation plots located throughout the park (Figures 8 and 9). One plot was sampled at Cheatham Annex, an area that has since returned to U.S. Navy ownership, and thus appears outside the park boundary on Figure 8. Species observed during quantitative plot sampling and in accuracy assessment observation points are listed in Appendix C. This list should not be considered a comprehensive flora for the park, but could be added to existing vascular plant lists for the area. Of the 432 vascular plant taxa noted during fieldwork, 38 were nonnative species, and, of those, 20 are considered invasive by the Virginia Department of Conservation and Recreation (VADCR 2003). Three species noted in the park, pink thoroughwort (*Fleischmannia incarnata = Eupatorium incarnatum*), hoary skullcap (*Scutellaria incana* var. *incana*), and sandpaper vervain (*Verbena scabra*), are considered imperiled in the state of Virginia (Townsend 2007). All three species have conservation ranks of G5S2, meaning that, while secure throughout their entire range, the species are at high risk of extirpation within the state of Virginia due to very restricted ranges, very few populations (often 20 or fewer), steep declines, or other factors. Seven species noted in the park are included on the Vascular Plant Watchlist of the Virginia Department of Conservation and Recreation, Division of Natural Heritage (Townsend 2007). Taxa on this list are decidedly uncommon in Virginia, but not scarce enough to merit inclusion on the Rare Vascular Plant List. Watchlist species are monitored to determine general population trends. Watchlist species noted in the park during fieldwork for this project include: rigid sedge (*Carex tetanica*), creeping burrhead (*Echinodorus cordifolius*), common spikerush (*Eleocharis palustris*), beaked spikerush (*Eleocharis rostellata*), hairy shadow witch (*Ponthieva racemosa*), drooping bulrush (*Scirpus lineatus*), and white crownbeard (*Verbesina virginica* var. *virginica*).

## Vegetation Classification and Characterization

Initial cluster analysis of the 2,250 plot regional dataset divided the data into 3 major subsets, upland forests (899 plots), non-tidal wetlands (553 plots), and tidal wetlands (798 plots). Subsequent cluster analysis divided these groups further into 22 subsets, each representing major branches on analysis dendrograms. More comprehensive cluster, statistical, and ordination analyses were conducted on these 22 subsets, resulting in a classification of over 100 vegetation associations. Over the course of the project, 20 new associations were described for the USNVC and 40 existing associations were revised.

A reduced dataset representing 11 major groupings in the original 2,250 plot cluster analysis was extracted and used to illustrate results pertaining to the seven national parks in this study. A table showing the distribution of vegetation classes across all seven parks, including Colonial National Historical Park is presented in Appendix D. Quantitative analysis classified 35 associations occurring in the seven national parks in Virginia. An additional 19 associations and 12 nonstandard park-specific vegetation classes representing disturbed, cultural, or exotic vegetation were also recognized from the seven parks, but were not represented by quantitative plot data, and thus not included in the quantitative analyses. Global and subnational (state)

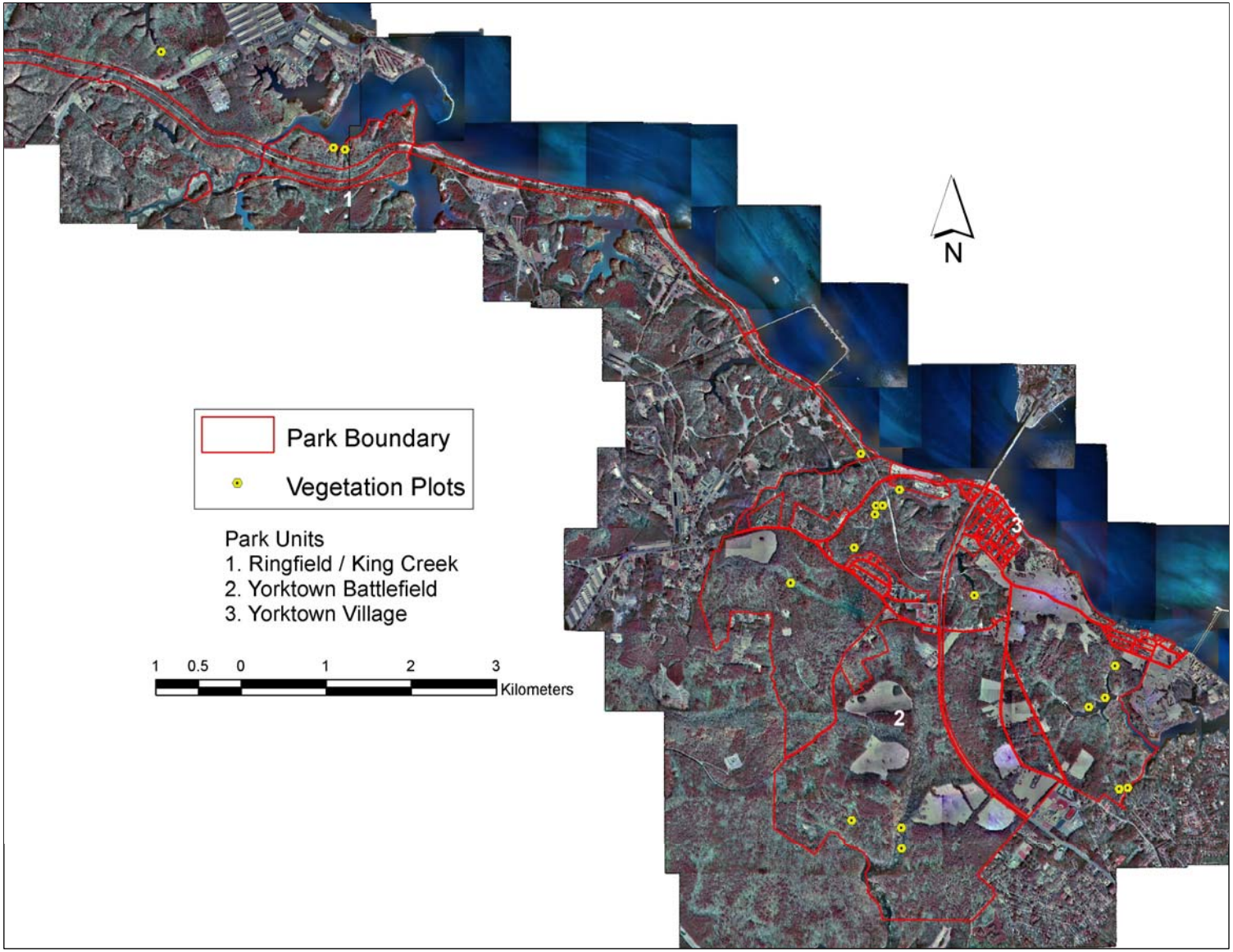



Figure 8. Locations of quantitative vegetation plots in the eastern half of Colonial National Historical Park.

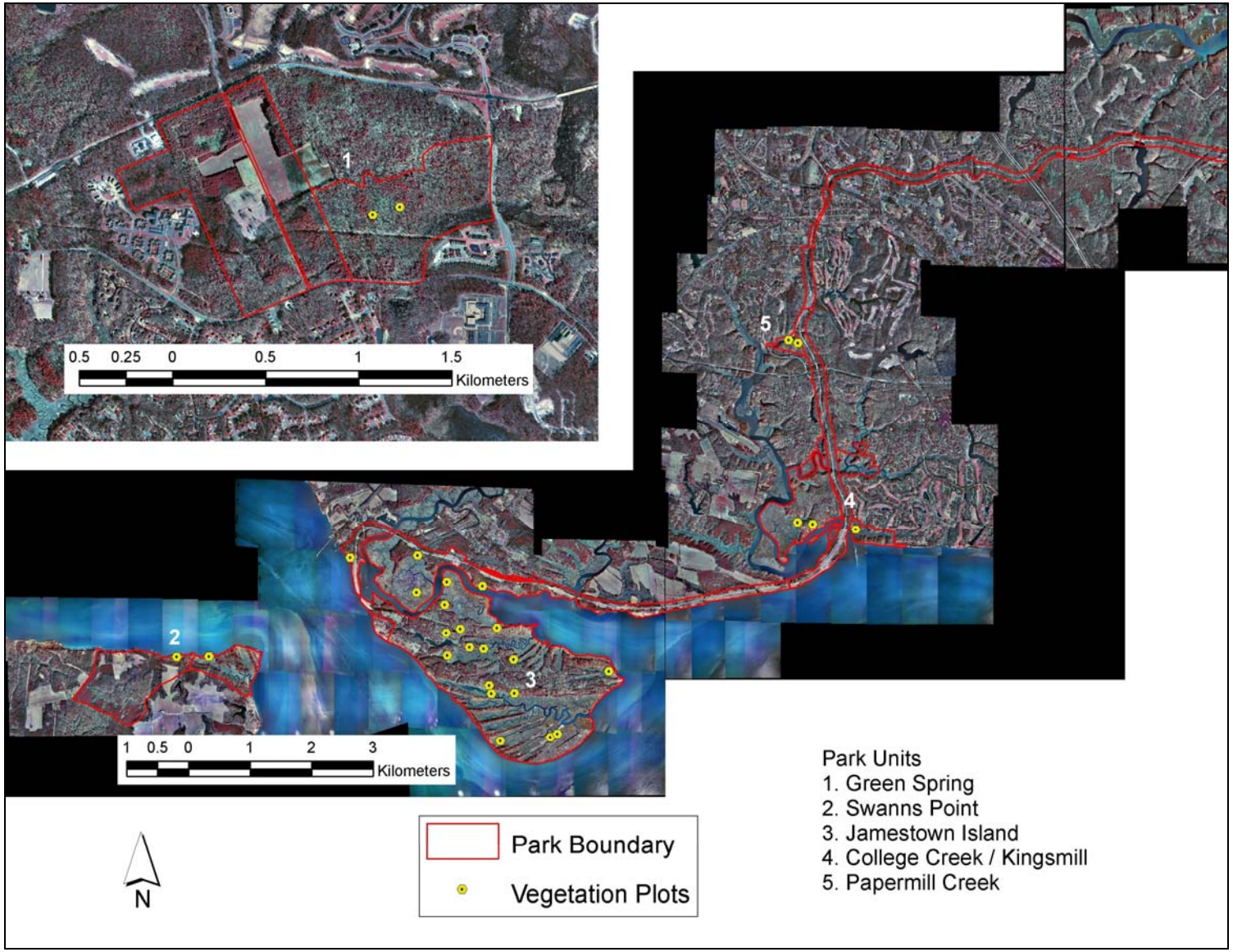



Figure 9. Locations of quantitative vegetation plots in the western half of Colonial National Historical Park.

conservation ranks used in Appendix D are defined in Appendix E, and a summary of select environmental variables for associations derived from the analysis of regional quantitative plot data is presented in Appendix F.

All 11 major vegetation groups in the regional analysis are represented at Colonial National Historical Park. The groups are 1) oak / heath forests, 2) pine - oak forests, 3) mesic acidic forests, 4) oak - hickory forests, 5) basic mesic and calcareous forests, 6) seepage wetlands, 7) alluvial forests, 8) swamp forests, 9) nonriverine forests, 10) tidal herbaceous marshes, and 11) tidal forests and shrublands. Cluster dendrograms, ordination scatterplots, and joint plots resulting from quantitative analysis of regional data from plots in these groups are presented in Appendix G. Compositional summary statistics for each association present in Colonial National Historical Park derived from the analysis of regional quantitative plot data are presented in Appendix H.

The analysis results presented in Appendix G support the classification of plot samples into the 11 major vegetation groups represented at Colonial National Historical Park. Classification dendrograms illustrate the compositional similarity among each group of plots in a vegetation association. The classifications are further supported by the ordination diagrams, which show the same groups of plots in ordination space.

The percentage variance represented by each ordination for the major vegetation groups in the park is presented in Table 10. Environmental variables significantly correlated with ordinations axes are illustrated with joint plot diagrams. All vegetation associations resulting from the regional analysis are shown in the dendrograms and ordination diagrams, even those not present in Colonial National Historical Park. In this way, species and environmental relationships among associations can be examined in a regional context.

Table 10. Proportion of variance represented by each axis, based on coefficients of determination ($r^2$) between ordination distances and distances in the original n-dimensional space for the major vegetation groups at Colonial National Historical Park. Two-dimensional ordinations have "n/a" listed in Axis 3 column.

| | Increment | | | |
|---|---|---|---|---|
| Vegetation Group | Axis 1 | Axis 2 | Axis 3 | Cumulative |
| oak / heath forests | 0.356 | 0.223 | 0.238 | 0.817 |
| pine - oak forests | 0.602 | 0.312 | n/a | 0.914 |
| mesic acidic forests | 0.124 | 0.426 | 0.233 | 0.783 |
| oak - hickory forests | 0.083 | 0.155 | 0.543 | 0.781 |
| basic mesic and calcareous forests | 0.341 | 0.272 | 0.215 | 0.828 |
| seepage wetlands | 0.329 | 0.531 | n/a | 0.860 |
| alluvial forests | 0.094 | 0.767 | n/a | 0.861 |
| swamp forests | 0.369 | 0.189 | 0.244 | 0.802 |
| nonriverine forests | 0.064 | 0.539 | 0.225 | 0.818 |
| tidal herbaceous marshes | 0.291 | 0.220 | 0.214 | 0.725 |
| tidal forests and shrublands | 0.718 | 0.126 | n/a | 0.843 |

The classification of 93 oak / heath forest sample plots is illustrated in Figures G1-G2 of Appendix G. Plot samples cluster into two compositionally distinct groups in both the dendrogram and the three-dimensional ordination (Appendix G, Figures G1 and G2). The two associations, Coastal Plain Mixed Oak / Heath Forest (CEGL006269) and Piedmont / Low Elevation Mixed Oak / Heath Forest (CEGL008521) separate along axis three of the ordination diagram. There were no environmental variables that were significantly correlated with the ordination axes. The single oak / heath sample plot from Colonial National Historical Park is classified as Piedmont / Low Elevation Mixed Oak / Heath Forest (CEGL008521). Environmental variables from plot samples classified as Piedmont / Low Elevation Mixed Oak / Heath Forest (CEGL008521) are summarized in Appendix F. A compositional summary based on 75 sample plots of this association is presented in Appendix H, Table H1. The plot sample from Colonial National Historical Park is fairly typical of the association, both compositionally and environmentally. The Colonial National Historical Park plot sample contained most of the constant species, but lacked common serviceberry (*Amelanchier arborea*), striped prince's pine (*Chimaphila maculata*), scarlet oak (*Quercus coccinea*), and sassafras (*Sassafras albidum*). Instead of pignut hickory (*Carya glabra*) or mockernut hickory (*Carya alba*), the Colonial National Historical Park example had sand hickory (*Carya pallida*). Piedmont / Low Elevation Mixed Oak / Heath Forest is found in three of the seven national parks included in this study (Appendix D).

Figures G3 and G4 of Appendix G illustrate the classification of 25 plots of pine - oak forest into two compositionally distinct groups. Coastal Plain Loblolly Pine - Oak Forest (CEGL004766) was classified from eight plot samples from Colonial National Historical Park. Eastern White Pine – Hardwood Forest (CEGL008539) is an association found primarily in the Piedmont and mountains, which was documented at Fredericksburg and Spotsylvania National Military Park. The two associations separate along axis 1 of the two-dimensional ordination, which represents 60% of the variance in the data (Table 10). Although there were no significant environmental variables separating the associations in analysis, samples of Coastal Plain Loblolly Pine - Oak Forest occurred on flat topography over very infertile soils, while samples of Eastern White Pine – Hardwood Forest were found on moderately steep to steep rocky slopes with slightly more fertile soils (Appendix F). Coastal Plain Loblolly Pine - Oak Forest was only documented at Colonial National Historical Park and is not in any of the other parks in this study (Appendix D).

Classification results for the mesic acidic forest group are presented in Appendix G, Figures G5-G7. Plot samples cluster into two compositionally distinct groups in both the dendrogram and the three-dimensional ordination (Appendix G, Figures G5 and G6). Axis three of the joint plot (Appendix G, Figure G7) is highly correlated with joint plot vectors representing pH, and the soil cations calcium, magnesium, manganese, and iron. The two associations classified within the mesic acidic forests group are Mesic Mixed Hardwood Forest (CEGL006075) and Piedmont / Coastal Plain Oak – Beech / Heath Forest (CEGL006919). Although both associations can occur in the same landscape, Piedmont / Coastal Plain Oak – Beech / Heath Forest is found on steeper, more exposed slopes with less fertile soils than Mesic Mixed Hardwood Forest. A summary of environmental variables for the two associations is presented in Appendix F. Both associations occur at Colonial National Historical Park. Two plot samples from the park represent Piedmont / Coastal Plain Oak – Beech / Heath Forest and three represent Mesic Mixed Hardwood Forest. A compositional summary for 26 sample plots of Piedmont / Coastal Plain Oak – Beech / Heath Forest is presented in Appendix H, Table H4 and a compositional summary for 170 sample plots

of Mesic Mixed Hardwood Forest is presented in Appendix H, Table H3. Plot samples of Piedmont / Coastal Plain Oak – Beech / Heath Forest from Colonial National Historical Park are fairly representative of the association. However, one sample lacked the nominal species American beech (*Fagus grandifolia)*, and both plot samples lacked the parenthetical nominals chestnut oak (*Quercus prinus)* and black oak (*Quercus velutina)*, although these species were seen in other examples in the park that were not quantitatively sampled. Colonial National Historical Park was the only park in this study where this community was documented (Appendix D). Plot samples of Mesic Mixed Hardwood Forest from Colonial National Historical Park are compositionally representative of the association, with all or most of the nominal and constant species. Mesic Mixed Hardwood Forest was documented in five of the seven national parks included in this study (Appendix D).

The results of the regional analysis of the oak - hickory forest group are illustrated in Figures G8-G10 of Appendix G. Plot samples cluster into two compositionally distinct groups in both the dendrogram (Appendix G, Figure G8) and the three-dimensional ordination (Appendix G, Figure G9). Strong correlations of soil fertility variables with axis three of the ordination suggest that soil nutrients have an important influence on vegetation patterns within this group (Appendix G, Figure G10). Two associations, Acidic Oak-Hickory Forest (CEGL008475) and Basic Oak - Hickory Forest (CEGL007232) were recognized from the analysis and there is much variation within each group of plot samples along a gradual cline of site conditions, soil chemistry, and floristic composition. Only Acidic Oak-Hickory Forest was classified from Colonial National Historical Park. The single plot sample from the park has somewhat typical species composition for the association (Appendix H, Table H5). It lacked the three nominal species northern red oak (*Quercus rubra)*, deerberry (*Vaccinium stamineum*), and nakedflower ticktrefoil (*Desmodium nudiflorum*), but had many of the constant species. Examples of Acidic Oak - Hickory Forest from Colonial National Historical Park had greater than average cover for chestnut oak (*Quercus prinus*) and post oak (*Quercus stellata*). Acidic Oak-Hickory Forest is found on acidic soils that are common throughout the Piedmont. Acidic Oak-Hickory Forest occurs in six of the seven national parks included in this study (Appendix D). The other association classified within the oak - hickory forest group, Basic Oak – Hickory Forest (CEGL007232), is not present at Colonial National Historical Park. Compared to Acidic Oak - Hickory Forest, Basic Oak - Hickory Forest is associated with soils that are more alkaline and characterized by high cation levels (Appendix F). This forest is the typical basic oak-hickory forest of the southern Virginia Piedmont and, although it is widely distributed in the Piedmont from Virginia to Alabama, it is an uncommon community type that is strongly restricted to mafic substrates and subject to ongoing threats from cutting and conversion of hardwood stands to pine silvicultures.

The classification of 77 basic mesic and calcareous forest sample plots is illustrated in Figures G11–G13 of Appendix G. Plot samples cluster into three compositionally similar groups in both the dendrogram and the three-dimensional ordination (Appendix G, Figures G11 and G12). Two associations in this group, Coastal Plain Dry Calcareous Forest (CEGL007748) and Coastal Plain Mesic Calcareous Ravine Forest (CEGL007181), are restricted to the Coastal Plain where they are found in association with Tertiary shell deposits. Coastal Plain Dry Calcareous Forest is represented in the analysis results by 24 sample plots, including six from Colonial National Historical Park. Coastal Plain Mesic Calcareous Ravine Forest is represented in the analysis results by 22 sample plots, including one from Colonial National Historical Park. The third

association in this group, Inner Piedmont / Lower Blue Ridge Basic Mesic Forest (CEGL006186), is known from steep rocky sites of sub-montane landscapes in the western and northern Piedmont and on lower slopes of the Blue Ridge. All associations in this group have high soil fertility relative to all other upland forest types (Appendix F), but even within this group, soil nutrients have a strong influence on vegetation pattern. Axis one of the joint plot (Appendix G, Figure G13) is highly correlated with the joint plot vectors representing pH, calcium:magnesium ratio, and fertility index. In the context of this ordination, plot samples representing the calcareous forests at Colonial National Historical Park are correlated with the highest soil fertility values and lower values of Topographic Relative Moisture Index (TRMI). Coastal Plain Dry Calcareous Forest is known from steep, usually south-facing, erosive ravine slopes that have cut down into deposits of shells and limesands. Plots classified as this association have the highest average soil pH values (6.5) and soil calcium (4707 ppm) of any upland forests in the study (Appendix F). A compositional summary of the association is presented in Appendix H, Table H7. The six plot samples from Colonial National Historical Park are compositionally representative examples of Coastal Plain Dry Calcareous Forest. This association is also found at George Washington Birthplace National Monument, but is not at any of the other parks included in this study (Appendix D). A compositional summary of Coastal Plain Mesic Calcareous Ravine Forest is presented in Appendix H, Table H6. Coastal Plain Mesic Calcareous Ravine Forest occurring on shell substrates may be confused with Coastal Plain Dry Calcareous Forest, and the two forests types may intergrade on the landscape. Coastal Plain Mesic Calcareous Ravine Forest is distinguished by the closed forest canopy, the lush forb-dominated herb layer, and by the presence of mesophytic species. The single plot from Colonial National Historical Park is very representative of the association, with all of the nominal species and many of the most-constant species. Coastal Plain Mesic Calcareous Ravine Forest has a very restricted range, known only from four counties around Colonial National Historical Park and the City of Suffolk in southeastern Virginia. The association is not in any other parks included in this study (Appendix D).

Classification results for the seepage wetland group are presented in Figures G14-G16 of Appendix G. Plot samples from 72 seepage wetlands cluster into three compositionally distinct groupings in both the dendrogram and the two-dimensional ordination (Appendix G, Figures G14 and G15). Axis one of the joint plot (Appendix G, Figure G16) is highly correlated with the joint plot vectors representing pH, calcium:magnesium ratio, base saturation, and fertility index, while axis two is significantly correlated with percent cover of boulders. Together these axes represent 86% of the variance in the data (Table 10). The only seepage wetland present in Colonial National Historical Park is Coastal Plain Calcareous Seepage Swamp (CEGL006413). Plots classified as this association have the highest average soil pH value in the group and very high levels of base cations (Appendix F). A compositional summary of the association is presented in Table H8 of Appendix H. The three plots from the park are very typical of the association, with all the nominal and most of the constant species. Coastal Plain Calcareous Seepage Swamp is restricted to the bottoms of highly calcareous, central Virginia Coastal Plain ravines that have cut into Tertiary shell deposits. This association is not found in any of the other national parks included in this study (Appendix D). The remaining two seepage wetland associations, Coastal Plain / Piedmont Acidic Seepage Swamp and Southern New England Red Maple Seepage Swamp, occur at opposite ends the soil fertility gradient (Appendix G, Figure G16). All three seepage wetland associations are considered either globally rare or uncommon in the state of Virginia (Appendix D).

The regional analysis of alluvial forest sample plots is illustrated in Figures G17-G19 of Appendix G. Plot samples cluster into three compositionally distinct groups in both the dendrogram and the two-dimensional ordination. Plot samples segregate along axis two, which represents 77% of the variance in the data (Table 10). The joint plot (Appendix G, Figure G19) shows the correlation of soil fertility variables with axis two of the ordination, suggesting that soil nutrients have an important influence on vegetation patterns within this group. The 48 plot samples representing the only alluvial forest association found at Colonial National Historical Park, Coastal Plain / Piedmont Small-Stream Floodplain Forest (CEGL004418), are at the low end of the soil fertility gradient (Appendix G, Figure G19) and have the lowest averages in the group for soil variables indicative of fertility (Appendix F, Table F2). Coastal Plain / Piedmont Small-Stream Floodplain Forest develops over acidic soils along small streams in the Coastal Plain of Maryland and Virginia and west across the Virginia and North Carolina Piedmont to the Cumberland Plateau and Ridge and Valley. Piedmont / Mountain Alluvial Forest (CEGL006492) is found on small to medium sized streams over more fertile alluvium, while Piedmont / Mountain Floodplain Forest (CEGL006217) is found on the large floodplains of major mid-Atlantic rivers over the most fertile alluvium (Appendix F). A compositional summary of Coastal Plain / Piedmont Small-Stream Floodplain Forest is presented in Appendix H, Table H9. The single plot sample from Colonial National Historical Park is representative of the association, with all the nominal species and many of the constant species. This association is found in four of the seven national parks in this study (Appendix D).

The classification of 70 swamp forest sample plots is illustrated in Figures G20-G22 of Appendix G. Plot samples cluster into two compositionally distinct groups in the dendrogram and into two less distinct groupings in the three-dimensional ordination (Appendix G, Figures G20 and G21). The joint plot shows strong correlations of soil fertility variables with axis three of the ordination, suggesting that soil nutrients have an important influence on vegetation patterns within this group (Appendix G, Figure G22). Plot samples classed as the only swamp forest association present at Colonial National Historical Park, Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type) (CEGL006606), are at the high end of the soil fertility gradient (Appendix G, Figure G22) and have the highest averages in the group for soil variables indicative of fertility (Appendix F, Table F2). These forests also tend to have longer hydroperiods and deeper flooding than forests classed as Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak - Red Maple Type) (CEGL006605), although these variables were not measured directly. The two plot samples from Colonial National Historical Park are compositionally typical of the association (Appendix H, Table H10), with all nominal species and many of the constant species. In this study, Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type) was only found at Colonial National Historical Park.

The nonriverine forest group is presented in Appendix G, Figures G23–G25. Plot samples from 62 nonriverine forest plots cluster into four compositionally distinct groups in the dendrogram, the two-dimensional ordination, and the three-dimensional ordination (Appendix G, Figures G23–G24). In terms of species composition, the associations show the greatest separation along axis two of the ordinations (Table 10; Appendix G, Figure G25). Ordination scores were not significantly correlated with available environmental data; however, as a group, these forests have low values for soil chemistry variables, indicating acid soils with low fertility (Appendix F). Three of the four associations occur at Colonial National Historical Park, Coastal Plain

Depression Wetland (Red Maple - Sweetgum - Willow Oak Type) (CEGL006110), Coastal Plain Depression Wetland (Swamp Tupelo Type) (CEGL006223), and Non-Riverine Saturated Forest (CEGL004644). The fourth association, Upland Depression Swamp (CEGL007403) is an isolated wetland association found in the Piedmont of Virginia and the Carolinas. Compositional summaries for all three associations found in Colonial National Historical Park are presented in Appendix H. One example of Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type) was sampled in Colonial National Historical Park and it is compositionally representative of the association, but lacks one nominal, swamp doghobble (*Leucothoe racemosa)*. Coastal Plain Depression Wetland (Swamp Tupelo Type) was not plot sampled in Colonial National Historical Park. The two plot samples of Non-Riverine Saturated Forest from the park are compositionally representative of the association, containing all but one of the nominal species and all of the most-constant species. The plots in Colonial National Historical Park lack coastal sweetpepperbush (*Clethra alnifolia)*, but have higher than average species richness (51 and 62 species per 400 $m^2$). Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type) was also documented in Fredericksburg and Spotsylvania National Military Park. Coastal Plain Depression Wetland (Swamp Tupelo Type) was only documented in Colonial National Historical Park. Non-Riverine Saturated Forest occurs in four of the seven national parks included in this study. All four of the nonriverine forest associations recognized in this analysis are uncommon to rare in the mid-Atlantic region and three are globally rare (Appendix D).

Classification of 129 tidal herbaceous marsh plots is illustrated in Appendix G, Figure G26. The dendrogram shows eight distinct compositional groups that correspond to eight tidal marsh associations. The ordination of the tidal herbaceous plots does not show a clear separation of associations along the three ordination axes (Appendix G, Figure G27). The eight associations were grouped into three units used to map tidal herbaceous marshes (see next section of report); Tidal Freshwater Marsh, Tidal Oligohaline Marsh, and Tidal Mesohaline and Polyhaline Marsh. Figure G28 illustrates how these three groups separate along all three ordination axes. Environmental relationships were not explored due to a lack of environmental data for the majority of the tidal herbaceous plot samples. All eight associations illustrated in the dendrogram (Appendix G, Figure G26) are found at Colonial National Historical Park, and ten quantitative plot samples from the park were included in the regional analysis. Compositional summaries for the eight associations are presented in Appendix H, Tables H14 - H21. These eight tidal marsh associations are considered common in the mid-Atlantic region, but have not yet been assigned conservation ranks. Four of the associations are also found at George Washington Birthplace National Monument, while the other four were only documented at Colonial National Historical Park in this study (Appendix D).

Figure G29 in Appendix G illustrates the classification of 94 tidal forest and shrubland plot samples. The groups segregate on axis one of the two-dimensional ordination (Figure G30) which represents 72% of the variance in the compositional data (Table 10). Environmental relationships were not explored due to lack of environmental data for the tidal forest and shrubland plot samples. Three of the four associations classified in this group are present at Colonial National Historical Park, Salt Scrub (CEGL003921), Tidal Shrub Swamp (Wax Myrtle Type) (CEGL004656), and Tidal Bald Cypress Forest / Woodland (CEGL004654). A compositional summary of each association is presented in Appendix H, Tables H22-H24. The fourth association, Tidal Shrub Swamp (Iva Type) was identified only from George Washington

Birthplace National Monument. The three tidal forest and shrubland associations identified from Colonial National Historical Park were not found in the other six national parks in this study (Appendix D). All are common tidal communities in the mid-Atlantic region except for the globally rare Tidal Bald Cypress Forest / Woodland, which is found only in Virginia and Maryland in very specific environmental settings.

In addition to the vegetation classes derived from quantitative analysis, other vegetation classes used to describe the vegetation in the seven parks were developed from qualitative observations in the parks. Many of these qualitatively-derived units were crosswalked to the USNVC association level, while others were not appropriate for inclusion in the USNVC, and were described as nonstandard, park-specific vegetation classes. Nineteen associations and 12 nonstandard park-specific vegetation classes representing disturbed or cultural vegetation were recognized from the seven parks. Colonial National Historical Park has 14 of these cultural or disturbed vegetation classes. Seven of these vegetation classes were crosswalked to the association level of the USNVC and seven represented vegetation that had no defined classification in the USNVC. These seven vegetation classes were given nonstandard, park-specific names to describe the vegetation in Colonial National Historical Park. All vegetation classes from the regional classification, their relationship to the USNVC, and their distribution across all seven parks in this study are shown in Appendix D.

Vegetation Community Descriptions and Map Classes

Forty map classes were used in the vegetation map for Colonial National Historical Park. Map classes are equivalent to one or more vegetation classes from the regional vegetation classification, or to a land-use class from the Anderson (Anderson et al. 1976) Level II classification system. Table 11 lists the 40 map classes used to map the park and shows the relationships to standard classifications and to the regional vegetation classes developed for the seven parks in this study. Twenty-six of the 40 map classes were crosswalked to the finest level of the USNVC (association). Seven of the 40 map classes were described as nonstandard, park-specific vegetation classes, and seven were crosswalked to the Anderson (Anderson et al. 1976) Level II classification. Detailed local descriptions for each USNVC association or other map class present at Colonial National Historical Park were written based on information collected within the park boundary. Two map classes, Tidal Mesohaline and Polyhaline Marsh, and Tidal Oligohaline Marsh, are crosswalked to multiple USNVC associations. Polygons mapped as Tidal Mesohaline and Polyhaline Marsh represent vegetation belonging to one or two associations. Polygons mapped as Tidal Oligohaline Marsh represent one to five associations, occurring individually or as a complex of multiple associations. A detailed local description was written for each association within both of these map classes. All map classes crosswalked to the association level of the USNVC include range wide descriptions (i.e. global descriptions). Global descriptions of the USNVC associations were extracted from the September 27, 2007 version of the USNVC (NatureServe 2007).

Detailed local and global descriptions of the USNVC associations are contained in Appendix I. Local descriptions for other map classes (nonstandard, park-specific vegetation classes and land-use classes) are also provided. The descriptions are indexed by the regional vegetation class or

Table 11. Vegetation-map classes and corresponding USNVC associations (NatureServe 2007) or other classification for Colonial National Historical Park.

| Map Class | USNVC Association (association code) | Regional Vegetation or Land-use Class * (name source) |
|---|---|---|
| Acidic Oak - Hickory Forest | *Quercus alba - Quercus rubra - Carya alba / Cornus florida / Vaccinium stamineum / Desmodium nudiflorum Piedmont* Forest (CEGL008475) | Acidic Oak – Hickory Forest (Fleming et al. 2006) |
| Beaches | Not defined - Anderson land-use class | Beaches (72) (Anderson et al. 1976) |
| Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type) | *Acer rubrum - Fraxinus pennsylvanica / Saururus cernuus* Forest (CEGL006606) | Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type) (Fleming et al. 2006) |
| Coastal Plain / Piedmont Small-Stream Floodplain Forest | *Liquidambar styraciflua - Liriodendron tulipifera / Lindera benzoin / Arisaema triphyllum* Forest (CEGL004418) | Coastal Plain / Piedmont Small-Stream Floodplain Forest (park-specific name) |
| Coastal Plain Calcareous Seepage Swamp | *Acer rubrum - Fraxinus pennsylvanica / Packera aurea - Carex bromoides - Pilea fontana - Bidens laevis* Forest (CEGL006413) | Coastal Plain Calcareous Seepage Swamp (NatureServe 2007) |
| Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type) | *Liquidambar styraciflua - Acer rubrum - Quercus phellos / Leucothoe racemosa* Forest (CEGL006110) | Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type) (Fleming et al. 2006) |
| Coastal Plain Depression Wetland (Swamp Tupelo Type) | *Liquidambar styraciflua - Acer rubrum - Nyssa biflora / Carex joorii* Forest (CEGL006223) | Coastal Plain Depression Wetland (Swamp Tupelo Type) (Fleming et al. 2006) |
| Coastal Plain Dry Calcareous Forest | *Quercus muehlenbergii / Cercis canadensis / Dichanthelium boscii - Bromus pubescens - Erigeron pulchellus* var. *pulchellus - Aquilegia canadensis* Forest (CEGL007748) | Coastal Plain Dry Calcareous Forest (Fleming et al. 2006) |
| Coastal Plain Loblolly Pine - Oak Forest | *Pinus taeda - Quercus (alba, falcata, stellata)* Southeastern Interior Forest (CEGL004766) | Coastal Plain Loblolly Pine - Oak Forest (park-specific name) |
| Coastal Plain Mesic Calcareous Ravine Forest | *Fagus grandifolia - Acer barbatum - Quercus muehlenbergii / Sanguinaria canadensis* Forest (CEGL007181) | Coastal Plain Mesic Calcareous Ravine Forest (Fleming et al. 2006) |
| Cultural Meadow | *Dactylis glomerata - Phleum pratense - Festuca* spp. - *Solidago* spp. Herbaceous Vegetation (CEGL006107) | Cultural Meadow (park-specific name) |
| Dense Hardwood Regeneration | Not defined - nonstandard, park-specific vegetation class | Dense Hardwood Regeneration (park-specific name) |
| Disturbed Calcareous Forest | Not defined - nonstandard, park-specific vegetation class | Disturbed Calcareous Forest (park-specific name) |
| Disturbed Depressional Wetland | Not defined - nonstandard, park-specific vegetation class | Disturbed Depressional Wetland (park-specific name) |
| Disturbed Seepage Swamp | Not defined - nonstandard, park-specific vegetation class | Disturbed Seepage Swamp (park-specific name) |
| Disturbed Tidal Hardwood Swamp | Not defined - nonstandard, park-specific vegetation class | Disturbed Tidal Hardwood Swamp (park-specific name) |
| Golden Bamboo Shrubland | *Phyllostachys aurea* Shrubland (CEGL008560) | Golden Bamboo Shrubland (NatureServe 2007) |
| Industrial and Commercial Complexes | Not defined - Anderson land-use class | Industrial and Commercial Complexes (15) (Anderson et al. 1976) |
| Loblolly Pine Plantation | *Pinus taeda* Planted Forest (CEGL007179) | Loblolly Pine Plantation (NatureServe 2007) |
| Mesic Mixed Hardwood Forest | *Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / (Ilex opaca* var. *opaca) / Polystichum acrostichoides* Forest (CEGL006075) | Mesic Mixed Hardwood Forest (Fleming et al. 2006) |
| Mixed Urban or Built-up Land | Not defined - Anderson land-use class | Mixed Urban or Built-up Land (16) (Anderson et al. 1976) |
| Non-Riverine Saturated Forest | *Quercus (phellos, pagoda, michauxii) / Ilex opaca* var. *opaca / Clethra alnifolia / Woodwardia areolata* Forest (CEGL004644) | Non-Riverine Saturated Forest (Fleming et al. 2006) |

Table 11. Vegetation-map classes and corresponding USNVC associations (NatureServe 2007) or other classification for Colonial National Historical Park (continued).

| Map Class | USNVC Association (association code) | Regional Vegetation or Land-use Class * (name source) |
|---|---|---|
| Other Urban or Built-up Land | Not defined - Anderson land-use class | Other Urban or Built-up Land (17) (Anderson et al. 1976) |
| Piedmont / Coastal Plain Oak - Beech / Heath Forest | *Fagus grandifolia - Quercus (alba, velutina, prinus) / Kalmia latifolia* Forest (CEGL006919) | Piedmont / Coastal Plain Oak - Beech / Heath Forest (Fleming et al. 2006) |
| Piedmont / Low Elevation Mixed Oak / Heath Forest | *Quercus alba - Quercus (coccinea, velutina, prinus) / Gaylussacia baccata* Forest (CEGL008521) | Piedmont / Low Elevation Mixed Oak / Heath Forest (Fleming et al. 2006) |
| Residential | Not defined - Anderson land-use class | Residential (11) (Anderson et al. 1976) |
| Salt Scrub | *Iva frutescens / Spartina patens* Shrubland (CEGL003921) | Salt Scrub (Fleming et al. 2006) |
| Semipermanent Impoundment | Not defined - nonstandard, park-specific vegetation class | Semipermanent Impoundment (park-specific name) |
| Successional Black Walnut Forest | *Juglans nigra / Verbesina alternifolia* Forest (CEGL007879) | Successional Black Walnut (NatureServe 2007) |
| Successional Mixed Scrub | Not defined - nonstandard, park-specific vegetation class | Successional Mixed Scrub (park-specific name) |
| Successional Sweetgum Forest | *Liquidambar styraciflua* Forest (CEGL007216) | Successional Sweetgum Forest (NatureServe 2007) |
| Successional Tree-of-Heaven Forest | *Ailanthus altissima* Forest (CEGL007191) | Successional Tree-of-Heaven Forest (NatureServe 2007) |
| Successional Tuliptree - Loblolly Pine Forest | *Liriodendron tulipifera - Pinus taeda* Forest (CEGL007521) | Successional Tuliptree - Loblolly Pine Forest (NatureServe 2007) |
| Tidal Bald Cypress Forest / Woodland | *Taxodium distichum / Carex hyalinolepis* Woodland (CEGL004654) | Tidal Bald Cypress Forest / Woodland (Fleming et al. 2006) |
| Tidal Freshwater Marsh | *Peltandra virginica - Pontederia cordata* Tidal Herbaceous Vegetation (CEGL004706) | Tidal Freshwater Marsh (Fleming et al. 2006) |
| Tidal Mesohaline and Polyhaline Marsh | *Spartina alterniflora - Distichlis spicata* Tidal Herbaceous Vegetation (CEGL006586)<br>OR<br>*Spartina alterniflora - Polygonum punctatum - Amaranthus cannabinus* Herbaceous Vegetation (CEGL006418) | Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) (park-specific name)<br>Tidal Mesohaline and Polyhaline Marsh (Transitional Marsh) (park-specific name) |
| Tidal Oligohaline Marsh | *Phragmites australis* Tidal Herbaceous Vegetation (CEGL004187)<br>OR<br>*Spartina cynosuroides* Herbaceous Vegetation (CEGL004195)<br>OR<br>*Hibiscus moscheutos - Polygonum punctatum - Peltandra virginica* Tidal Herbaceous Vegetation (CEGL006181)<br>OR<br>*Peltandra virginica - Schoenoplectus (pungens, tabernaemontani)* Tidal Herbaceous Vegetation (CEGL006578)<br>OR<br>*Schoenoplectus americanus - Spartina patens* Herbaceous Vegetation (CEGL006612) | Tidal Oligohaline Marsh (Common Reed Tidal Marsh) (park-specific name)<br>Tidal Oligohaline Marsh (Big Cordgrass Type) (Fleming et al. 2006)<br>Tidal Oligohaline Marsh (Mixed Forbs Type) (Fleming et al. 2006)<br>Tidal Oligohaline Marsh (Interior Depression Marsh) (park-specific name)<br>Tidal Oligohaline Marsh (Saltmeadow Cordgrass - Olney Three-Square Low Interior Marsh Type) (Fleming et al. 2006) |
| Tidal Shrub Swamp (Wax Myrtle Type) | *Morella cerifera - Rosa palustris / Thelypteris palustris* var. *pubescens* Shrubland (CEGL004656) | Tidal Shrub Swamp (Wax Myrtle Type) (park-specific name) |
| Transportation, Communications, and Utilities | Not defined - Anderson land-use class | Transportation, Communications, and Utilities (14) (Anderson et al. 1976) |
| Water | Not defined - Anderson land-use class | Water (5) (Anderson et al. 1976) |

* Equivalent to the Common name (Park-specific) as used in detailed descriptions in Appendix I.

land-use class name. Representative photographs of most of the vegetation classes are provided after the descriptions.

Photographs were taken by VADNH staff unless otherwise indicated. A bibliography for the sources cited in the global vegetation descriptions from the USNVC is also provided in Appendix I.

Fields used in the local and global descriptions are defined in Appendix J. Each USNVC association is also crosswalked to the state classification for Virginia (Fleming et. al 2006). The state conservation rank (S Rank), global conservation rank (G Rank), and classification confidence for state and global classifications are included in the descriptions. Definitions of the conservation ranks are listed in Appendix E.

The dichotomous key to the vegetation classes of Colonial National Historical Park is presented in Appendix K. The dichotomous key should be used in conjunction with the detailed vegetation descriptions.

Accuracy Assessment

Positional Accuracy

The final horizontal positional accuracies of the leaf-on and leaf-off mosaics are 1.047 meters and 0.943 meters, respectively, both of which meet Class 1 National Map Accuracy Standards (FGDC 1998b). A copy of each spreadsheet, containing the x and y coordinates for each ground control point and the accuracy calculation formula, is included in the NCSU-CEO data archive.

Thematic Accuracy

The results of thematic accuracy assessment for the original vegetation map were calculated with a contingency matrix (Table 12). The Kappa Index for the original vegetation map was 72.8% ± 5.7%, with an overall accuracy of 74.3%. This accuracy falls below the USGS-NPS VMP requirement of 80%. Nine classes have errors of omission that fall below 80%, and six classes have errors of commission that fall below 80%. Errors of omission are errors in classifying the accuracy assessment observation and represent the probability that the ground samples have been classed correctly. Errors of commission are map errors and denote the probability that the mapped vegetation associations represent the associations actually found on the ground

Since the overall thematic accuracy did not meet the 80% USGS-NPS VMP standard, all cases where accuracy assessment observations differed from the mapped data were reviewed to determine which errors were acceptable or understandable and which errors could be easily corrected to increase the accuracy of the map. Examination of the errors associated with each observation shows that they can be attributed to below minimum mapping unit inclusions of other vegetation types within the target polygons, problems with field keys and/or descriptions that lead to user error, accuracy assessment points falling within ecotones or transitional areas, seasonal constraints on vegetation identification, compositional similarities among map classes making them difficult to discern in the field, or to the misclassification of polygons during initial photo interpretation.

Problems with the field keys were addressed by modifying the keys to better help the user make distinctions between similar vegetation types. Descriptions of map classes were modified, where needed, to include comments about similar vegetation classes or seasonal constraints on vegetation identification. Polygons that could be confidently reclassified using accuracy assessment data were reattributed in the final version of the map and minor refinements to the map were made using information collected during accuracy assessment.

The following revisions were made to the vegetation map:

- The ecotonal area between two polygons mapped as Coastal Plain / Piedmont Small-Stream Floodplain Forest and Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash – Red Maple Type) was edited to better reflect what was observed on the ground.
- Two polygons initially mapped as Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash – Red Maple Type) were reclassified as Non-Riverine Saturated Forest based on accuracy assessment data and the landscape position.
- Three polygons initially mapped as Coastal Plain Loblolly Pine - Oak Forest were reclassified as Successional Tuliptree – Loblolly Pine Forest.
- A 0.6 hectare inclusion of Tidal Bald Cypress Forest / Woodland was split out of a polygon initially mapped as Coastal Plain Loblolly Pine - Oak Forest.
- Three polygons initially mapped as Mesic Mixed Hardwood Forest were reclassified as Acidic Oak – Hickory Forest, Piedmont / Coastal Plain Oak - Beech / Heath Forest, and Successional Tuliptree - Loblolly Pine Forest.
- The boundary between a polygon mapped as Mesic Mixed Hardwood Forest and the adjacent Coastal Plain / Piedmont Small-Stream Floodplain Forest was refined to better reflect what was observed on the ground.
- One polygon initially mapped as Non-Riverine Saturated Forest was reclassified to Successional Tuliptree - Loblolly Pine Forest.
- One polygon initially mapped as Salt Scrub was reclassified to Coastal Plain Loblolly Pine - Oak Forest .
- A 1.2 ha inclusion of Tidal Oligohaline Marsh was split out of a polygon initially mapped as Coastal Plain Loblolly Pine - Oak Forest .
- A portion of the single polygon mapped as Successional Tree-of-Heaven Forest was remapped to split out an area of Sucessional Tuliptree – Loblolly Pine Forest.
- Seven polygons initially mapped as Tidal Oligohaline Marsh were reclassified to the map class Tidal Mesohaline and Polyhaline Marsh.
- A new polygon of Coastal Plain Dry Calcareous Forest encountered during accuracy assessment, in transit between sampling points, was split out of an area initially mapped as Mesic Mixed Hardwood Forest.

A second contingency matrix was constructed using the revised vegetation map as reference data. The final contingency matrix based on the revised vegetation map is presented in Table 13. The Kappa Index for the final vegetation map was 83.8% ± 4.7%, with an overall accuracy of 84.7%. Errors of omission in the final vegetation map equal or exceed 80% for all but five map classes: Coastal Plain Loblolly Pine – Oak Forest (76%), Coastal Plain Mesic Calcareous Ravine Forest (25%), Successional Black Walnut Forest (75%), Successional

Table 12. Contingency matrix and calculated errors for the thematic accuracy assessment of the original vegetation map for Colonial National Historical Park. Cells highlighted in gray show the number of sampling points that were correct.

| | Mapped Vegetation Class (Reference Data) | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Accuracy Assessment Observation | Acidic Oak - Hickory Forest | Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type) | Coastal Plain / Piedmont Small-Stream Floodplain Forest | Coastal Plain Calcareous Seepage Swamp | Coastal Plain Loblolly Pine - Oak Forest | Coastal Plain Mesic Calcareous Ravine Forest | Disturbed Tidal Hardwood Swamp | Golden Bamboo Shrubland | Loblolly Pine Plantation | Mesic Mixed Hardwood Forest | Non-Riverine Saturated Forest | Piedmont / Coastal Plain Oak - Beech / Heath Forest | Salt Scrub | Successional Black Walnut Forest | Successional Tree-of-Heaven Forest | Successional Tuliptree - Loblolly Pine Forest | Tidal Bald Cypress Forest / Woodland | Tidal Freshwater Marsh | Tidal Mesohaline and Polyhaline Marsh | Tidal Oligohaline Marsh | Tidal Shrub Swamp (Wax Myrtle Type) | Grand Total | Error of Commission (Percent Correct) |
| Acidic Oak - Hickory Forest | 5 | | | | | | | | | 2 | | | | | | | | | | | | 7 | 71% |
| Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type) | | 1 | 2 | | | | | | | | 1 | | | | | | | | | | | 4 | 25% |
| Coastal Plain / Piedmont Small-Stream Floodplain Forest | | | 4 | | | | | | | | | | | | | | | | | | | 4 | 100% |
| Coastal Plain Calcareous Seepage Swamp | | | | 5 | | | | | | | | | | | | | | | | | | 5 | 100% |
| Coastal Plain Loblolly Pine - Oak Forest | | | | | 12 | | | | | | | | 1 | | | 1 | | | | | | 14 | 86% |
| Coastal Plain Mesic Calcareous Ravine Forest | | | | | | 1 | | | | | | | | | | | | | | | | 1 | 100% |
| Disturbed Tidal Hardwood Swamp | | | | | | | 3 | | | | | | | | | | | | | | | 3 | 100% |
| Golden Bamboo Shrubland | | | | | | | | 2 | | | | | | | | | | | | | | 2 | 100% |
| Loblolly Pine Plantation | | | | | | | | | 4 | | | | | | | | | | | | | 4 | 100% |
| Mesic Mixed Hardwood Forest | | | | | | 3 | | | | 24 | | 1 | | | | 3 | | | | | | 31 | 77% |
| Non-Riverine Saturated Forest | | 2 | | | | | | | | | 2 | | | | | | | | | | | 4 | 50% |
| Piedmont / Coastal Plain Oak - Beech / Heath Forest | | | | | | | | | | 1 | | 4 | | | | | | | | | | 5 | 80% |
| Salt Scrub | | | | | | | | | | | | | 4 | | | | | | | | | 4 | 100% |
| Semipermanent Impoundment | | | | | | | | | | | | | | | | | | | | 1 | | 1 | NA |
| Successional Black Walnut Forest | | | | | | | | | | | | | | 3 | | | | | | | | 3 | 100% |
| Successional Mixed Scrub | | | | | 1 | | | | | | | | | 1 | | 1 | | | | | | 3 | NA |
| Successional Tuliptree - Loblolly Pine Forest | | | | | 6 | | | | 1 | 3 | 1 | | | | 1 | 25 | | | | | | 37 | 68% |
| Tidal Bald Cypress Forest / Woodland | | | | | 1 | | | | | | | | | | | | 5 | | | | | 6 | 83% |
| Tidal Freshwater Marsh | | | | | | | | | | | | | | | | | | 6 | | | | 7 | 86% |
| Tidal Mesohaline and Polyhaline Marsh | | | | | | | | | | | | | | | | | | 1 | 4 | 7 | | 12 | 33% |
| Tidal Oligohaline Marsh | | | | | | | | | | | | | | | | | | 3 | 1[1] | 21 | | 25 | 84% |
| Tidal Shrub Swamp (Wax Myrtle Type) | | | | | | | | | | | | | | | | | | | | | 1 | 1 | 100% |
| Grand Total | 5 | 3 | 6 | 5 | 20 | 4 | 3 | 2 | 5 | 30 | 4 | 5 | 5 | 4 | 1 | 30 | 5 | 10 | 5 | 30 | 1 | 183 | |
| Error of Omission (Percent Correct) | 100% | 33% | 67% | 100% | 60% | 25% | 100% | 100% | 80% | 80% | 50% | 80% | 80% | 75% | 0% | 83% | 100% | 60% | 80% | 70% | 100% | | |

| | |
|---|---|
| Total points correct | 136 |
| Overall Accuracy | 74.3% |
| Kappa Index | 72.8% |
| 90% Confidence Interval | 5.7% |

Table 13. Contingency matrix and calculated errors for the final edited vegetation map for Colonial National Historic Park. Cells highlighted in gray show the number of sampling points that were correct.

| | Mapped Vegetation Class (Reference Data) | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Accuracy Assessment Observation | Acidic Oak - Hickory Forest | Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type) | Coastal Plain / Piedmont Small-Stream Floodplain Forest | Coastal Plain Calcareous Seepage Swamp | Coastal Plain Loblolly Pine - Oak Forest | Coastal Plain Mesic Calcareous Ravine Forest | Disturbed Tidal Hardwood Swamp | Golden Bamboo Shrubland | Loblolly Pine Plantation | Mesic Mixed Hardwood Forest | Non-Riverine Saturated Forest | Piedmont / Coastal Plain Oak - Beech / Heath Forest | Salt Scrub | Successional Black Walnut Forest | Successional Tree-of-Heaven Forest | Successional Tuliptree - Loblolly Pine Forest | Tidal Bald Cypress Forest / Woodland | Tidal Freshwater Marsh | Tidal Mesohaline and Polyhaline Marsh | Tidal Oligohaline Marsh | Tidal Shrub Swamp (Wax Myrtle Type) | Grand Total | Error of Commission (Percent Correct) |
| Acidic Oak - Hickory Forest | 6 | | | | | | | | | 1 | | | | | | | | | | | | 7 | 86% |
| Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type) | | 2 | 1 | | | | | | | | 1 | | | | | | | | | | | 4 | 50% |
| Coastal Plain / Piedmont Small-Stream Floodplain Forest | | | 5 | | | | | | | | | | | | | | | | | | | 5 | 100% |
| Coastal Plain Calcareous Seepage Swamp | | | | 5 | | | | | | | | | | | | | | | | | | 5 | 100% |
| Coastal Plain Loblolly Pine - Oak Forest | | | | | 13 | | | | | | | | | | | 1 | | | | | | 14 | 93% |
| Coastal Plain Mesic Calcareous Ravine Forest | | | | | | 1 | | | | | | | | | | | | | | | | 1 | 100% |
| Disturbed Tidal Hardwood Swamp | | | | | | | 3 | | | | | | | | | | | | | | | 3 | 100% |
| Golden Bamboo Shrubland | | | | | | | | 2 | | | | | | | | | | | | | | 2 | 100% |
| Loblolly Pine Plantation | | | | | | | | | 4 | | | | | | | | | | | | | 4 | 100% |
| Mesic Mixed Hardwood Forest | | | | | | 3 | | | | 23 | | 1 | | | | 3 | | | | | | 30 | 77% |
| Non-Riverine Saturated Forest | | | | | | | | | | | 4 | | | | | | | | | | | 4 | 100% |
| Piedmont / Coastal Plain Oak - Beech / Heath Forest | | | | | | | | | | | | 5 | | | | | | | | | | 5 | 100% |
| Salt Scrub | | | | | | | | | | | | | 4 | | | | | | | | | 4 | 100% |
| Semipermanent Impoundment | | | | | | | | | | | | | | | | | | | 1 | | | 1 | N/A |
| Successional Black Walnut Forest | | | | | | | | | | | | | | 3 | | | | | | | | 3 | 100% |
| Successional Mixed Scrub | | | | | 1 | | | | | | | | | 1 | | 1 | | | | | | 3 | N/A |
| Successional Tuliptree - Loblolly Pine Forest | | | | | 3 | | | | 1 | 2 | | | | | 1 | 30 | | | | | | 37 | 81% |
| Tidal Bald Cypress Forest / Woodland | | | | | | | | | | | | | | | | | 6 | | | | | 6 | 100% |
| Tidal Freshwater Marsh | | | | | | | | | | | | | | | | | | 6 | | 1 | | 7 | 86% |
| Tidal Mesohaline and Polyhaline Marsh | | | | | | | | | | | | | | | | | | 1 | 11 | | | 12 | 92% |
| Tidal Oligohaline Marsh | | | | | | | | | | | | | | | | | | 3 | 1 | 21 | | 25 | 84% |
| Tidal Shrub Swamp (Wax Myrtle Type) | | | | | | | | | | | | | | | | | | | | | 1 | 1 | 100% |
| Grand Total | 6 | 2 | 6 | 5 | 17 | 4 | 3 | 2 | 5 | 26 | 5 | 6 | 4 | 4 | 1 | 35 | 6 | 10 | 12 | 23 | 1 | 183 | |
| Error of Omission (Percent Correct) | 100% | 100% | 83% | 100% | 76% | 25% | 100% | 100% | 80% | 88% | 80% | 83% | 100% | 75% | 0% | 86% | 100% | 60% | 92% | 91% | 100% | | |

| | |
|---|---|
| Total points correct | 155 |
| Overall Accuracy | 84.7% |
| Kappa Index | 83.8% |
| 90% Confidence Interval | 4.7% |

Tree-of-Heaven Forest (0%), and Tidal Freshwater Marsh (60%). Four accuracy assessment points that fell in areas mapped as Coastal Plain Loblolly Pine – Oak Forest were not classified in agreement with the map. These errors can be attributed to below minimum mapping unit inclusions of other vegetation types within the target polygons and incomplete inspection of polygons. Since the compositional data collected in accuracy assessment support the original mapped class, a misunderstanding of the key or descriptions seems a likely cause of error. Only 25% of the accuracy assessment points that fell into Coastal Plain Calcareous Ravine Forest were in agreement with the map. This is an understandable error since confirmation of this vegetation in the field can depend on the visibility of several indicator species that are only apparent early in the growing season. Modifications were made to the local descriptions noting that, late in the season when some herb species are not evident, Coastal Plain Mesic Calcareous Ravine Forest may be confused with Mesic Mixed Hardwood Forest. The one polygon of Successional Black Walnut Forest that was classified as Successional Mixed Scrub was transitional in composition and structure and could not be confidently reclassified based on accuracy assessment data. The error of omission for Successional Tree-of-Heaven Forest is 0% since it is mapped as only one polygon and the polygon was identified as Successional Tuliptree - Loblolly Pine Forest during accuracy assessment. Examination of accuracy assessment data revealed that only a small portion of the polygon was observed and that tree of heaven (*Ailanthus altissima*) may have been misidentified as black walnut (*Juglans nigra*). Four polygons mapped as Tidal Freshwater Marsh were identified as other tidal marsh map classes in accuracy assessment. Vegetation at some of these locations was transitional between concepts and difficult to classify from accuracy assessment data.

The error of commission exceeds 80% for all classes in the final vegetation map except Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type) (50%) and Mesic Mixed Hardwood Forest (77%). One area mapped as Coastal Plain / Piedmont Small-Stream Floodplain Forest and one area mapped as Non-Riverine Saturated Forest were incorrectly identified as Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash – Red Maple Type) in the accuracy assessment. These map classes can be difficult to distinguish in the field, particularly in ecotonal or disturbed areas, and on photography since all are deciduous wetland forests that have similar photosignatures. Three areas mapped as Coastal Plain Mesic Calcareous Ravine Forest and three areas mapped as Successional Tuliptree – Loblolly Pine Forest were identified as Mesic Mixed Hardwood Forest in accuracy assessment. On the ground, Coastal Plain Mesic Calcareous Ravine Forest may be confused with Mesic Mixed Hardwood Forest, particularly late in the growing season when some of the indicator species are not visible. The two map classes are both deciduous upland forests with similar canopy composition and similar landscape positions, and thus could easily be confused in photo interpretation. Confusion between Successional Tuliptree - Loblolly Pine Forest and Mesic Mixed Hardwood Forest both on the ground and in photointerpretation is also understandable since some stands of these map classes can be compositionally similar, and both map classes can have virtually identical photo signatures. The error of commission could not be calculated for Semipermanent Impoundment or Sucessional Mixed Scrub since these classes were not included in the accuracy assessment. Both classes are present in the contingency matrix to indicate when accuracy assessment observations identified sample points as these classes.

## Vegetation Map Production

The final vegetation map for Colonial National Historical Park is shown in Figures 10, 11, and 12 and a summary of the map class distribution and abundance is provided in Table 14. The mapping boundary was based on park boundary data obtained from Colonial National Historical Park in May 2003. The mapping boundary includes lands under a scenic easement at Swanns Point and it excludes the Cheatham Annex, an area that returned to US Navy ownership in February 2004. The vegetation map was clipped at the park boundary because areas outside the park were not surveyed or included in the accuracy assessment. The original vegetation map was revised based on the accuracy assessment sampling data to correct certain map class errors and create a more accurate map. Specific map edits are listed in the Accuracy Assessment results section of ths report.

Polygons that are attributed with Anderson Level II class 14 (Transportation, Communication, and Utilities) are further attributed in the comment field of the vegetation map attribute table to identify what finer feature they represent (transportation or utilities). The map class Cultural Meadow includes mowed roadsides larger than 0.5 ha. Those polygons representing mowed roadsides are indicated as such in the comment field of the map attribute table. Mowed roadsides smaller than 0.5 hectare are included either with the adjacent road (Anderson Level II class 14 - Transportation, Communication, and Utilities) or the adjacent vegetation polygon. Cultural Meadow polygons not representing mowed roadsides are indicated with the term “field” in the map attribute table. Other Urban or Built-up Land polygons are further distinguished in the comment field of the map attribute table if they represent a golf course, riprap, or a spillway. Disturbed examples of Non-Riverine Saturated Forest that do not have the typical species composition are labeled as "disturbed" in the comment field of the vegetation map attribute table.

A field was included in the map attribute table to indicate which United States Fish and Wildlife Service (USFWS) wetland system (*sensu* Cowardin et al. 1979) a map class represents. Polygons representing wetland formations (i.e. those with temporarily flooded, seasonally flooded, saturated, semipermanently flooded, or tidal hydrologic modifiers) are tagged to the appropriate system in the USFWS wetland classification. Polygons representing vegetation that is not classed as a wetland have the value of “upland” in this field. Polygons representing deepwater areas without emergent vegetation are labeled as “open water” in this field. Maps of polygons representing the wetland map classes are shown in Figures 13 and 14. These maps do not show jurisdictional wetlands, but rather the distribution of wetland map classes with USNVC formations containing wetland modifers. The hydrology of the map class may not represent the hydrology on the ground and small areas of wetlands may be included within polygons classed as “upland”.

## Project Deliverables

Final products of the vegetation mapping project are shown in Table 15. All products have been delivered to the National Park Service by the Virginia Department of Conservation and Recreation, Division of Natural Heritage with this report or at an earlier date by NCSU-CEO.

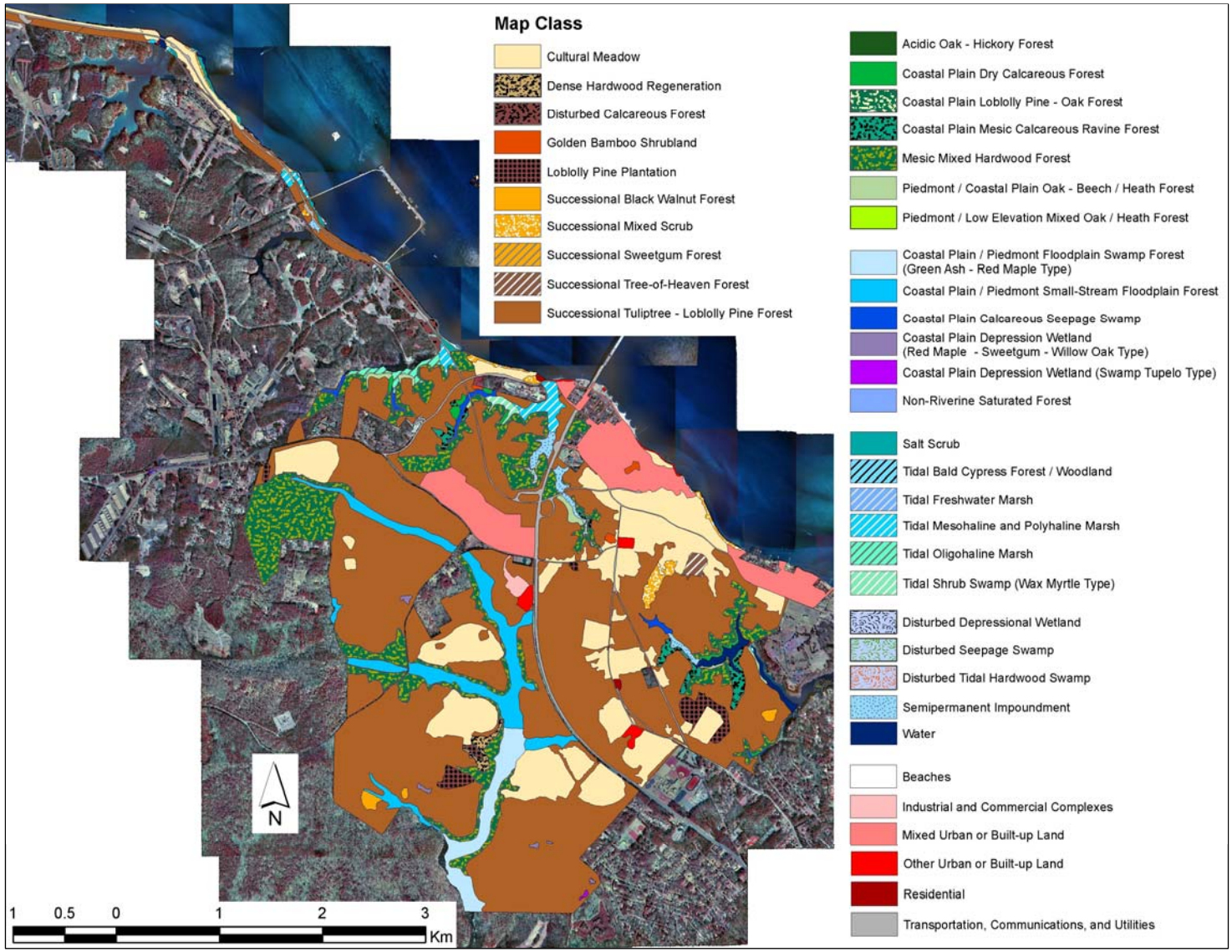



Figure 10. Vegetation and Anderson Level II map classes for Colonial National Historical Park, Yorktown Battlefield north to Bellfield Plantation.

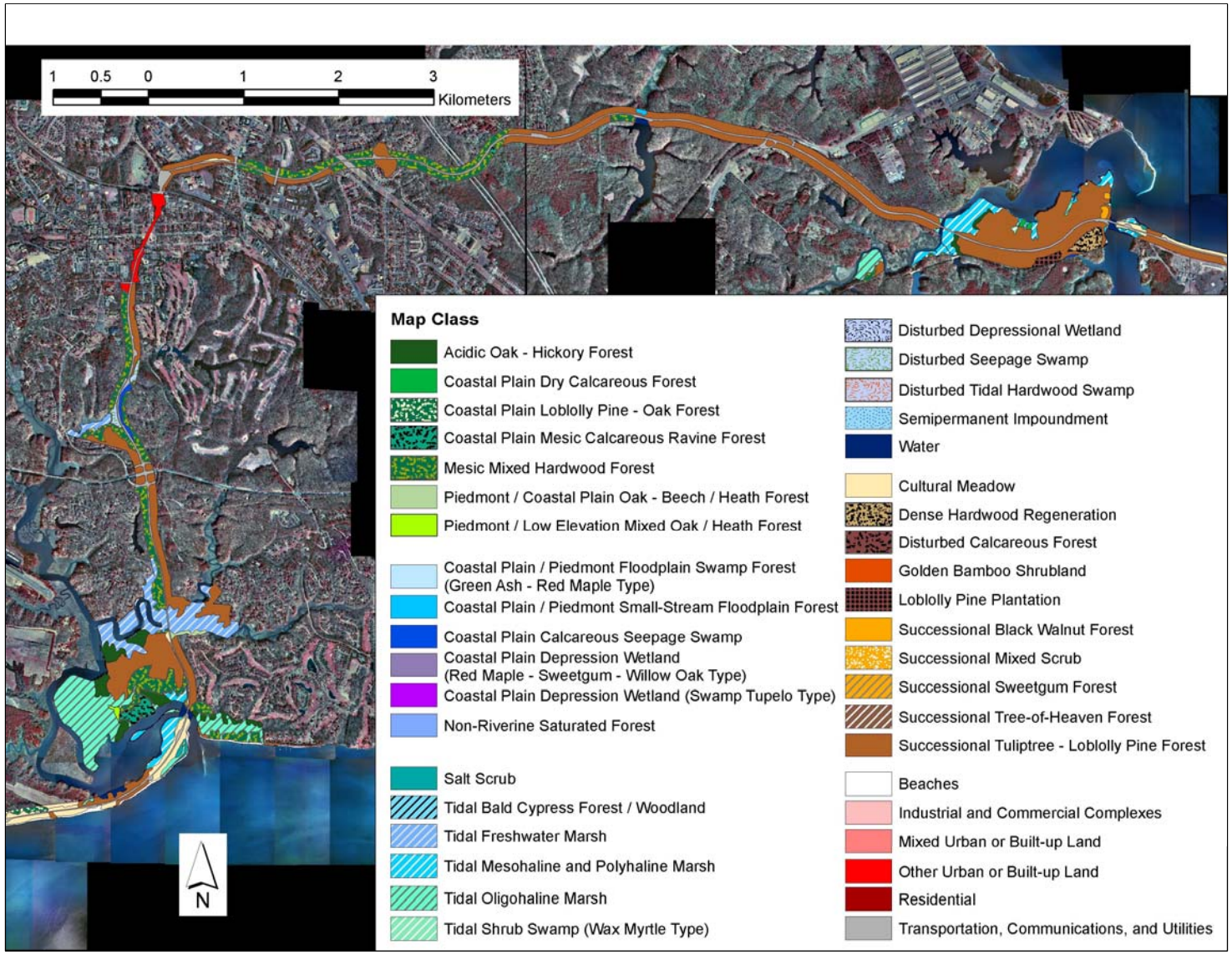



Figure 11. Vegetation and Anderson Level II map classes for Colonial National Historical Park, Poley Point to College Creek.

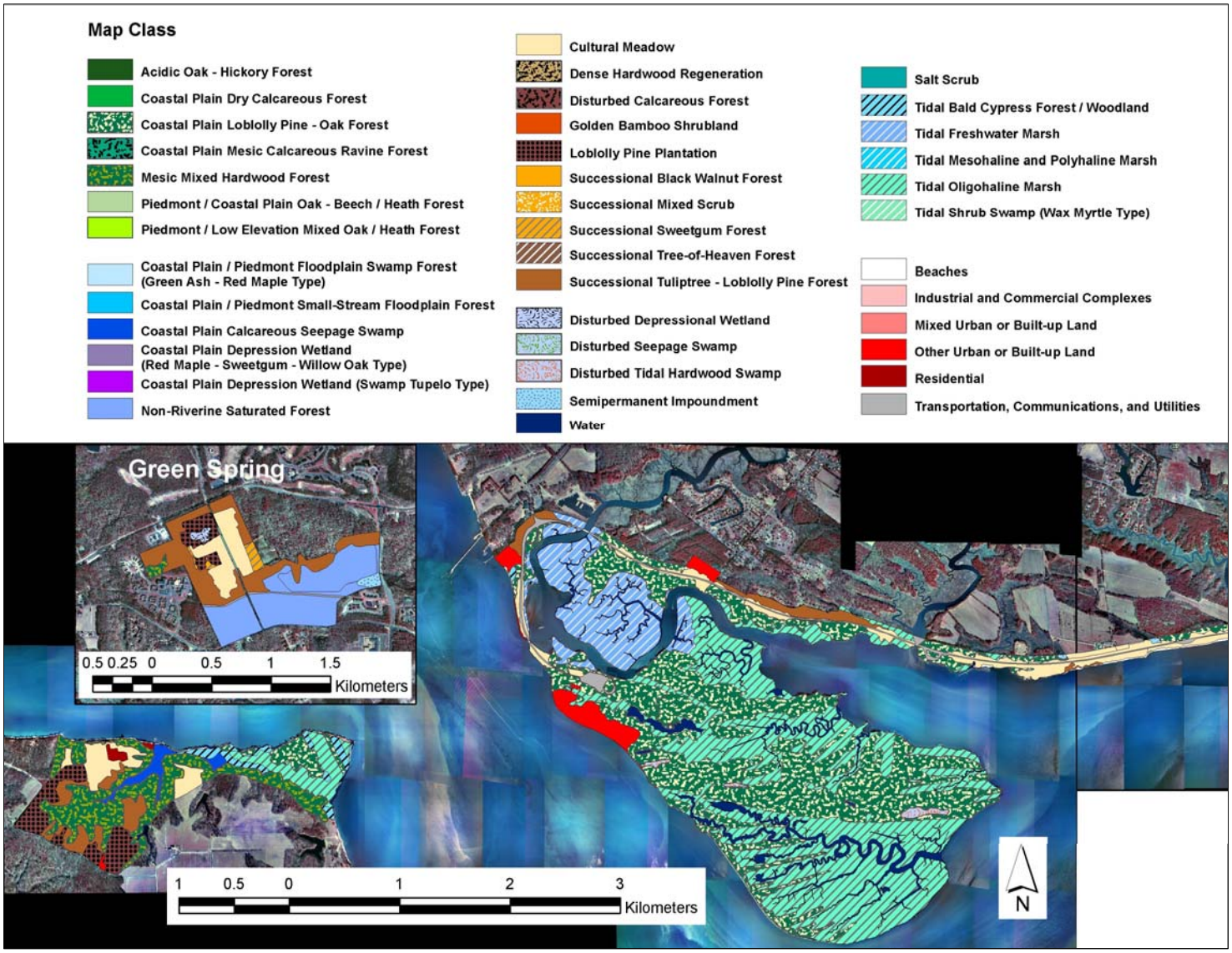



Figure 12. Vegetation and Anderson Level II map classes for Colonial National Historical Park, Jamestown Island, Swanns Point, and Green Spring.

Table 14. Number of polygons, total mapped hectares (acres), and number of quantitative plots sampled for 40 vegetation-map classes at Colonial National Historical Park.

| Map class | Number of polygons | Total mapped hectares | Total mapped acres | Number of plots sampled |
|---|---|---|---|---|
| Acidic Oak - Hickory Forest | 12 | 18.9 | 46.8 | 1 |
| Beaches | 25 | 11.4 | 28.2 | 0 |
| Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type) | 1 | 30.9 | 76.4 | 2 |
| Coastal Plain / Piedmont Small-Stream Floodplain Forest | 7 | 65.9 | 162.9 | 1 |
| Coastal Plain Calcareous Seepage Swamp | 11 | 19.5 | 48.3 | 3 |
| Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type) | 5 | 1.8 | 4.4 | 1 |
| Coastal Plain Depression Wetland (Swamp Tupelo Type) | 1 | 0.3 | 0.7 | 0 |
| Coastal Plain Dry Calcareous Forest | 9 | 5.8 | 14.4 | 6 |
| Coastal Plain Loblolly Pine - Oak Forest | 29 | 310.7 | 767.8 | 8 |
| Coastal Plain Mesic Calcareous Ravine Forest | 9 | 20.4 | 50.3 | 2 |
| Cultural Meadow | 71 | 363.0 | 897.0 | 0 |
| Dense Hardwood Regeneration | 2 | 10.9 | 26.9 | 0 |
| Disturbed Calcareous Forest | 6 | 8.8 | 21.7 | 1 |
| Disturbed Depressional Wetland | 1 | 1.5 | 3.7 | 0 |
| Disturbed Seepage Swamp | 6 | 5.9 | 14.7 | 0 |
| Disturbed Tidal Hardwood Swamp | 3 | 4.6 | 11.4 | 1 |
| Golden Bamboo Shrubland | 3 | 2.1 | 5.3 | 0 |
| Industrial and Commercial Complexes | 1 | 3.8 | 9.4 | 0 |
| Loblolly Pine Plantation | 13 | 51.4 | 127.1 | 0 |
| Mesic Mixed Hardwood Forest | 55 | 338.2 | 835.8 | 3 |
| Mixed Urban or Built-up Land | 3 | 109.7 | 271.1 | 0 |
| Non-Riverine Saturated Forest | 5 | 53.4 | 132.0 | 2 |
| Other Urban or Built-up Land | 24 | 38.8 | 95.8 | 0 |
| Piedmont / Coastal Plain Oak - Beech / Heath Forest | 10 | 7.6 | 18.7 | 2 |
| Piedmont / Low Elevation Mixed Oak / Heath Forest | 1 | 0.9 | 2.2 | 1 |
| Residential | 4 | 3.4 | 8.3 | 0 |
| Salt Scrub | 9 | 5.5 | 13.6 | 0 |
| Semipermanent Impoundment | 8 | 12.9 | 31.9 | 0 |
| Successional Black Walnut Forest | 5 | 5.6 | 13.8 | 0 |
| Successional Mixed Scrub | 7 | 11.6 | 28.6 | 0 |
| Successional Sweetgum Forest | 3 | 2.9 | 7.1 | 0 |
| Successional Tree-of-Heaven Forest | 1 | 4.0 | 10.0 | 0 |
| Successional Tuliptree - Loblolly Pine Forest | 98 | 1250.5 | 3090.0 | 0 |
| Tidal Bald Cypress Forest / Woodland | 9 | 12.0 | 29.6 | 3 |
| Tidal Freshwater Marsh | 17 | 124.8 | 308.4 | 2 |
| Tidal Mesohaline and Polyhaline Marsh | 24 | 42.7 | 105.6 | 1 |
| Tidal Oligohaline Marsh | 43 | 367.8 | 908.9 | 8 |
| Tidal Shrub Swamp (Wax Myrtle Type) | 5 | 4.2 | 10.4 | 0 |
| Transportation, Communications, and Utilities | 14 | 93.5 | 231.1 | 0 |
| Water | 59 | 70.6 | 174.3 | 0 |
| TOTAL | 619 | 3498.4 | 8644.5 | 48 |

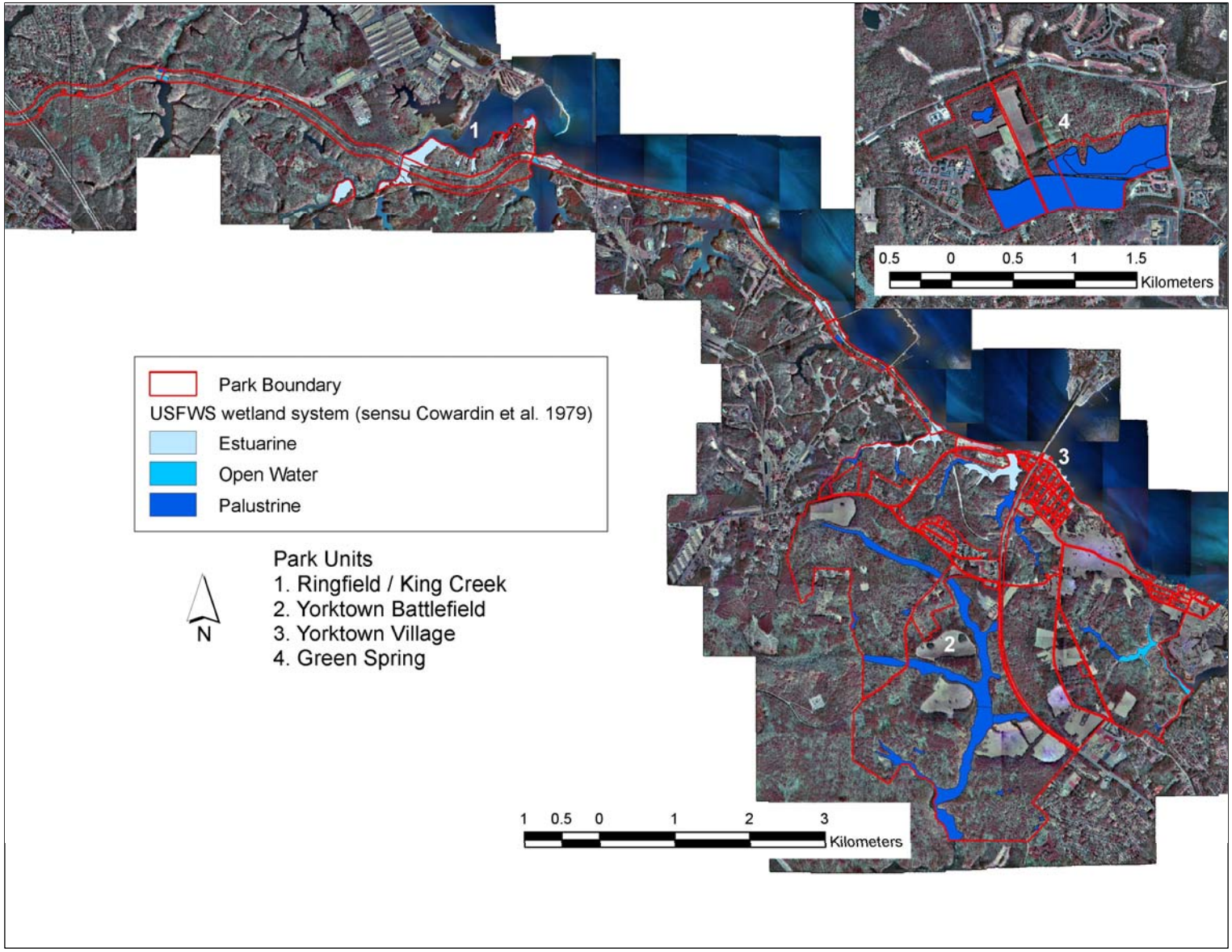



Figure 13. Distribution of wetland vegetation-map classes in the eastern half of Colonial National Historical Park.

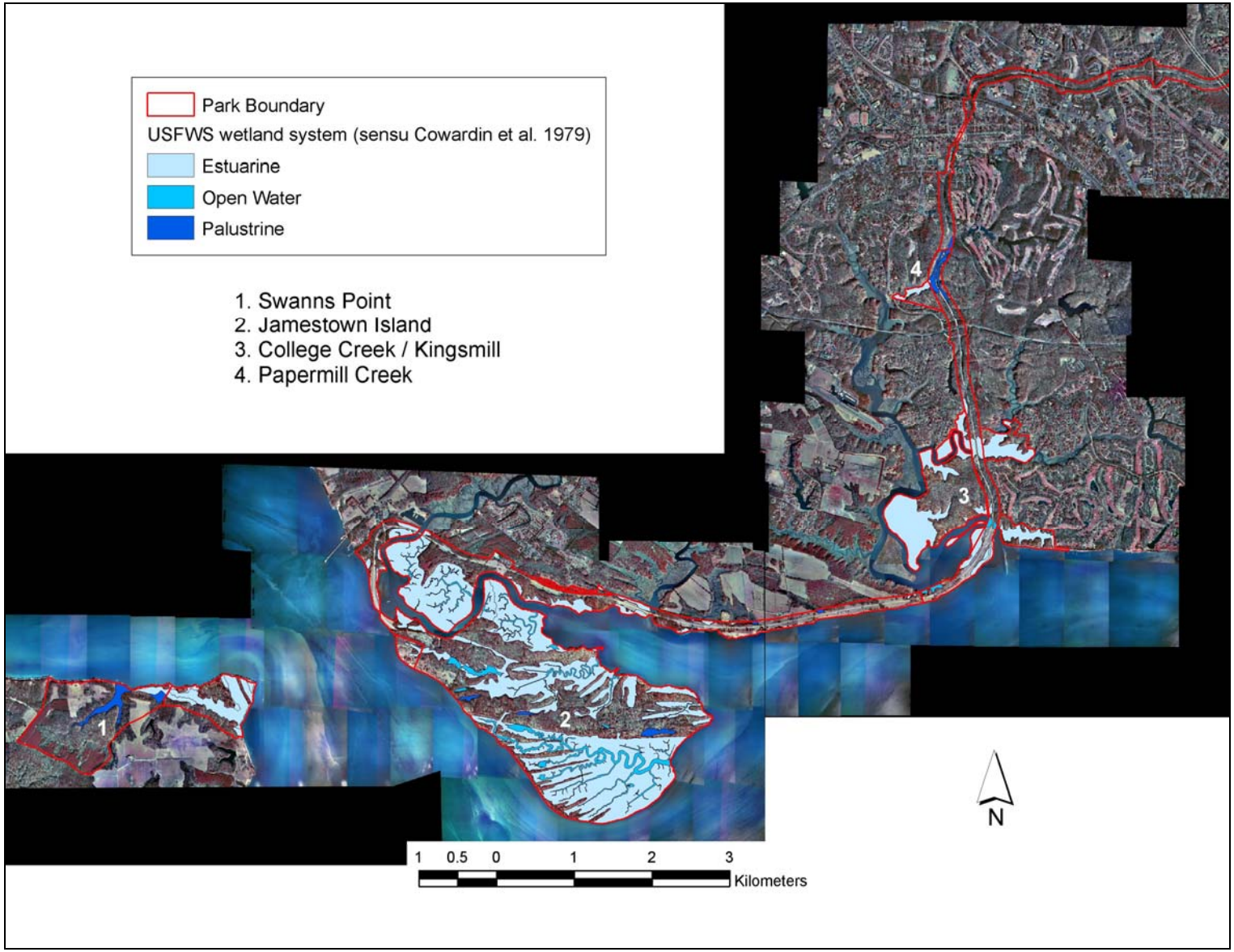



Figure 14. Distribution of wetland vegetation-map classes in the western half of Colonial National Historical Park.

Table 15. Summary of products resulting from the classification and mapping of vegetation at Colonial National Historical Park.

| Product | FGCD-complaint spatial metadata |
|---|---|
| Park orthophoto mosaics (leaf-on and leaf-off) | Yes |
| Vegetation plot sampling data in the PLOTS 2.0 database | Not applicable |
| Vegetation plot point data (ArcView shapefile) | Yes |
| Thematic accuracy assessment sampling points (ArcView shapefile) | Yes |
| Digital photos representative of vegetation types | Not applicable |
| Association-level vegetation polygon map | Yes |
| Final report with vegetation keys and descriptions in digital and hardcopy format | Not applicable |

# Discussion

## Vegetation Classification and Characterization

A comprehensive regional analysis resulted in the classification of over 100 USNVC associations, spanning nearly all major physiographic provinces in the region. Thirty-five of the associations are represented in the seven national parks included in this study. An additional 19 associations and 12 nonstandard, park-specific classes representing disturbed, cultural, or exotic vegetation were also recognized from the seven parks. This study at Colonial National Historical Park identified and characterized 40 map classes, representing 31 USNVC associations, seven Anderson Level II land-use classes (Anderson et al. 1976), and seven nonstandard, park-specific vegetation classes (Table 11). The diversity seen in the vegetation map reflects the varied environmental settings of Colonial National Historical Park, as well as the park's location in the midst a rapidly developing urban/suburban area, and its mandate to preserve historic and cultural features.

Transitional vegetation and cultural map classes cover 56.7% of the land in Colonial National Historical Park. Transitional vegetation alone covers 37.4% of the land in the park (1308.4 ha [3233.0 ac]). This vegetation is the result of relatively recent (20-80 years) abandonment of pine plantations and fields, or tree canopy removal by disturbances such as pine bark beetle infestation, wind, beaver activity, and timber harvests or other silvicultural practices. Transitional uplands are dominated by early successional, weedy tree species in the canopy and subcanopy, and can have high cover of nonnative plants in the shrub and herbaceous layers. Transitional vegetation is also found fringing roadways and parking areas where upland and wetland vegetation has been disturbed or fragmented by road construction. Beaver-disturbed areas, or areas artificially impounded, typically occur as semipermanently flooded habitats variously dominated by trees, shrubs, herbs, or open water. Where roads or berms have altered the natural tidal flooding regime of formerly tidal vegetation, disturbed wetlands exist that are transitional between oligohaline and freshwater systems. Each of these map classes are rapidly changing in species composition and vegetation structure. In the absence of beaver and nonnative plant species invasions, some of these stands would eventually succeed into one of the later successional forest types mapped in the park. Map classes representing transitional vegetation include: Disturbed Calcareous Forest, Disturbed Depressional Wetland, Disturbed Seepage Swamp, Disturbed Tidal Hardwood Swamp, Semipermanent Impoundment, Successional Black Walnut Forest, Successional Mixed Scrub, Successional Sweetgum Forest, Successional Tree-of-Heaven Forest, and Successional Tuliptree - Loblolly Pine Forest. These map classes are described in Appendix I.

Cultural map classes cover 19.3% of the park's acreage (676.6 ha [1671.9 ac]). Cultural map classes include Anderson land-use classes as well as vegetation resulting from planting or active cultivation. Cultural Meadow is the most common cultural map class in the park, covering 363.0 ha (897.0 ac). Cultural Meadow includes all mowed or maintained fields and agricultural leases in the park, as well as mowed roadsides over 0.5 ha in size. Most of the Cultural Meadow areas are managed to keep an open landscape similar to the open farmland conditions found during the 18th century. Other cultural map classes include Dense Hardwood Regeneration, Golden Bamboo Shrubland, Loblolly Pine Plantation, Industrial and Commercial Complexes, Mixed

Urban or Built-up Land, Other Urban or Built-up Land, Residential, and Transportation, Communications, and Utilities. These map classes are described in Appendix I.

Wetland map classes account for 23.8% of the park area or about 835.9 ha (2065.4 ac). These map classes include areas of open water on the coastline where the park boundary falls within large water bodies. Open water is also found on larger tidal creeks in and around Jamestown Island, and in ponds, and is mapped as a total of 70.6 ha (174.3 ac). Wetland map classes also include tidal wetlands (568.5 ha [1404.7 ac]), nontidal wetlands (171.9 ha [424.7 ac]), and other transitional or disturbed wetland vegetation as described above (25.0 ha [61.7 ac]). Tidal wetlands (including intertidal beaches) cover 16.3% of the park area. Tidal vegetation is represented by the map classes Salt Scrub, Tidal Bald Cypress Forest / Woodland, Tidal Freshwater Marsh, Tidal Mesohaline and Polyhaline Marsh, Tidal Oligohaline Marsh, and Tidal Shrub Swamp (Wax Myrtle Type).

Tidal Oligohaline Marsh is the most common tidal vegetation in the park (367.8 ha [908.9 ac]) and occurs at Swanns Point, Jamestown Island, Kingsmill / College Creek, and as small patches along King Creek. It is dominated by species indicative of oligohaline conditions, where salt concentrations are between 0.5 and 5 ppt. This map class includes five associations which can occur singly or in a complex. Much of the vegetation mapped as Tidal Oligohaline Marsh is either the association Tidal Oligohaline Marsh (Mixed Forbs Type) or Tidal Oligohaline Marsh (Big Cordgrass Type). Tidal Oligohaline Marsh (Mixed Forbs Type) is dominated by variable mixtures of tidal forbs such as dotted smartweed (*Polygonum punctatum*), green arrow arum (*Peltandra virginica*), crimsoneyed rosemallow (*Hibiscus moscheutos* ssp. *moscheutos*), and narrowleaf cattail (*Typha angustifolia*). It is currently documented from Virginia, Maryland, and New Jersey. Tidal Oligohaline Marsh (Big Cordgrass Type) is dominated by big cordgrass (*Spartina cynosuroides*), and often forms tall, extensive, nearly monospecific stands, particularly along edges of the main tidal channels. It is a common marsh association, ranging from Georgia north to New Jersey. Other associations included in areas mapped as Tidal Oligohaline Marsh include dense stands of the invasive, nonnative grass, common reed (*Phragmites australis*), and less common associations that occur on the interior of larger marshes. Tidal Oligohaline Marsh (Common Reed Tidal Marsh) ranges from Texas to Florida and north to Canada. Tidal Oligohaline Marsh (Interior Depression Marsh) is currently only documented from Virginia. Tidal Oligohaline Marsh (Saltmeadow Cordgrass - Olney Three-Square Low Interior Marsh Type) has been documented from Virginia to New Jersey, but may extend south to Georgia. Due to the difficulty of delineating the five associations separately over large areas, these associations were combined into a single map class that was used in all parks in this study.

Tidal Freshwater Marsh is mapped as 124.8 ha (308.4 ac) and is found at Jamestown Island in the vicinity of Sandy Bay and the upper portions of the Back River, at Papermill Creek, and at College Creek / Kingsmill along Halfway Creek. Tidal Freshwater Marsh is distinguished from other tidal marsh vegetation in Colonial National Historical Park by occurring in areas where there is enough freshwater input to influence the vegetation composition so that the dominant species include green arrow arum (*Peltandra virginica*) and annual wildrice (*Zizania aquatica* var. *aquatica*). This association is found on the Atlantic Coast from Maine to Virginia, excluding New Hampshire and Rhode Island, and occupies a relatively uncommon, specialized habitat. Many examples have been impacted by the damming of tidal rivers and by pollution in urban areas. It is estimated that less than 200 high quality examples remain throughout its range.

Tidal Mesohaline and Polyhaline Marsh covers 42.7 ha (105.6 ac) in the park and is found as small pocket marshes along the York River from Ringfield / King Creek to Yorktown Creek and in the vicinity of College Creek / Kingsmill. This tidal vegetation is characterized by plants associated with mesohaline or polyhaline conditions, where salt concentrations are between 5 and 18 ppt or 18 to 30 ppt, respectively. Tidal Mesohaline and Polyhaline Marsh can be one of two associations, but were combined into one map class since they cannot be mapped separately based on photo signatures. Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) is the more common of the two associations and is distinguished by the dominance of smooth cordgrass (*Spartina alterniflora*) occurring with species indicative of mesohaline conditions such as saltmeadow cordgrass (*Spartina patens*) and inland saltgrass (*Distichlis spicata*). Tidal Mesohaline and Polyhaline Marsh (Transitional Marsh) is distinguished by the dominance of smooth cordgrass (*Spartina alterniflora*) occurring with species indicative of more oligohaline or freshwater conditions such as big cordgrass (*Spartina cynosuroides*), green arrow arum (*Peltandra virginica*), and annual wildrice (*Zizania aquatica* var. *aquatica*). Little is known about the conservation status of these associations. They have been documented from Virgina, Maryland, and Delaware.

Tidal Bald Cypress Forest / Woodland (12.0 ha [29.6 ac]) is found along the James River at Swanns Point with small, disturbed examples mapped at Jamestown Island. This forest forms a fringe between open tidal water and tidal marsh, and can occur along the riverfront or on protected shorelines. This globally rare association occupies very specialized habitats in Maryland and Virginia. Salt Scrub (5.5 ha [13.6 ac]) occurs as small, linear patches along the York River north of Yorktown, and along the James River in the vicinity of Kingsmill. This sandy, tidal shrubland is often found in a complex with tidal herbaceous vegetation. Salt Scrub is a common coastal association found from South Carolina to Massachusetts. Tidal Shrub Swamp (Wax Myrtle Type) covers only 4.2 ha (10.4 ac) in the park and is found in small patches in the vicinity of Yorktown, along Colonial Parkway, Ringfield / King Creek, and at College Creek / Kingsmill. These dense shrublands occur adjacent to tidal marshes and are dominated by the shrub wax myrtle (*Morella cerifera*) in association with narrowleaf cattail (*Typha angustifolia*). Tidal Shrub Swamp (Wax Myrtle Type) is known from North Carolina, Virginia, and Maryland.

Nontidal forested wetlands include six map classes that cover 171.9 ha (424.7 ac) in the park. Coastal Plain / Piedmont Small-Stream Floodplain Forest (65.9 ha [162.9 ac]) and Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type) (30.9 ha [76.4 ac]) are found on the floodplains of small streams in the park. The majority of Coastal Plain / Piedmont Small-Stream Floodplain Forest is mapped in Yorktown Battlefield where it is found along Baptist Run and Great Run over deep, sandy alluvial soils that are subject to occasional, brief flooding, typically once or twice a year. Small areas classed as Coastal Plain / Piedmont Small-Stream Floodplain Forest are also found along Colonial Parkway, just north of Jones Millpond. Coastal Plain / Piedmont Small-Stream Floodplain Forest is characterized by species adapted to well-drained alluvial soils such as tuliptree (*Liriodendron tulipifera*), American sycamore (*Platanus occidentalis*), New York fern (*Thelypteris noveboracensis*), Christmas fern (*Polystichum acrostichoides*), and nodding fescue (*Festuca subverticillata*). The deep, moist, well drained soils of Coastal Plain / Piedmont Small-Stream Floodplain Forest are highly susceptible to nonnative species invasion, and thus it is important not to site trails and roads in the active floodplain and to mitigate impacts from surrounding development. Coastal Plain / Piedmont

Small-Stream Floodplain Forest is a relatively common association (G4), but high quality, undisturbed examples are rare. It is widespread from the Coastal Plain of Maryland and Virginia through the Piedmont of Virginia and North Carolina to the Cumberland Plateau. Coastal Plain / Piedmont Small-Stream Floodplain Forest was mapped in four of the seven parks included in this study. Along Beaverdam Creek in Yorktown Battlefield, Coastal Plain / Piedmont Small-Stream Floodplain Forest grades into Coastal Plain / Piedmont Floodplain Swamp (Green Ash – Red Maple Type), which is found on poorly drained portions of the floodplain, with pronounced seasonal flooding. Coastal Plain / Piedmont Floodplain Swamp (Green Ash – Red Maple Type) typically has high cover of green ash (*Fraxinus pennsylvanica*) and/or red maple (*Acer rubrum*) and more cover by species favoring longer hydroperiods and poorly drained, mucky soils such as lizard's tail (*Saururus cernuus*) and threeway sedge (*Dulichium arundinaceum*). Much of the area mapped as Coastal Plain / Piedmont Floodplain Swamp (Green Ash – Red Maple Type) has been altered by beaver activity, which threatens to convert this area to Semipermanent Impoundment. Coastal Plain / Piedmont Floodplain Swamp (Green Ash – Red Maple Type) is known from the Chesapeake Bay region from Virginia north through Deleware, and into the Coastal Plain of New Jersey. Colonial National Historical Park is the only park in this study where this association was documented.

The four remaining nontidal wetland map classes are considered non-alluvial wetlands. Non-Riverine Saturated Forest is mapped as 53.4 ha (132.0 ac) on a nearly flat, broad stream terrace in the vicinity of Powhatan Creek and Green Spring. This wetland forest is distinguished by its landscape position in an inactive floodplain and the high frequency of hydric oaks and other characteristic herbaceous species. Most of the area mapped as Non-Riverine Saturated Forest at Green Spring is regeneration of sweetgum (*Liquidambar styraciflua*) codominating with loblolly pine (*Pinus taeda*), but there are a few patches of more mature hydric oaks scattered throughout the stand, representing the historic condition of the forest. Non-Riverine Saturated Forest is restricted to extensive, flat terraces and very wide, ancient floodplains that are no longer subject to alluvial processes, but are saturated or seasonally flooded due to a high water table. These specialized wetland habitats were probably never common on the landscape, and mature, undisturbed examples of this globally rare association are quite rare. Non-Riverine Saturated Forest is only known from about 25 sites in 13 counties in Virginia and it may range into Maryland. Much of the suitable habitat for the association has been lost to agriculture, hydrologic alterations, and conversion of hardwood forests to silvicultural pine plantations.

The non-alluvial wetland Coastal Plain Calcareous Seepage Swamp forms over moderately to highly base-rich substrates in the bottoms of ravines that have downcut into Tertiary shell deposits or limesands. The association is endemic to the central Virginia Coastal Plain and is known only from ravines within the James and York River drainages in James City, Surry, and York counties, Virginia. In Colonial National Historical Park, this vegetation covers 30.9 ha (76.3 ac) and is mapped at Swanns Point, along Colonial Parkway near Papermill Creek, and in various ravine bottoms in the vicinity of Yorktown Battlefield. Coastal Plain Calcareous Seepage Swamp is easily recognized in the field by its occurrence in narrow ravine bottoms and the characteristic canopy and herbaceous flora. The examples mapped at Swanns Point represent a unique variant of this association that is codominated by bald cypress (*Taxodium distichum*). High-quality examples of Coastal Plain Calcareous Seepage Swamp are uncommon throughout the range of this globally rare association. Areas of Coastal Plain Calcareous Seepage Swamp are relatively small in size and threatened by beaver activities, agricultural pollutants, hydrologic

disturbances, and logging. Because of their isolated hydrology and small size, these forested wetlands are often exempt from protective wetland regulations and much of the habitat throughout its range is vulnerable to destruction by indirect development impacts such as siltation, canopy removal, and subsequent nonnative species invasions. Despite considerable efforts to inventory this community over the years, fewer than 50 patches of this vegetation are known, covering an aggregate area of perhaps 121 ha (300 ac). In Colonial National Historical Park, wetlands mapped as Disturbed Seepage Swamp may have once been this association, but now lack the species composition to confidently classify them as Coastal Plain Calcareous Seepage Swamp.

Two associations representing non-alluvial, coastal plain depression wetlands are mapped as small, isolated features in the vicinity of Yorktown Battlefield and together cover 2.0 ha (4.9 ac). Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type) and Coastal Plain Depression Wetland (Swamp Tupelo Type) occur as seasonally flooded, deciduous forests in an otherwise upland landscape. These wetlands have fluctuating, seasonally perched water tables, and are believed to be sinkhole features that formed through dissolution of underlying carbonate-rich, shell marl deposits. The marl deposits are too deep to influence soil or water chemistry of the depressions, which are strongly acidic. Coastal Plain Depression Wetland (Swamp Tupelo Type) is subject to deeper flooding and has a longer hydroperiod than Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type). Coastal Plain depression wetlands are known from the Coastal Plain of Virginia north to New York, and can range into the eastern edge of the Piedmont in Virginia. Coastal Plain Depression Wetland (Swamp Tupelo Type) is the less common of the two associations, known only from Virginia and Delaware. These associations are naturally small in size, occurring in complexes over no more than 10 ha (25 ac) and, on average, covering much smaller areas. The greatest threat to this vegetation is incompatible human use of surrounding lands, generally agriculture with insufficient buffers to protect from pesticide and fertilizer use. Since these associations depend on intact hydrology, another major threat is altered hydrology from ditching or over-pumping of groundwater.

Seven upland forest map classes that represent later successional vegetation cover 702.5 ha (1,736.0 ac) or just over 20% of park land in upland areas that have not been converted to pine forests or other transitional vegetation. The most common upland forest map class is Mesic Mixed Hardwood Forest which covers almost 10% (338.2 ha [835.8 ac]) of the park land and is found on mesic lower slopes and ravines. Some of the forested areas in Colonial National Historical Park that are mapped as Successional Tuliptree - Loblolly Pine Forest may have been Mesic Mixed Hardwood Forest prior to canopy removal. Mesic Mixed Hardwood Forest is a common and widespread community in the Mid-Atlantic Piedmont and Coastal Plain and was documented in five of the seven parks in this study. Coastal Plain Loblolly Pine - Oak Forest is the matrix forest of Jamestown Island and the surrounding area, covering 310.7 ha (767.8 ac). It is found in low-lying areas or sandy interfluves surrounded by tidal wetlands, and is distinguished by the presence of oaks and coastal shrubs such as as wax myrtle (*Morella cerifera*) and swamp bay (*Persea palustris*). Coastal Plain Loblolly Pine - Oak Forest was only documented at Colonial National Historical Park and is not in any of the other parks in this study. It is a middle to late successional forest found over sandy soils in the Coastal Plain of Virginia and Maryland. It is thought to follow land clearing or cessation of agriculture in near-coastal areas.

The five remaining upland associations occur as small patches in specialized habitats. Two associations, Coastal Plain Mesic Calcareous Ravine Forest (20.4 ha [50.3 ac]) and Coastal Plain Dry Calcareous Forest (5.8 ha [14.3 ac]), are found on slopes of ravines that cut into Tertiary shell deposits or limesands, including the Pliocene marine shell deposits of the calcium-rich Yorktown Formation. Coastal Plain Mesic Calcareous Ravine Forest is on more mesic, north- to northwest-facing slopes and was mapped at College Creek / Kingsmill, as small patches on the ravine slopes of Yorktown Creek and its tributary, and on the slopes over Wormley Pond. Coastal Plain Dry Calcareous Forest is on dry, convex, southeast- to southwest-facing slopes and is mapped in the vicinity of Yorktown Battlefield on the ravine slopes of Ballard Creek, around Wormley Pond, and at King Creek / Ringfield. Coastal Plain Dry Calcareous Forest is distinguished from Coastal Plain Mesic Calcareous Ravine Forest by its more open canopy structure, more graminoid species cover, the occurrence of eastern redcedar (*Juniperus virginiana* var. *virginiana*), and the general absence of mesophytic species that characterize Coastal Plain Mesic Calcareous Ravine Forest such as pawpaw (*Asimina triloba*), northern spicebush (*Lindera benzoin*), bloodroot (*Sanguinaria canadensis*), northern maidenhair (*Adiantum pedatum*), and black bugbane (*Cimicifuga racemosa*). Also, Coastal Plain Mesic Calcareous Ravine Forest tends to have a better developed herbaceous strata with upwards of 50-75% coverage. Both communities have very restricted ranges, and high quality examples are uncommon. Coastal Plain Mesic Calcareous Ravine Forest is endemic to the southeastern Virginia Coastal Plain, and Coastal Plain Dry Calcareous Forest is only known from fewer than 30 scattered locations in the Coastal Plain of Virginia and Maryland. Timber harvest or other canopy disturbances degrade this community by allowing additional light and aggressive growth of invasive, nonnative plants which thrive in well-lit, calcareous situations and compete with the native flora. The examples of these communities in Colonial National Historical Park represent some of the few protected examples in the world. Areas mapped as the transitional vegetation class Disturbed Calcareous Forest (see above) may have formerly been either Coastal Plain Mesic Calcareous Ravine Forest or Coastal Plain Dry Calcareous Forest, but now have a species composition too altered to assign them a natural community classification.

Acidic Oak - Hickory Forest, Piedmont / Coastal Plain Oak - Beech / Heath Forest, and Piedmont / Low Elevation Mixed Oak / Heath Forest are three upland forest classes that occur over acidic, nutrient-poor soils. Acidic Oak - Hickory Forest is mapped on short, steep slopes and associated flat areas above tidal marshes at Ringfield / King Creek and at College Creek / Kingsmill, covering a total area of 18.9 ha (46.8 ac) in 12 patches. Acidic Oak - Hickory Forest ranges through the Piedmont of the Carolinas and Virginia, north into south-central Maryland, extending into the inner Coastal Plain in parts of Virginia. Throughout most of its range, it is a matrix or large-patch forest. However, on inner Coastal Plain landscapes, such as Colonial National Historical Park, Acidic Oak-Hickory Forest is often found as a small patch forest. It is not a rare community type (G4G5), but extensive stands and stands older than about 80 years old are uncommon, since most of the rolling upland landscapes of the Piedmont have been logged repeatedly since European settlement or converted to pine plantations. Acidic Oak – Hickory Forest was mapped in six of the seven parks included in this study. Piedmont / Coastal Plain Oak - Beech / Heath Forest is mapped on a total of 7.6 ha (18.7 ac) at College Creek / Kingsmill, Papermill Creek, and on the ravine slopes of Ballard Creek and Yorktown Creek in the vicinity of Yorktown Battlefield. It is distinguished from other forests by its occurrence on steep slopes and the presence of a dense shrub layer of mountain laurel (*Kalmia latifolia*). Some polygons mapped as this type may be similar to Mesic Mixed Hardwood Forest, but usually occupy drier,

steeper sites that support fewer mesophytic plants and a greater abundance of heath shrubs. Colonial National Historical Park was the only park in this study where this community was documented. In Virginia, Piedmont / Coastal Plain Oak - Beech Heath Forest is common in the fall-line zone of the Piedmont and adjacent inner Coastal Plain, but is also found on dissected landscapes in the outer Piedmont and the northern Coastal Plain north of James River and occasionally on short, steep bluffs bordering outer Coastal Plain estuaries. It ranges north to New Jersey. Piedmont / Low Elevation Mixed Oak / Heath Forest is found on xeric sites over well-drained, sandy soils derived from fluvial terrace gravels. It is mapped as a single polygon in the College Creek / Kingsmill area of Colonial National Historical Park, where it covers 0.9 ha (2.2 ac). The vegetation in Colonial National Historical Park was classified as this association because of the dominance of black huckleberry (*Gaylussacia baccata*) and presence of chestnut oak (*Quercus prinus*), two species more typical of oak / heath forests in the Piedmont and low elevations of the Central Appalachians. Piedmont / Low Elevation Mixed Oak / Heath Forest is found in three of the seven national parks included in this study. It is a widespread, matrix-forming forest community known from nutrient-poor uplands of Virginia's Piedmont and inner Coastal Plain, and at low elevations in the northern Blue Ridge and Ridge and Valley. It also extends north into Maryland and south to low elevations of Tennessee's Cumberland Plateau.

Of the 40 map classes used to map the vegetation at Colonial National Historical Park, eighteen are equal to natural communities as defined in the Natural Communities of Virginia (http://www.dcr.virginia.gov/natural_heritage/nctoc.shtml). Exemplary occurrences of these communities are tracked by Virginia's Department of Conservation and Recreation, Division of Natural Heritage. In order to be considered an exemplary occurrence, stands have to meet strict type-specific criteria of size, condition, and landscape context. Examples of seven natural communities mapped at Colonial National Historical Park met the criteria to be considered Natural Heritage exemplary natural community occurrences. A portion of the area mapped as Non-Riverine Saturated Forest at Green Spring met the criteria to be considered a Natural Heritage exemplary natural community occurrence. Examples of Coastal Plain Calcareous Seepage Swamp mapped at Swanns Point, in a ravine system in the northern portion of Yorktown Battlefield, and in a ravine south of Wormley pond, met the criteria to be considered Natural Heritage exemplary natural community occurrences. The other areas mapped as Coastal Plain Calcareous Seepage Swamp were too disturbed to be considered viable exemplary occurrences. The globally rare community Coastal Plain Depression Wetland (Swamp Tupelo Type), mapped in the southern portion of Yorktown Battlefield, met the criteria to be considered a Natural Heritage exemplary natural community occurrence, and is part of the larger Grafton Pond depression pond complex that extends onto property adjacent to Colonial National Historical Park. The example of Tidal Bald Cypress Forest / Woodland mapped at Swanns Point is a Natural Heritage exemplary natural community occurrence. Small areas of Tidal Bald Cypress Forest / Woodland mapped at Jamestown Island are disturbed and have been cut off from natural tidal flooding regimes and do not meet the criteria to be considered exemplary occurrences. The Coastal Plain Mesic Calcareous Ravine Forests mapped at Wormley Pond, in the ravine system north of Hickory Hill, and at Kingsmill are considered Natural Heritage exemplary natural community occurrences. The other areas mapped as this association were either not confirmed in the field or are too disturbed to be considered viable exemplary occurrences. All areas mapped as the globally rare community Coastal Plain Dry Calcareous Forest met the criteria to be considered Natural Heritage exemplary natural community occurrences. The Tidal Oligohaline Marsh around Jamestown Island is documented as a Natural

Heritage exemplary natural community occurrence because of its large size and overall high quality. Areas representing the other 11 natural communities mapped in Colonial National Historical Park do not meet the criteria to be considered Natural Heritage exemplary natural community occurrences, but these native plant associations are an important part of the park's natural resources and should be targets for conservation and management.

Invasive nonnative plant species are one of the main threats to the native vegetation associations at Colonial National Historical Park. Thirty-eight nonnative plant species were noted in the quantitative plots and accuracy assessment observations. The fertile, eroding soils of Coastal Plain Dry Calcareous Forest supported the greatest diversity of nonnative plant species, where 16 nonnative species were noted. Of the other map classes, wetlands and transitional vegetation had the highest cover by invasive, nonnative species. The most common and problematic species include Japanese honeysuckle (*Lonicera japonica*), Nepalese browntop (*Microstegium vimineum*), and common reed (*Phragmites australis*). Japanese honeysuckle and Nepalese browntop are particularly troublesome because of their shade tolerance and aggressive growth habits. These species can be opportunistic invaders of the older, more intact forest communities, getting a foothold where roads, trails, tip-up mounds, downfalls, and other gap-disturbances have disturbed mineral soil. Once established, colonies are able to more easily expand or spread into nearby microhabitats. Common reed is an aggressive, invasive perennial grass that invades tidal wetlands.

Japanese honeysuckle is especially destructive to native vegetation because of its rapid, twining growth and dense, semi-evergreen foliage that shades out competitors. The vines frequently strangle shrubs and tree saplings, and over-grow more delicate herbs in a variety of settings. Nepalese browntop is the fastest spreading, most problematic exotic everywhere in Virginia today. Within the past two decades, it has abundantly invaded moist, openly shaded habitats throughout the mid-Atlantic region, forming monospecific carpets of tangled culms that tend to crowd out competing herbaceous species (Tu 2000). A recent study strongly suggests that Nepalese browntop responds to forest canopy disturbances with a sudden increase in biomass that impedes woody regeneration and lowers overall species diversity and stem densities (Oswalt et al. 2007). Other studies have demonstrated that once established, Nepalese browntop over-runs native herbaceous competitors and leads to dramatic declines of herb richness within a few years (Barden 1987, Hunt and Zaremba 1992). Common reed (*Phragmites australis*) is an aggressive wetland invader that out-competes native plant species, eliminates diverse wetland plant communities, and provides little food or shelter for wildlife. It grows in dense single-species stands and forms a thick mat of roots and rhizomes, spreading by seed and rhizomes. Common reed becomes established in areas where soil is exposed through natural (storms, wave action) or anthropogenic disturbances (construction, ditching).

Other highly invasive, nonnative species noted in the park include tree of heaven (*Ailanthus altissima*), autumn olive *(Elaeagnus umbellata* var. *parvifolia),* and Chinese lespedeza *(Lespedeza cuneata).* Species noted that are considered moderately invasive by the Virginia Department of Conservation and Recreation (VADCR 2003) include English Ivy (*Hedera helix),* golden bamboo (*Phyllostachys aurea),* princesstree *(Paulownia tomentosa)*Canada bluegrass *(Poa compressa),* rough bluegrass (*Poa trivialis),* white poplar *(Populus alba),* curley dock (*Rumex crispus),* and Chinese wisteria (*Wisteria sinensis).* Species considered occasionally invasive include orchardgrass (*Dactylis glomerata*), and common periwinkle (*Vinca minor*).

## Vegetation Map Production

The final map for Colonial National Historical Park depicts 40 map classes. Twenty-six map classes are crosswalked to USNVC vegetation associations, seven are nonstandard, park-specific vegetation classes, and seven are Anderson land-use classes. Because of the difficulty of distinguishing certain associations on aerial photography, two map classes, Tidal Oligohaline Marsh and Tidal Mesohaline and Polyhaline Marsh, represent more than one USNVC association. Polygons mapped as Tidal Mesohaline and Polyhaline Marsh represent vegetation belonging to one or two associations. Polygons mapped as Tidal Oligohaline Marsh represent one to five associations, occurring singly or as a complex. Polygons representing multiple associations were not labeled to the association level. Each polygon representing a single USNVC association was attributed with the appropriate USNVC formation and alliance based on the hierarchy of the USNVC. Polygons mapped as nonstandard classes were also attributed to USNVC formations when possible. The final map table includes 14 formations, 33 alliances, and 24 associations.

The Kappa index for the final vegetation map exceeds the USGS-NPS VMP protocol requirement of 80%. Errors of commission and omission reported for seven map classes fall below the USGS-NPS VMP protocol requirement of 80%. Examination of the errors associated with each observation shows they can be attributed to below minimum mapping unit inclusions of other vegetation types within the target polygons, to the incomplete survey of target polygons, to seasonal constraints in identifying certain associations in the field, or to observations made in ecotonal areas transitional to other vegetation types. Additionally, some of the mapping errors were due to the difficulty of distinguishing deciduous associations on aerial photography, since many deciduous signatures are virtually identical.

Aerial photography flown in March 2002 served as the base map for the final vegetation map. Since that time, the vegetation in the park has continued to change. In September 2003, Hurricane Isabel altered the mapped vegetation in many areas of the park. The temporal progression of transitional vegetation and the natural dynamics of coastal areas will continue to alter the mapped vegetation, as will the park's ongoing management of invasive species. Despite these changes, the vegetation map produced by this project provides crucial baseline data for the park resource managers.

## Recommendations for Future Projects

Invasive nonnative plant species are the main threat to the native vegetation associations at Colonial National Historical Park. Continued monitoring and management of invasive species in and around all the natural communities in the park should be a priority for the park's resource managers. Early detection and control of invasive nonnative species on forest edges and along trails and roads can help prevent new invasions. The most common and problematic species include Japanese honeysuckle, Nepalese browntop, and common reed. Dormant season herbicide application can be effective in treating Japanese honeysuckle infestations, but timing is critical. As a rule, foliar application of 1.5% glyphosate (*e.g.,* Roundup) after the first killing frost and before the first hard frost is most effective (Nuzzo 1997). The annual, Nepalese browntop is a prolific seed-producer, and seed banks can persist for at least five years (Tu 2000). Control of the species can be very labor intensive (*i.e.*, hand-pulling) or destructive to non-target plants (*i.e.*,

herbicide application). Since the species can germinate following early-season removal, removal two or more times a season to more quickly deplete the seed bank has shown promise as a technique for discrete, high-priority sites (The Nature Conservancy, Maryland Field Office, Invasive Species Biologist, Mary Travaglini, pers. comm. 2007). Twelve species of fungi and eight arthropod species are reported as natural enemies of Nepalese browntop in Asia, but no biological controls are currently available in the United States (Zheng et al. 2006). Eradication of the species from large sites where it is well established is not a realistic goal with the tools now available. However, reducing populations to manageable or non-invasive levels, especially in rare habitats and vegetation types, should be a high priority for the National Park Service. While not a long-term solution, keeping Nepalese browntop in check while more effective biological controls are developed is the best strategy available at present and is critical to avoiding drastic declines in biodiversity and forest health in the near future. Both mechanical and chemical controls may be used to combat infestations of common reed. Mowing, flooding, and prescribed fire in combination with successive herbicide treatments have all been shown to be effective against this invasive perennial grass (Thompson et al. 1984, Caffrey 1996, Kay 1995, Monteiro et al. 1999). European insects that feed exclusively on common reed are being evaluated for their potential as biological control agents, but any practical tools are years away from being available (Tewksbury 2002). Herbicides that contain glyphosate or imazapyr, applied to actively growing plants, are the most effective method for controlling extensive invasions of common reed. Both chemicals are available in formulations that are approved for use in wetland habitats.

Small patch communities occurring over fertile, calcareous substrates are the most susceptible to exotic species invasions. Coastal Plain Calcareous Seepage Swamp, Coastal Plain Mesic Calcareous Ravine Forest, and Coastal Plain Dry Calcareous Forest are some of the rarest natural communities in the mid-Atlantic region and should be targeted for monitoring and control of invasive, nonnative species. Future invasions may be controlled by ensuring that there are adequate, undisturbed woodland buffers surrounding occurrences of these communities.

The significant wetland community at Green Spring is saturated by groundwater discharged from the base of slopes on the north edge of the wetland. Maintenance of requisite habitat conditions requires protection of upslope hydrologic recharge zones and sufficient buffer to ensure the quality and quantity of both groundwater seepage and surface water. Clearcutting, site clearing, road construction, and other development actions are potential sources of groundwater perturbation, erosion, run-off, and siltation which could threaten this community Protection of the land upslope of this community and south of Monticello Avenue should be a priority for park managers. Nepalese browntop was observed with low cover in the Non-Riverine Saturated Forest at Green Spring. Monitoring and control of this invasive grass should be a priority in this rare and threatened wetland community.

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# Appendix A. Quantitative vegetation plot sampling form.

VA DEPT. OF CONSERVATION AND RECREATION - DIV. OF NATURAL HERITAGE *rev. 2004-05-03 KDP* P.1

**GENERAL INFORMATION**
PLOT: _____
Project: Mid atlantic Veg mapping
Date: _____
Surveyors: _____

Plot dimensions: _____ by _____ m
Sample area _____ sq. m

**PLOT DOCUMENTATION**
Source Code: _____
Film Roll: _____
Frames: _____
Description of pic(s):

**Relative Stand Size**
A - extensive (> 100x plot size)
B - large (10-100x plot size)
C - small (3-10x plot size)
D - very small (1-3x plot size)
U - Unknown

**PLOT LOCATION**
Managed Area (Park):
Survey Site: _____ Quad: _____
County:

GPS unit: Garmin GPSMAP76
UTM zone: Datum: WGS 84
GPS pointname or file:
est accuracy: _____ m/ft # of sats fixed:
Reciever status: 2D / 3D / 2D WAAS / 3D WAAS

**Field** UTM X __ __ __,__ __ __ E Y __,__ __ __,__ __ __ N
LAT _____
Long _____
Marked est. location on toposheet ____ yes

**SITE CHARACTERISTICS** compass: magnetic corrected
**Elevation** _____ m/ft
via GPS __ map __ altimeter __

**Slope** (o) ____
single measure. __ avg of __
or:
A - 0-3% (level or nearly so)
B - 3-8% (gentle/undulating)
C - 8-16% (sloping/rolling)
D - 16-30% (moderate/hilly)
E - 30-65% (steep)
F - 65-75% (very steep)
G - 75+% (extremely steep)

**Slope Shape (V w/ slope)**

| VERTICALLY | HORIZONTALLY |
|---|---|
| C - concave | C - concave |
| X - convex | X - convex |
| S - straight | S - straight |

H - hummock (___%) and hollow (___%) microtopography
I - irregular craggy/ bouldery microtopography

**Aspect** (N = 0o): _____
single measure. _____
avg of _____

F (flat)
V (variable)

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

**Topographic Position**
A - crest
B - upper slope
C - middle slope
D - lower slope
E - toe slope
F - plain/level/bottom
G - basin/depression

**Landform**
IF - interfluve
G - gap/saddle
SS - side slope
SB - slope bench
FP - fan piedmont
C - cove
E - escarpment/face
O - bedrock outcrop
DS - debris slope
H - hill/monadnock
U - rolling upland
OTHER:
P - flat plain
D - dune
OF - overwash flat
I - interdune
TF - tidal flat
R - ravine
S - seep/swale
A - alluvial plain
L - levee
CS - channel shelf
BS - backswamp
B - basin/sag pond

| Surface Substrate | % Cover |
|---|---|
| bedrock | |
| boulders and stones | |
| gravel and cobbles | |
| litter / organic matter | |
| decaying wood | |
| water | |
| mineral soil / sand | |
| other | |
| (bryophytes and lichens) | |
| TOTAL | 100% |

**Soil Drainage Class**
A - very poorly drained
B - poorly drained
C - somewhat poorly drained
D - moderately well drained
E - well drained
F - rapidly drained

**Inundation**
A - never
B - infrequently
C - regularly: for <6 mos.
D - regularly: for >6 mos.
E - always submerged by shallow water (<30cm)
F - always submerged by deep water (>30cm)

**Soil Moisture Regime**
A - very xeric (moist for neglig. time after ppt)
B - xeric (moist for brief time)
C - somewhat xeric (moist for short time)
D - submesic (moist for moderately short time)
E - mesic (moist for significant time)
F - subhygric (wet for significant part of growing season; mottles <20cm)
G - hygric (wet for most of growing season; permanent seepage/mottling)
H - subhydric (water table at or near surface for most of the year)
I - hydric (water table at or above surface year round)
- ephemeral seepage/subsurface water present locally in plot

**Hydrologic Regime**
__ Terrestrial(i.e. not a wetland)

Tidal
A - Irregularly exposed
B - Regularly flooded
C - Irregularly flooded
D - Wind tidally flooded

Non-Tidal
A - Permanently flooded
B - Semipermanently flooded
C - Seasonally flooded
D - Intermittently flooded
E - Temporarily flooded
F - Saturated

Salinity/Halinity
A - Saltwater
B - Brackish
C - Oligohaline
D - Freshwater

Refractometer Measurement: ___

Cowardin System
Upland Riverine Lacustrine Estuarine Palustrine

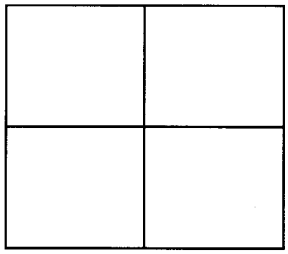
**Soil Sample** Single Sample ___ Composite Sample ___ Mean of ___

**Soil Profile Description**
Horizon/
Depth(cm) Description (texture, structure, consistency)
0-

**PLOT CONFIGURATION, MAP SKETCH, AND DIRECTIONS FOR RELOCATING PLOT** P.2

The template below is a standard modular layout for a 400m2 plot. Freehand sketch any alternative configurations, indicate the plot architecture, points where GPS positions were collected, locations of permanent stakes (if any), modules and corners sampled, locations of soil samples, locations and bearings of photopoints, and directions and distances to landmarks (include species and dbh of witness trees). Use the symbols in the key below for GPS points, permanent markers, and photos. Also provide complete directions for relocating permanently marked plots, accompanied if possible by a sketch showing plot orientation and depicting roads, trails, etc., as well as distinctive features of the vegetation. Attach copy of USGS topographic quad map indicating location of plot.

___ °
bearing of
centerline



20 x 20 m

| | |
|---|---|
| ⊗ | GPS position |
| ○→ | centerline with bearing |
| ● | |

**Evidence of Disturbance**

logging ___ fire ___ exotic plants ___ erosion ___ trails/roads ____ clearing ____

grazing/browsing ___ wind/ice damage ___ ditching/hydrologic alteration ____

chestnut blight ____ pine bark beetle _____ dogwood anthracnose ____ oak decline ____

hemlock adelgid ___ gypsy moth ___ spruce decline ___ Other: _____

Disturbance Coments:

Provisional Community name (floristic description of sample):

**QUALITATIVE ASSESSMENT AND NOTES**

Write a brief word picture of community. Describe variation within occurrence in terms of veg structure and environment. Note vertical stratification or horizontal zonation patterns. Describe dominant and characteristic species and inclusion communities (if present). If community occurs as a mosaic describe spatial districtution and associated community types . Include landscape context information (adjacent communities). Describe any special or unusual features of the vegetation. If possible, note the origin and (for moderately even-aged forests) approximate age of the stand. Record also the presence at the site of species not sampled in the plot. Note, where appropriate, the approximate distance and direction to proximate water sources, such as river channels, perennial streams, intermittent streams, and seepage or runoff areas. For riparian sites note the height of primary and secondary water marks and the presence of fluvial features.

**PHYSIOGNOMY (entire stand)**

Forest Woodland
Shrubland
Herbaceous with sparse tree layer
Herbaceous with sparse shrub layer
Herbaceous
Nonvascular Bryophyte Lichen
Sparsely Vegetated

**DOMINANT LEAF PHENOLOGY(entire stand)**

Deciduous (< 25% evergreen)
Mixed deciduous (25-49% evergreen)
Mixed evergreen (25-49% deciduous)
Evergreen (< 25% deciduous)
Perennial graminoid
Perennial forb
Perennial mixed
Annual herbaceous
Not applicable

**STRATA STRUCTURE**

| | % cover | height (m) |
|---|---|---|
| Tree (>6m woody) | | |
| Shrub (0.5-6m woody) | | |
| Herb (all herbs+ <0.5 woody) | | |
| Bryophyte/Lichen | | |

## II. VEGETATION STRUCTURE AND PHYSIOGNOMY

PLOT ____________, P.3

NOTE: Record height (m), cover class (10 pt scale), and phenology / lifeform for each stratum.

| Stratum | T35+ | | T20-35 | | T10-20 | | T6-10 | | S1 | | S2 | | H | | N | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COVER CLASS | | | | | | | | | | | | | | | | |
| Max Height m | | | | | | | | | | | | | | | | |
| Phenology/ | D | ME | D | ME | D | ME | D | ME | D | ME | D | ME | Pt | F | B | LIC |
| Growth form | MD | E | MD | E | MD | E | MD | E | MD | E | MD | E | G | W | MIXED | |

**maximum CANOPY HEIGHT** ______ **m**

COLUMN VALUES:

| | |
|---|---|
| T>35 = tree canopy > 35m (T1) | H = field layer (0 -0.5 m) |
| T20 = tree canopy 20-35m (T2) | N = nonvascular |
| T10 = tree canopy 10-20m (T2) | V = vines |
| T6 = tree canopy 6-10m (T3) | E = epiphytes |
| S1 = tree or shrub 1-6m | TC = total cover |
| S2 = woody sp. 0.5 - 1 m | C = collection |

**WOODY STEMS** >= 2.5 CM DBH IN PLOT; record in 5cm classes; record to the nearest cm if DBH>40cm

| SPECIES | 2.5 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40+ |
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*In TNC Plots database: T1 = T>35; T2 = greatest of T20 or T10; T3 = T6

* Put total cover for vines (V) and epiphytes (E) but indicate height strata by a check

## III. SPECIES COMPOSITION AND COVER CLASS BY STRATUM.

Record species cover in the following cover classes:

**1=trace, 2=a few (<1%), 3=1-2%, 4=2-5%, 5=5-10%, 6=10-25%, 7=25-50%, 8=50-75%, 9=75-100%.**

record cover values for each stratum AND for total cover in entire sample. Check "C" for collection, "D" for discard, ID flag 1-5

| T>35 | T20 | T10 | T6 | S1 | S2 | H | N | V | E | | TC | TAXON | C | # | D | ID |
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Appendix B. Accuracy assessment data form for the vegetation map of Colonial National Historical Park.

**I. IDENTIFIERS AND LOCATION DATA**

1. AA Point Code _AA_____ 2. Park Code: COLO 3. Date (*y/m/d*): 2006 /

4. Observer(s) _____

5. GPS unit (*circle*): Garmin GPSMap76 / Garmin GPSMap76s

6. DATUM (*circle*): WGS84 / other (*specify* _____) 7. GPS file name _____

8. Estimated accuracy _____ m 9. Number of points averaged _____

10. Receiver status (*circle*): 2D / 3D / 2D WAAS / 3D WAAS / no signal (*estimated location marked on DRG*)

11. Field UTM X ___ ___ ___ ___ ___ ___ m E Y ___ ___ ___ ___ ___ ___ ___ m N

OR Lat _____ Long _____

**II. ENVIRONMENTAL / SITE DESCRIPTION**

1. Environmental Comments (*if site is a wetland, indicate type of hydrology, e.g., seepage wetland, temporarily flooded stream bottom, seasonally flooded pond, etc.*)

**III. VEGETATION DESCRIPTION** *(observation is within a 0.5 ha area – approx. a 40 m radius circle)*

1. Prevalent vegetation association within 0.5 ha of observation area, based on field key:

2. Other vegetation associations present within 0.5 ha observation area:

3. Representativeness: is the vegetation within the 0.5 ha observation area representative of vegetation in the surrounding mapped polygon? If vegetation of the AA point is an anomalous inclusion in the polygon, please note

4. Approximately what percentage of the mapped polygon did you observe? OR approximate size of area observed? (*This may be also be drawn on a map. Include with form*)

COLO AA DATA FORM, p.2 AA POINT CODE _____

**IV. VEGETATION STRUCTURE** (*check maximum cover class in each stratum*):

| Stratum / max. ht. | 1-25% cover | 26-50% cover | 51-75% cover | 76-100% cover |
|---|---|---|---|---|
| 35 m | | | | |
| 20 m | | | | |
| 10 m | | | | |
| 6 m | | | | |
| 2 m | | | | |
| 0.5 m + herbs | | | | |

**V. VEGETATION COMPOSITION** (*list characteristic species and indicate dominant by a "D," present by a "P," and rare by "R" in the appropriate strata*).

| SPECIES | Canopy layer | Sub-canopy layer | Shrub layer | Herb layer |
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**VI. ADDITIONAL COMMENTS** (*use this space to provide additional comments about vegetation structure or composition*)

**VII. CLASSIFICATION COMMENTS** (*use this space to provide additional comments about problems or ease in applying the vegetation key at this site, rationale for choice of association if there was doubt, etc.* ***Comments for modifying the key are welcome***)

## INSTRUCTIONS FOR COLONIAL NATIONAL HISTORICAL PARK VEGETATION MAP ACCURACY ASSESSEMENT

This observation point field form was developed for the Mid-Atlantic Vegetation mapping project. Its purpose is to generate record observations at vegetation polygons and compare them to the mapped data. The general procedure you will follow is to navigate to the pre-selected point using a Garmin GPSMap76 or GPSMap76s GPS unit. Try to navigate as close as possible to the pre-selected point. The species list is collected at that point and the 0.5 ha surrounding the point. Comments re: the vegetation within the entire polygon are also recorded on this form. Once at the pre-selected observation point, you will record your location by collecting a waypoint with the GPS unit and record the required data in the order that it appears on the field form.

The materials you should have before you begin are 1) plots of the 7.5' DRG (and photos if helpful) showing the polygon boundaries, but no information about polygon attributes; 2) pre-selected AA point coordinates loaded into your GPS unit; 3) the field key to vegetation types, and 4) vegetation type descriptions. You should also carry a compass. A measure tape may help for distances and heights. Once you have navigated to an observation point, you should closely observe the vegetation within the prescribed data collection area, which in most cases will be a approximated circular 0.5 ha area (radius = ca. 40 m). You can simply pace one or more radii of 40 meters from the point to assist in gauging the extent of the observation area. Keep the observations within the defined polygon and adjust the area surveyed accordingly (i.e. if the polygon is linear or less than 0.5 ha, keep the observation within the polygon)

In cases where an observation point falls in an ecotone, or contains two distinctly different vegetation types, describe the type that covers the larger area and provide notes (see section III3) on the second type. In the rare instance where an observation area is equally divided between two vegetation types, you will have to complete observation point field forms for each type. During navigation to and from a point, generally observe the vegetation in the mapped polygon so that you can answer section III2 (see below).

### Specific Instructions for completing the AA field form:

I.1-4. Self explanatory

I.5-11. Indicate GPS unit used and record the file name for the location data that you collect. Record the number of points averaged, accuracy, and either UTM or Lat/Long coordinates displayed by the GPS unit. In the event that GPS locational data cannot be obtained, mark your estimated location on a 7.5' USGS quad or DRG.

II.1. Make note of any other environmental characteristics that might assist in interpreting the site. Also use this space to record general information on hydrology, if the site is a wetland.

III.1. Use the field key to determine the vegetation type prevalent at the site.

III.2. If one or more additional vegetation types occur within the sample site, record them.

III.3. To the extent possible, and based on general observations made navigating to and from the point, note whether the prevalent vegetation of the sample site is representative of the larger polygon in which it is located. It is especially important to note instances where the vegetation of the site is an anomaly or local inclusion within the polygon.

III.4. Provide a rough estimate of the percentage of the larger polygon that you observed (*e.g.*, 10%, 20%, etc.). or draw the area on your map and include with this form.

IV. Check the maximum cover class for each vertical vegetation stratum indicated on the table. The heights in the left column indicate the maximum height of each stratum. The lowest stratum contains all woody plants < 0.5 m tall and all herbaceous plants, regardless of height.

V. List species you would consider to be characteristic of the vegetation at the site. These generally include dominant species and less abundant species that are indicative of specific site conditions such as soil chemistry or

hydrologic regime. Write the species in the left column and note its status in the appropriate layer(s) using the symbols “D” for dominant, “P” for present, and “R” for rare (1-3 individuals).

VI. Use this space to record any additional information or comments about vegetation structure or composition that would assist in interpreting this site.

VII. Use this space to record any additional information about vegetation classification. It is especially important to note if problems were encountered applying the field key or interpreting the vegetation.

Appendix C. Vascular plants observed in quantitative vegetation plots and accuracy assessment observation points in Colonial National Historical Park in 2003–2005.

Nomenclature follows the PLANTS 3.5 Database developed by the Natural Resource Conservation Service in cooperation with the Biota of North America Program (USDA, NRCS 2004).

| Family | Scientific Name | Common Name |
|---|---|---|
| Acanthaceae | *Ruellia caroliniensis* | Carolina wild petunia |
| Aceraceae | *Acer barbatum* | southern sugar maple |
| | *Acer rubrum* | red maple |
| Alismataceae | *Echinodorus cordifolius* | creeping burrhead |
| | *Sagittaria lancifolia* ssp. *media* | bulltongue arrowhead |
| | *Sagittaria subulata* | awl-leaf arrowhead |
| Amaranthaceae | *Amaranthus cannabinus* | tidalmarsh amaranth |
| Anacardiaceae | *Rhus copallinum* | flameleaf sumac |
| | *Toxicodendron radicans* | eastern poison ivy |
| Annonaceae | *Asimina triloba* | pawpaw |
| Apiaceae | *Cicuta maculata* var. *maculata* | spotted water hemlock |
| | *Cryptotaenia canadensis* | Canadian honewort |
| | *Daucus carota* | Queen Anne's lace[e] |
| | *Eryngium aquaticum* var. *aquaticum* | rattlesnakemaster |
| | *Hydrocotyle americana* | American marshpennywort |
| | *Hydrocotyle verticillata* var. *verticillata* | whorled marshpennywort |
| | *Ligusticum canadense* | Canadian licorice-root |
| | *Osmorhiza* sp. | a sweetroot |
| | *Sanicula canadensis* | Canadian blacksnakeroot |
| Apocynaceae | *Trachelospermum difforme* | climbing dogbane |
| | *Vinca minor* | common periwinkle[e#] |
| Aquifoliaceae | *Ilex decidua* | possumhaw |
| | *Ilex opaca* var. *opaca* | American holly |
| | *Ilex verticillata* | common winterberry |
| Araceae | *Arisaema triphyllum* | Jack in the pulpit |
| | *Orontium aquaticum* | goldenclub |
| | *Peltandra virginica* | green arrow arum |
| Araliaceae | *Aralia spinosa* | devil's walkingstick |
| | *Hedera helix* | English ivy[e#] |
| Aristolochiaceae | *Aristolochia serpentaria* | Virginia snakeroot |
| | *Hexastylis virginica* | Virginia heartleaf |
| Asclepiadaceae | *Matelea carolinensis* | maroon Carolina milkvine |
| Aspleniaceae | *Asplenium platyneuron* | ebony spleenwort |
| Asteraceae | *Ageratina altissima* | white snakeroot |
| | *Ageratina aromatica* | lesser snakeroot |
| | *Ambrosia artemisiifolia* | annual ragweed |
| | *Antennaria plantaginifolia* | woman's tobacco |
| | *Antennaria solitaria* | singlehead pussytoes |
| | *Arnoglossum atriplicifolium* | pale Indian plaintain |
| | *Baccharis halimifolia* | eastern baccharis |
| | *Bidens bipinnata* | Spanish needles |
| | *Bidens coronata* | crowned beggarticks |
| | *Bidens laevis* | smooth beggartick |
| | *Conoclinium coelestinum* | blue mistflower |

| Family | Scientific Name | Common Name |
|---|---|---|
| Asteraceae (cont.) | *Conyza canadensis* | Canadian horseweed |
| | *Elephantopus carolinianus* | Carolina elephantsfoot |
| | *Erechtites hieraciifolia* var. *hieraciifolia* | American burnweed |
| | *Erigeron pulchellus* var. *pulchellus* | robin's plantain |
| | *Eupatorium capillifolium* | dogfennel |
| | *Eupatorium hyssopifolium* var. *laciniatum* | hyssopleaf thoroughwort |
| | *Eupatorium serotinum* | lateflowering thoroughwort |
| | *Fleischmannia incarnata* | pink thoroughwort |
| | *Hieracium gronovii* | queendevil |
| | *Hieracium venosum* | rattlesnakeweed |
| | *Hypochaeris radicata* | hairy catsear[e] |
| | *Iva frutescens* | Jesuit's bark |
| | *Lactuca canadensis* | Canada lettuce |
| | *Leucanthemum vulgare* | oxeye daisy[e] |
| | *Mikania scandens* | climbing hempvine |
| | *Packera anonyma* | Small's ragwort |
| | *Packera aurea* | golden ragwort |
| | *Pityopsis graminifolia* | narrowleaf silkgrass |
| | *Pluchea odorata* | sweetscent |
| | *Prenanthes altissima* | tall rattlesnakeroot |
| | *Prenanthes trifoliolata* | gall of the earth |
| | *Pseudognaphalium obtusifolium* | rabbittobacco |
| | *Rudbeckia laciniata* | cutleaf coneflower |
| | *Silphium trifoliatum* | whorled rosinweed |
| | *Smallanthus uvedalius* | hairy leafcup |
| | *Solidago caesia* | wreath goldenrod |
| | *Solidago rugosa* | wrinkleleaf goldenrod |
| | *Solidago sempervirens* | seaside goldenrod |
| | *Solidago ulmifolia* var. *ulmifolia* | elmleaf goldenrod |
| | *Sonchus asper* | spiny sowthistle[e] |
| | *Symphyotrichum lanceolatum* ssp. *lanceolatum* | white panicle aster |
| | *Symphyotrichum lateriflorum* | calico aster |
| | *Symphyotrichum novi-belgii* var. *elodes* | New York aster |
| | *Symphyotrichum subulatum* | eastern annual saltmarsh aster |
| | *Symphyotrichum tenuifolium* | perennial saltmarsh aster |
| | *Symphyotrichum undulatum* | waxyleaf aster |
| | *Taraxacum officinale* | common dandelion[e] |
| | *Verbesina alternifolia* | wingstem |
| | *Verbesina occidentalis* | yellow crownbeard |
| | *Verbesina virginica* var. *virginica* | white crownbeard |
| | *Vernonia noveboracensis* | New York ironweed |
| Azollaceae | *Azolla caroliniana* | Carolina mosquitofern |
| Balsaminaceae | *Impatiens capensis* | jewelweed |
| Berberidaceae | *Podophyllum peltatum* | mayapple |
| Betulaceae | *Carpinus caroliniana* | American hornbeam |
| | *Ostrya virginiana* | hophornbeam |
| Bignoniaceae | *Bignonia capreolata* | crossvine |
| | *Campsis radicans* | trumpet creeper |
| Blechnaceae | *Woodwardia areolata* | netted chainfern |
| Boraginaceae | *Cynoglossum virginianum* var. *virginianum* | wild comfrey |
| | *Myosotis macrosperma* | largeseed forget-me-not |
| Brassicaceae | *Arabis laevigata* var. *laevigata* | smooth rockcress |

| Family | Scientific Name | Common Name |
|---|---|---|
| Brassicaceae (cont.) | *Cardamine pensylvanica* | Pennsylvania bittercress |
| Campanulaceae | *Lobelia cardinalis* | cardinalflower |
| Caprifoliaceae | *Lonicera japonica* | Japanese honeysuckle[e#] |
| | *Sambucus nigra* ssp. *canadensis* | common elderberry |
| | *Symphoricarpos orbiculatus* | coralberry |
| | *Viburnum nudum* | possumhaw |
| | *Viburnum prunifolium* | blackhaw |
| | *Viburnum rufidulum* | rusty blackhaw |
| Caryophyllaceae | *Cerastium fontanum* ssp. *vulgare* | big chickweed[e] |
| | *Stellaria pubera* | star chickweed |
| Celastraceae | *Euonymus americana* | strawberry bush |
| Ceratophyllaceae | *Ceratophyllum demersum* | coon's tail |
| Clethraceae | *Clethra alnifolia* | coastal sweetpepperbush |
| Clusiaceae | *Hypericum hypericoides* ssp. *hypericoides* | St. Andrew's cross |
| | *Hypericum hypericoides* ssp. *multicaule* | St. Andrew's cross |
| | *Hypericum mutilum* | dwarf St. Johnswort |
| | *Triadenum walteri* | greater marsh St. Johnswort |
| Commelinaceae | *Commelina communis* | Asiatic dayflower[e#] |
| | *Commelina erecta* | whitemouth dayflower |
| | *Murdannia keisak* | wartremoving herb[e#] |
| Cornaceae | *Cornus florida* | flowering dogwood |
| | *Cornus foemina* | stiff dogwood |
| Cupressaceae | *Juniperus virginiana* var. *virginiana* | eastern redcedar |
| Cuscutaceae | *Cuscuta* sp. | a dodder |
| Cyperaceae | *Carex aggregata* | glomerate sedge |
| | *Carex albicans* | whitetinge sedge |
| | *Carex amphibola* | eastern narrowleaf sedge |
| | *Carex blanda* | eastern woodland sedge |
| | *Carex bromoides* | bromelike sedge |
| | *Carex cephalophora* | oval-leaf sedge |
| | *Carex crinita* | fringed sedge |
| | *Carex debilis* | white edge sedge |
| | *Carex digitalis* | slender woodland sedge |
| | *Carex festucacea* | fescue sedge |
| | *Carex glaucescens* | southern waxy sedge |
| | *Carex gracillima* | graceful sedge |
| | *Carex granularis* | limestone meadow sedge |
| | *Carex hirsutella* | fuzzy wuzzy sedge |
| | *Carex hyalinolepis* | shoreline sedge |
| | *Carex intumescens* | greater bladder sedge |
| | *Carex joorii* | cypress swamp sedge |
| | *Carex laevivaginata* | smoothsheath sedge |
| | *Carex laxiculmis* var. *laxiculmis* | spreading sedge |
| | *Carex laxiflora* var. *laxiflora* | broad looseflower sedge |
| | *Carex lupulina* | hop sedge |
| | *Carex lurida* | shallow sedge |
| | *Carex nigromarginata* | black edge sedge |
| | *Carex oxylepis* | sharpscale sedge |
| | *Carex pensylvanica* | Pennsylvania sedge |
| | *Carex radiata* | eastern star sedge |
| | *Carex rosea* | rosy sedge |
| | *Carex stipata* var. *maxima* | stalkgrain sedge |

| Family | Scientific Name | Common Name |
|---|---|---|
| Cyperaceae (cont.) | *Carex stipata* var. *stipata* | owlfruit sedge |
| | *Carex styloflexa* | bent sedge |
| | *Carex striata var. brevis* | Walter's sedge* |
| | *Carex swanii* | Swan's sedge |
| | *Carex tetanica* | rigid sedge |
| | *Carex tonsa* | shaved sedge |
| | *Carex tribuloides* | blunt broom sedge |
| | *Cyperus filicinus* | fern flatsedge |
| | *Cyperus odoratus* | fragrant flatsedge |
| | *Dulichium arundinaceum* | threeway sedge |
| | *Eleocharis obtusa* | blunt spikerush |
| | *Eleocharis palustris* | common spikerush |
| | *Eleocharis parvula* | dwarf spikerush |
| | *Eleocharis rostellata* | beaked spikerush |
| | *Fimbristylis castanea* | marsh fimbry |
| | *Schoenoplectus americanus* | chairmaker's bulrush |
| | *Schoenoplectus pungens* var. *pungens* | common threesquare |
| | *Schoenoplectus robustus* | sturdy bulrush |
| | *Schoenoplectus tabernaemontani* | softstem bulrush |
| | *Scirpus lineatus* | drooping bulrush |
| | *Scirpus polyphyllus* | leafy bulrush |
| | *Scleria oligantha* | littlehead nutrush |
| Dioscoreaceae | *Dioscorea oppositifolia* | Chinese yam |
| Dryopteridaceae | *Polystichum acrostichoides* | Christmas fern |
| Ebenaceae | *Diospyros virginiana* | common persimmon |
| Elaeagnaceae | *Elaeagnus umbellata* var. *parvifolia* | autumn olive[e#] |
| Ericaceae | *Epigaea repens* | trailing arbutus |
| | *Gaylussacia baccata* | black huckleberry |
| | *Gaylussacia frondosa* | blue huckleberry |
| | *Kalmia latifolia* | mountain laurel |
| | *Leucothoe racemosa* | swamp doghobble* |
| | *Oxydendrum arboreum* | sourwood |
| | *Rhododendron periclymenoides* | pink azalea |
| | *Vaccinium corymbosum* | highbush blueberry |
| | *Vaccinium formosum* | southern blueberry |
| | *Vaccinium fuscatum* | black highbush blueberry |
| | *Vaccinium pallidum* | Blue Ridge blueberry |
| | *Vaccinium stamineum* | deerberry |
| Euphorbiaceae | *Acalypha virginica* | Virginia threeseed mercury |
| Fabaceae | *Amphicarpaea bracteata* | American hogpeanut |
| | *Apios americana* | groundnut |
| | *Baptisia tinctoria* | horseflyweed |
| | *Cercis canadensis* var. *canadensis* | eastern redbud |
| | *Clitoria mariana* | Atlantic pigeonwings |
| | *Desmodium nudiflorum* | nakedflower ticktrefoil |
| | *Desmodium paniculatum* var. *paniculatum* | panicledleaf ticktrefoil |
| | *Desmodium perplexum* | perplexed ticktrefoil |
| | *Desmodium rotundifolium* | prostrate ticktrefoil |
| | *Galactia volubilis* | downy milkpea |
| | *Gymnocladus dioicus* | Kentucky coffeetree[e] |
| | *Kummerowia striata* | Japanese clover[e] |
| | *Lespedeza cuneata* | Chinese lespedeza[e#] |

| Family | Scientific Name | Common Name |
|---|---|---|
| Fabaceae (cont.) | *Robinia pseudoacacia* | black locust |
| | *Vicia caroliniana* | Carolina vetch |
| | *Wisteria sinensis* | Chinese wisteria[e#] |
| Fagaceae | *Fagus grandifolia* | American beech |
| | *Quercus alba* | white oak |
| | *Quercus coccinea* | scarlet oak |
| | *Quercus falcata* | southern red oak |
| | *Quercus laurifolia* | laurel oak |
| | *Quercus lyrata* | overcup oak |
| | *Quercus marilandica* | blackjack oak[*] |
| | *Quercus michauxii* | swamp chestnut oak |
| | *Quercus muehlenbergii* | chinkapin oak |
| | *Quercus nigra* | water oak |
| | *Quercus pagoda* | cherrybark oak |
| | *Quercus palustris* | pin oak |
| | *Quercus phellos* | willow oak |
| | *Quercus prinus* | chestnut oak |
| | *Quercus rubra* | northern red oak |
| | *Quercus stellata* | post oak |
| | *Quercus velutina* | black oak |
| Gentianaceae | *Sabatia angularis* | rosepink |
| Haloragaceae | *Myriophyllum sibiricum* | shortspike watermilfoil |
| Hamamelidaceae | *Liquidambar styraciflua* | sweetgum |
| Hydrangeaceae | *Decumaria barbara* | woodvamp |
| | *Hydrangea arborescens* | wild hydrangea |
| Iridaceae | *Iris virginica* var. *virginica* | Virginia iris |
| | *Sisyrinchium angustifolium* | narrowleaf blue-eyed grass |
| Juglandaceae | *Carya alba* | mockernut hickory |
| | *Carya cordiformis* | bitternut hickory |
| | *Carya glabra* | pignut hickory |
| | *Carya pallida* | sand hickory |
| | *Juglans nigra* | black walnut |
| Juncaceae | *Juncus coriaceus* | leathery rush |
| | *Juncus dichotomus* | forked rush |
| | *Juncus effusus* | common rush |
| | *Juncus tenuis* | poverty rush |
| | *Luzula acuminata* | hairy woodrush |
| Lamiaceae | *Ajuga chamaepitys* | yellow bugle[e] |
| | *Lycopus virginicus* | Virginia water horehound |
| | *Mentha arvensis* | wild mint |
| | *Prunella vulgaris* ssp. *vulgaris* | common selfheal[e] |
| | *Salvia lyrata* | lyreleaf sage |
| | *Scutellaria incana* var. *incana* | hoary skullcap |
| | *Teucrium canadense* | Canada germander |
| Lauraceae | *Lindera benzoin* | northern spicebush |
| | *Persea palustris* | swamp bay |
| | *Sassafras albidum* | sassafras |
| | *Lemna minor* | common duckweed |
| Liliaceae | *Allium canadense* var. *canadense* | meadow garlic |
| | *Allium ampeloprasum var. atroviolaceum* | broadleaf wild leek[e]* |
| | *Maianthemum racemosum* ssp. *racemosum* | feathery false lily of the vally |
| | *Polygonatum biflorum* | smooth Solomon's seal |

| Family | Scientific Name | Common Name |
|---|---|---|
| Liliaceae (cont.) | *Uvularia perfoliata* | perfoliate bellwort |
| | *Uvularia sessilifolia* | sessileleaf bellwort |
| Lycopodiaceae | *Lycopodium digitatum* | fan clubmoss |
| Lythraceae | *Decodon verticillatus* | swamp loosestrife |
| | *Lythrum lineare* | wand lythrum |
| Magnoliaceae | *Liriodendron tulipifera* | tuliptree |
| | *Magnolia virginiana* | sweetbay |
| Malvaceae | *Hibiscus moscheutos* ssp. *moscheutos* | crimsoneyed rosemallow |
| | *Kosteletzkya virginica* | Virginia saltmarsh mallow |
| Menispermaceae | *Menispermum canadense* | common moonseed |
| Monotropaceae | *Monotropa uniflora* | Indianpipe |
| Moraceae | *Morus rubra* | red mulberry |
| Myricaceae | *Morella cerifera* | wax myrtle |
| Nyssaceae | *Nyssa biflora* | swamp tupelo |
| | *Nyssa sylvatica* | blackgum |
| Oleaceae | *Fraxinus americana* | white ash |
| | *Fraxinus pennsylvanica* | green ash |
| | *Ligustrum sinense* | Chinese privet[e#] |
| Onagraceae | *Circaea lutetiana* ssp. *canadensis* | broadleaf enchanter's nightshade |
| | *Ludwigia palustris* | marsh seedbox |
| Ophioglossaceae | *Botrychium biternatum* | sparselobe grapefern |
| | *Botrychium virginianum* | rattlesnake fern |
| | *Ophioglossum vulgatum* | southern adderstongue |
| Orchidaceae | *Cypripedium acaule* | moccasin flower |
| | *Goodyera pubescens* | downy rattlesnake plantain |
| | *Liparis liliifolia* | brown widelip orchid |
| | *Ponthieva racemosa* | hairy shadow witch |
| | *Tipularia discolor* | crippled cranefly |
| Orobanchaceae | *Epifagus virginiana* | beechdrops |
| Osmundaceae | *Osmunda cinnamomea* var. *cinnamomea* | cinnamon fern |
| | *Osmunda regalis* var. *spectabilis* | royal fern |
| Oxalidaceae | *Oxalis stricta* | common yellow oxalis |
| | *Oxalis violacea* | violet woodsorrel |
| Papaveraceae | *Sanguinaria canadensis* | bloodroot |
| Passifloraceae | *Passiflora lutea* | yellow passionflower |
| Phytolaccaceae | *Phytolacca americana* | American pokeweed |
| Pinaceae | *Pinus taeda* | loblolly pine |
| | *Pinus virginiana* | Virginia pine |
| Platanaceae | *Platanus occidentalis* | American sycamore |
| Poaceae | *Agrostis perennans* | upland bentgrass |
| | *Andropogon virginicus* | broomsedge bluestem |
| | *Brachyelytrum erectum* | bearded shorthusk |
| | *Bromus pubescens* | hairy woodland brome |
| | *Chasmanthium latifolium* | Indian woodoats |
| | *Chasmanthium laxum* | slender woodoats |
| | *Chasmanthium sessiliflorum* | longleaf woodoats |
| | *Cinna arundinacea* | sweet woodreed |
| | *Dactylis glomerata* | orchardgrass[e#] |
| | *Danthonia spicata* | poverty oatgrass |
| | *Dichanthelium acuminatum* | tapered rosette grass |
| | *Dichanthelium boscii* | Bosc's panicgrass |
| | *Dichanthelium clandestinum* | deertongue |

| Family | Scientific Name | Common Name |
|---|---|---|
| Poaceae (cont.) | *Dichanthelium commutatum* | variable panicgrass |
| | *Dichanthelium dichotomum* | cypress panicgrass |
| | *Dichanthelium sphaerocarpon* var. *isophyllum* | roundseed panicgrass |
| | *Dichanthelium sphaerocarpon* var. *sphaerocarpon* | roundseed panicgrass |
| | *Distichlis spicata* | inland saltgrass |
| | *Echinochloa muricata* | rough barnyardgrass |
| | *Echinochloa walteri* | coast cockspur grass |
| | *Elymus hystrix* var. *hystrix* | eastern bottlebrush grass |
| | *Elymus villosus* | hairy wildrye |
| | *Elymus virginicus* var. *halophilus* | Virginia wildrye |
| | *Elymus virginicus* var. *virginicus* | Virginia wildrye |
| | *Festuca subverticillata* | nodding fescue |
| | *Glyceria septentrionalis* | floating mannagrass |
| | *Glyceria striata* | fowl mannagrass |
| | *Leersia oryzoides* | rice cutgrass |
| | *Leersia virginica* | whitegrass |
| | *Lolium pratense* | meadow ryegrass[e] |
| | *Melica mutica* | twoflower melicgrass |
| | *Microstegium vimineum* | Nepalese browntop[e#] |
| | *Muhlenbergia* sp. | a muhly |
| | *Panicum anceps* | beaked panicgrass |
| | *Panicum virgatum* var. *virgatum* | switchgrass |
| | *Phragmites australis* | common reed [e#] |
| | *Phyllostachys aurea* | golden bamboo[e#] |
| | *Piptochaetium avenaceum* | blackseed speargrass |
| | *Poa autumnalis* | autumn bluegrass |
| | *Poa compressa* | Canada bluegrass[e#] |
| | *Poa cuspidata* | early bluegrass |
| | *Poa trivialis* | rough bluegrass[e#] |
| | *Saccharum giganteum* | sugarcane plumegrass |
| | *Schizachyrium scoparium* | little bluestem |
| | *Setaria magna* | giant bristlegrass |
| | *Sorghastrum elliottii* | slender Indiangrass |
| | *Spartina alterniflora* | smooth cordgrass |
| | *Spartina cynosuroides* | big cordgrass |
| | *Spartina patens* | saltmeadow cordgrass |
| | *Sphenopholis intermedia* | slender wedgescale |
| | *Sphenopholis nitida* | shiny wedgescale |
| | *Sphenopholis pensylvanica* | swamp wedgescale |
| | *Tridens flavus* | purpletop tridens |
| | *Zizania aquatica* var. *aquatica* | annual wildrice |
| Polygalaceae | *Polygala* sp. | a polygala |
| Polygonaceae | *Polygonum arifolium* | halberdleaf tearthumb |
| | *Polygonum caespitosum* var. *longisetum* | oriental ladysthumb[e#] |
| | *Polygonum punctatum* | dotted smartweed |
| | *Polygonum sagittatum* | arrowleaf tearthumb |
| | *Polygonum setaceum* | bog smartweed |
| | *Polygonum virginianum* | Jumpseed |
| | *Rumex crispus* | curly dock[e#] |
| | *Rumex verticillatus* | swamp dock |
| Pontederiaceae | *Pontederia cordata* | pickerelweed |
| Portulacaceae | *Claytonia virginica* | Virginia springbeauty |

| Family | Scientific Name | Common Name |
|---|---|---|
| Primulaceae | *Samolus valerandi* ssp. *parviflorus* | seaside brookweed |
| Pteridaceae | *Adiantum pedatum* | northern maidenhair |
| Pyrolaceae | *Chimaphila maculata* | striped prince's pine |
| Ranunculaceae | *Anemone virginiana* var. *virginiana* | tall thimbleweed |
| | *Aquilegia canadensis* | red columbine |
| | *Cimicifuga racemosa* | black bugbane* |
| | *Hepatica nobilis* var. *obtusa* | roundlobe hepatica |
| | *Ranunculus abortivus* | littleleaf buttercup |
| | *Ranunculus bulbosus* | St. Anthony's turnip[e] |
| | *Ranunculus recurvatus* | Blisterwort |
| Rhamnaceae | *Berchemia scandens* | Alabama supplejack |
| Rosaceae | *Agrimonia rostellata* | beaked agrimony |
| | *Amelanchier arborea* | common serviceberry |
| | *Duchesnea indica* | Indian strawberry[e] |
| | *Geum canadense* | white avens |
| | *Geum virginianum* | cream avens |
| | *Potentilla canadensis* | dwarf cinquefoil |
| | *Prunus serotina* var. *serotina* | black cherry |
| | *Rosa palustris* | swamp rose |
| | *Rubus flagellaris* | northern dewberry |
| Rubiaceae | *Cephalanthus occidentalis* | common buttonbush |
| Rubiaceae | *Galium aparine* | stickywilly |
| | *Galium circaezans* | licorice bedstraw |
| | *Galium obtusum* ssp. *filifolium* | bluntleaf bedstraw |
| | *Galium obtusum* ssp. *obtusum* | bluntleaf bedstraw |
| | *Galium pilosum* | hairy bedstraw |
| | *Galium triflorum* | fragrant bedstraw |
| | *Galium uniflorum* | oneflower bedstraw |
| | *Houstonia caerulea* | azure bluet |
| | *Mitchella repens* | partridgeberry |
| Salicaceae | *Populus alba* | white poplar[e#] |
| | *Populus heterophylla* | swamp cottonwood |
| | *Salix nigra* | black willow |
| Saururaceae | *Saururus cernuus* | lizard's tail |
| Saxifragaceae | *Heuchera americana* | American alumroot |
| Scrophulariaceae | *Chelone glabra* | white turtlehead |
| | *Mimulus* sp. | a monkeyflower |
| | *Penstemon laevigatus* | eastern smooth beardtongue |
| | *Paulownia tomentosa* | princesstree[e#*] |
| | *Verbascum thapsus* | common mullein[e] |
| | *Veronica arvensis* | corn speedwell[e] |
| Selaginellaceae | *Selaginella apoda* | meadow spikemoss |
| Simaroubaceae | *Ailanthus altissima* | tree of heaven[e#] |
| Smilacaceae | *Smilax bona-nox* | saw greenbrier |
| | *Smilax glauca* | cat greenbrier |
| | *Smilax herbacea* | smooth carrionflower |
| | *Smilax rotundifolia* | roundleaf greenbrier |
| | *Smilax walteri* | coral greenbrier |
| Solanaceae | *Physalis heterophylla* | clammy groundcherry |
| Sparganiaceae | *Sparganium americanum* | American bur-reed |
| Taxodiaceae | *Taxodium distichum* | bald cypress |

| Family | Scientific Name | Common Name |
|---|---|---|
| Thelypteridaceae | *Phegopteris hexagonoptera* | broad beechfern |
| | *Thelypteris noveboracensis* | New York fern |
| | *Thelypteris palustris* var. *pubescens* | eastern marsh fern |
| Typhaceae | *Typha ×glauca* | hybrid cattail |
| | *Typha angustifolia* | narrowleaf cattail |
| | *Typha latifolia* | broadleaf cattail |
| Ulmaceae | *Celtis laevigata* | sugarberry |
| | *Celtis occidentalis* | common hackberry |
| | *Ulmus americana* | American elm |
| | *Ulmus rubra* | slippery elm |
| Urticaceae | *Boehmeria cylindrica* | smallspike false nettle |
| | *Pilea fontana* | lesser clearweed |
| | *Pilea pumila* | Canadian clearweed |
| Valerianaceae | *Valerianella radiata* | beaked cornsalad |
| Verbenaceae | *Callicarpa americana* | American beautyberry |
| | *Phryma leptostachya* | American lopseed |
| | *Phyla lanceolata* | lanceleaf fogfruit |
| | *Verbena scabra* | sandpaper vervain |
| Violaceae | *Viola arvensis* | European field pansy[e*] |
| | *Viola cucullata* | marsh blue violet |
| | *Viola sororia* | common blue violet |
| Viscaceae | *Phoradendron leucarpum* | oak mistletoe |
| Vitaceae | *Parthenocissus quinquefolia* | Virginia creeper |
| | *Vitis aestivalis* | summer grape |
| | *Vitis rotundifolia* | muscadine |
| | *Vitis vulpina* | frost grape |

[e] Species not native to Virginia.
[#] Species considered to be invasive nonnative species by the VADCR (VADCR 2003).
[*] Species not measured in quantitative plots or accuracy assessment observations, but noted during fieldwork and used to characterize a vegetation class in Appendix I.

Appendix D. Distribution of vegetation classes, derived from the analysis of regional quantitative plot data, across seven national parks in Virginia.

Vegetation was classified and mapped in seven national park units in Virginia: Appomattox Court House National Historical Park (APCO), Booker T. Washington National Monument (BOWA), Colonial National Historical Park (COLO), Fredericksburg and Spotsylvania National Military Park (FRSP), George Washington Birthplace National Monument (GEWA), Petersburg National Battlefield (PETE), and Richmond National Battlefield Park (RICH). The classification used to map these parks was developed regionally, using quantitative data that were collected from all seven parks and combined with existing data from throughout the Mid-Atlantic Piedmont and Coastal Plain. Quantitative analysis classified 35 associations occurring in the seven parks. An additional 19 associations and 12 nonstandard, park-specific vegetation classes representing disturbed, cultural, or exotic vegetation were also recognized from the seven parks, but were not represented by quantitative data. The relationship of all vegetation classes to the map classes used to map Colonial National Historical Park can be found in Table 11 of the main report. Vegetation classes listed with USNVC codes are equivalent to associations in the United States National Vegetation Classification (NatureServe 2007). Global and State conservation ranks are defined in Appendix E.

Appendix D. Distribution of vegetation classes across seven national parks in Virginia.

| | USNVC code | Global/State Conservation Ranks | BOWA | APCO | FRSP | RICH | PETE | COLO | GEWA | Plots in regional analysis |
|---|---|---|---|---|---|---|---|---|---|---|
| **UPLAND FORESTS** | | | | | | | | | | |
| **Oak / Heath Forests** | | | | | | | | | | **93** |
| Coastal Plain Mixed Oak / Heath Forest | CEGL006269 | G4G5/S4 | | | x | x | x | | | 18 |
| Piedmont / Low Elevation Mixed Oak / Heath Forest | CEGL008521 | G5/S5 | | x | x | | | x | | 75 |
| **Pine - Oak Forests** | | | | | | | | | | **25** |
| Coastal Plain Loblolly Pine - Oak Forest | CEGL004766 | GNR/SNR | | | | | | x | | 8 |
| Eastern White Pine - Hardwood Forest | CEGL008539 | G4/S4? | | | x | | | | | 17 |
| **Mesic Acidic Forests** | | | | | | | | | | **196** |
| Mesic Mixed Hardwood Forest | CEGL006075 | G5/S5 | | x | x | x | x | x | | 170 |
| Piedmont / Coastal Plain Oak - Beech / Heath Forest | CEGL006919 | GNR/SNR | | | | | | x | | 26 |
| **Oak - Hickory Forests** | | | | | | | | | | **137** |
| Acidic Oak - Hickory Forest | CEGL008475 | G4G5/S4 | x | x | x | x | x | x | | 121 |
| Basic Oak - Hickory Forest | CEGL007232 | G3G4/S3 | | x | | | | | | 16 |
| **Basic Mesic and Calcareous Forests** | | | | | | | | | | **77** |
| Inner Piedmont / Lower Blue Ridge Basic Mesic Forest | CEGL006186 | G4?/S4 | x | x | | | | | | 31 |
| Coastal Plain Mesic Calcareous Ravine Forest | CEGL007181 | G2?/S2 | | | | | | x | | 22 |
| Coastal Plain Dry Calcareous Forest | CEGL007748 | G1/S1 | | | | | | x | x | 24 |
| **NON-TIDAL WETLANDS** | | | | | | | | | | |
| **Seepage Wetlands** | | | | | | | | | | **72** |
| Coastal Plain / Piedmont Acidic Seepage Swamp | CEGL006238 | G3?/S3? | | | x | x | x | | x | 39 |
| Northern Piedmont / Lower New England Basic Seepage Swamp | CEGL006406 | G4G5/S2? | | x | | | | | | 18 |
| Coastal Plain Calcareous Seepage Swamp | CEGL006413 | G2/S1S2 | | | | | | x | | 15 |
| **Alluvial Forests** | | | | | | | | | | **100** |
| Coastal Plain / Piedmont Small-Stream Floodplain Forest | CEGL004418 | G4/S4 | | | x | x | x | x | | 48 |
| Piedmont / Mountain Alluvial Forest | CEGL006492 | G4/S4 | x | x | | | | | | 14 |
| Piedmont / Mountain Floodplain Forest | CEGL006217 | G4/S4 | | | x | | | | | 38 |
| **Swamp Forests** | | | | | | | | | | **70** |
| Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak - Red Maple Type) | CEGL006605 | G3G4/S3 | | | x | | x | | | 47 |
| Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type) | CEGL006606 | GNR/SNR | | | | | | x | | 23 |
| **Nonriverine Forests** | | | | | | | | | | **62** |
| Upland Depression Swamp | CEGL007403 | G2G3/S2 | | x | | | | | | 9 |
| Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type) | CEGL006110 | G4G5/S3 | | | x | | | x | | 14 |
| Coastal Plain Depression Wetland (Swamp Tupelo Type) | CEGL006223 | G2S2 | | | | | | x | | 18 |
| Non-Riverine Saturated Forest | CEGL004644 | G2?/S2 | | | x | x | | x | x | 21 |
| **TIDAL WETLANDS** | | | | | | | | | | |
| **Tidal Herbaceous Marshes** | | | | | | | | | | **133** |
| Tidal Freshwater Marsh | CEGL004706 | G3G4/SNR | | | | | | x | | 18 |
| Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) | CEGL006586 | GNR/SNR | | | | | | x | x | 13 |
| Tidal Mesohaline and Polyhaline Marsh (Transitional Marsh) | CEGL006418 | GNR/SNR | | | | | | x | | 18 |
| Tidal Oligohaline Marsh (Common Reed Tidal Marsh) | CEGL004187 | GNA/SNA | | | | | | x | x | 7 |
| Tidal Oligohaline Marsh (Interior Depression Marsh) | CEGL006578 | GNR/SNR | | | | | | x | | 13 |
| Tidal Oligohaline Marsh (Big Cordgrass Type) | CEGL004195 | G4/SNR | | | | | | x | x | 18 |
| Tidal Oligohaline Marsh (Mixed Forbs Type) | CEGL006181 | GNR/SNR | | | | | | x | x | 32 |
| Tidal Oligohaline Marsh (Saltmeadow Cordgrass - Olney Three-Square Low Interior Marsh Type) | CEGL006612 | GNR/SNR | | | | | | x | | 14 |
| **Tidal Forests and Shrublands** | | | | | | | | | | **97** |
| Salt Scrub | CEGL003921 | G5/SNR | | | | | | x | | 13 |
| Tidal Shrub Swamp (Iva Type) | CEGL006848 | G5/SNR | | | | | | | x | 30 |
| Tidal Shrub Swamp (Wax Myrtle Type) | CEGL004656 | G4/SNR | | | | | | x | | 49 |
| Tidal Bald Cypress Forest / Woodland | CEGL004654 | G2S2 | | | | | | x | | 5 |

| | USNVC code | Global/State Conservation Ranks | BOWA | APCO | FRSP | RICH | PETE | COLO | GEWA | Plots in regional analysis |
|---|---|---|---|---|---|---|---|---|---|---|
| **DISTURBED, CULTURAL, EXOTIC VEGETATION** | | | | | | | | | | |
| **Upland Forests and Shrublands** | | | | | | | | | | |
| Dense Hardwood Regeneration | nonstandard | | x | x | | | | x | | 0 |
| Disturbed Acidic Slope Forest | CEGL007726 | GNA/SNA | | | | | | | x | 0 |
| Disturbed Calcareous Forest | nonstandard | | | | | | x | x | x | 0 |
| Early-Successional Loblolly Pine Forest | CEGL006011 | GNA/SNA | | | | | x | | x | 0 |
| Golden Bamboo Shrubland | CEGL008560 | GNA/SNA | | | | | | x | | 0 |
| Loblolly Pine - Hardwood Forest | CEGL008462 | GNA/SNA | | | | x | x | | x | 0 |
| Loblolly Pine Plantation | CEGL007179 | GNA/SNA | | x | x | x | x | x | x | 0 |
| Successional Black Locust Forest | CEGL007279 | GNA/SNA | | | | | | | x | 0 |
| Successional Black Walnut Forest | CEGL007879 | GNA/SNA | | x | | x | | x | | 0 |
| Successional Mixed Scrub | nonstandard | | | | x | x | x | x | | 0 |
| Successional Red-cedar Forest | CEGL006024 | GNA/SNA | | x | x | x | | | x | 0 |
| Successional Sweetgum Forest | CEGL007216 | GNA/SNA | | | | | x | x | x | 0 |
| Successional Tree-of-Heaven Forest | CEGL007191 | GNA/SNA | | x | | | | x | | 0 |
| Successional Tuliptree - Loblolly Pine Forest | CEGL007521 | GNA/SNA | | | | | | x | | 0 |
| Successional Tuliptree Forest | CEGL007221 | GNA/SNA | x | x | x | x | x | | | 0 |
| Successional Virginia Pine Forest | CEGL002591 | GNA/SNA | x | x | x | | | | | 0 |
| Virginia Pine Plantation | CEGL004730 | GNA/SNA | | x | | | | | | 0 |
| White Pine Plantation | CEGL007178 | GNA/SNA | x | | | | | | | 0 |
| **Wetland Vegetation** | | | | | | | | | | |
| Beaver Wetland Complex | CEGL005082 | G4G5/SNR | | x | x | x | x | | | 0 |
| Successional River Birch - Red Maple Floodplain Forest | CEGL006976 | GNR/SNR | | | x | | | | | 0 |
| Successional Tuliptree Floodplain Forest | CEGL007330 | GNA/SNA | | | x | | | | | 0 |
| Disturbed Depressional Wetland | nonstandard | | | | | | | x | | 0 |
| Disturbed Seepage Swamp | nonstandard | | | | | | | x | | 0 |
| Disturbed Tidal Hardwood Swamp | nonstandard | | | | | | | x | | 0 |
| Non-Riverine Saturated Forest - pine subtype | nonstandard | | | | | x | | | | 0 |
| Successional Shrub Swamp | nonstandard | | | | | x | | | | 0 |
| **Cultural Vegetation** | | | | | | | | | | |
| Cultural Meadow | CEGL006107 | GNA/SNA | x | x | x | x | x | x | x | 0 |
| Forested Earthworks | nonstandard | | | | | x | x | | | 0 |
| Grazed Woodlot | nonstandard | | | x | | | | | | 0 |
| Open Earthworks | nonstandard | | | | | x | x | | | 0 |
| Semipermanent Impoundment | Nonstandard | | | | x | | x | x | x | 0 |

Appendix E. Definitions of global and subnational (state) conservation ranks.

NatureServe and the Network of Natural Heritage Programs and Conservation Data Centers work together to assign conservation status ranks to elements of biodiversity (plants, animals, and ecological communities). These ranks have been developed using range-wide data collected by the Natural Heritage Network for nearly three decades and are critical in setting conservation priorities. Community types are ranked on a global (G), national (N), and subnational (S) scale of 1 to 5, with 1 indicating critical imperilment due to rarity, endemism, and/or threats, and 5 indicating little or no risk of extirpation or elimination.

The primary ranking factors used in assessing the appropriate conservation status rank for an ecological community element are: (1) the total number of occurrences, and (2) the total area (acreage) of the element. Secondary ranking factors, such as the geographic range over which the element occurs, the threats to the occurrences, and the viability of the occurrences, also affect the rank.

Additional factors that have been used in arriving at an assessment of a community's range-wide (global) rank include the geographic range over which the type occurs, the long term decline of the type across this range, the degree of site specificity exhibited by the type, and the rarity across the range based on state ranks assigned by state Natural Heritage Programs.

To learn more about Natural Heritage Methodology, go to
http://www.natureserve.org/prodServices/heritagemethodology.jsp.

## Global Rank Codes and Definitions

Global ranks (i.e. range-wide conservation status ranks) are assigned at NatureServe's Headquarters or by a designated lead office in the Heritage/Conservation Data Center Network.

**GX - Extirpated -** Eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species.

**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).

**G1 - Critically Imperiled -** 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 -** 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 - Vulnerable** - 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 - Apparently Secure** - Uncommon but not rare. Apparently secure, but with cause for long-term concern. May be quite rare in parts of its range, especially at the periphery; apparently not vulnerable in most of its range

**G5 - Secure** - 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.

**GNA - Rank not applicable** - Common cultural, ruderal, planted, modified, managed, invasive, and/or non-natural type that is not a suitable target for conservation activities.

**GNR - Not Yet Ranked** - Status has not yet been assessed.

**GU - Unrankable** - Status cannot be determined at this time.

**G#G# - Rank Range** - The actual rank of the element is within the range specified by the numbers; however, the exact status of the rarity of the element is uncertain. For example, G2G3 indicates that the rank may be either G2 or G3.

## State Rank Codes and Definitions

State ranks are assigned by the Virginia Division of Natural Heritage and apply to an element only as it exists in each state, regardless of its range-wide status.

**SX - Extirpated** - Presumed extirpated from the state. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

**SH - Historical** - Possibly extirpated (Historical). Historically known from the state, but not verified for an extended period, usually >15 years; this rank is used primarily when inventory has been attempted recently.

**S1 - Critically Imperiled** - Critically imperiled in the state because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from the state; generally with 5 or fewer occurrences state-wide, and/or covering less than 50 ha (124 ac) in aggregate; or covering a larger area but highly threatened with destruction or modification.

**S2 - Imperiled** - Imperiled in the state because of rarity or because of some factor(s) making it very vulnerable to extirpation from the state. Generally with 6–20 occurrences state-wide, and/or covering less than 250 ha (618 ac) in aggregate; or covering a larger area but threatened with destruction or modification.

**S3 - Vulnerable** - Vulnerable in the state either because rare and uncommon, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation. Generally with 21–100 occurrences state-wide; or with a larger number of occurrences subject to relatively high levels of threat; may be of relatively frequent occurrence in specific localities or geographic parts of the state.

**S4 - Apparently Secure** - Uncommon but not rare, and usually widespread in the state. Some cause for long-term concern due to declines or other factors.

**S5 - Secure** - Demonstrably widespread, abundant, and secure in the state, and essentially ineradicable under present conditions.

**SNA - Rank not applicable** - Common cultural, ruderal, planted, modified, managed, invasive, and/or non-natural type that is not a suitable target for conservation activities.

**SNR - Not Ranked** - Status has not yet been assessed. As the state vegetation classifications are further revised by additional information, the SNR will be changed to a numeric rank based on available data.

**SU - Unrankable** - Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.

**S#S# - Rank Range** - The actual rank of the element is within the range specified by the numbers; however, the exact status of the rarity of the element is uncertain. For example, S1S3 indicates that the rank may be either S1, S2, or S3.

## Global and State Rank Qualifier Codes and Definitions

**? - Inexact or Uncertain** - 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.

**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.

Appendix F. Environmental variable averages for associations derived from the analysis of regional quantitative plot data.

Mean values for selected continuous and ordinal environmental variables were calculated for the 35 associations occurring in seven national parks in Virginia that were derived from the analysis of quantitative plot data. Calculations were performed with raw (untransformed) values by taking the average across all plots representing a given association. Environmental variables were only summarized if at least half the plots in a given association contained data; otherwise the table cells are shaded. Mean aspect was calculated as the average position along an arc defined by the range of aspect values. Topographic variables and percentage substrate are presented in a separate table from soil chemistry variables.

Column headings are as follows:

Topographic variables
- Aspect
- Slope Inclination (see Table 4)
- Topographic Position (see Table 4)
- TRMI = Topographic Relative Moisture Index

Percentage substrate
- %Bedrock = percentage cover by bedrock in plot
- %Large Rocks = percentage cover by boulders and stones (rocks > 10 cm) in plot
- %Small Rocks = percentage cover by gravel and cobble (rocks 0.2–10 cm) in plot
- %Min. Soil = percentage cover by bare sand or mineral soil in plot
- %Litter&Duff = percentage cover by leaf litter and duff in plot
- %Wood = percentage cover by dead wood in plot
- %Water = percentage cover by water in plot
- %NonVasc = percentage cover by nonvascular plants in plot

Soil chemistry variables are as defined in Table 5.

Associations present in Colonial National Historical Park are listed in bold font.

Table F1. Environmental variable averages by association – topographic variables and percentage substrate.

| | USNVC Code | Aspect | Slope Inclination | Toporaphic Position | TRMI | %Bedrock | %Large Rocks | %Small Rocks | %Min. Soil | %Litter & Duff | %Wood | %Water | %NonVasc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oak / Heath Forests | | | | | | | | | | | | | |
| Coastal Plain Mixed Oak / Heath Forest | CEGL006269 | flat to SW | gentle to moderate | lower to middle slope | 26.7 | 0 | 0 | 0 | 6 | 91 | 3 | 0 | 1 |
| **Piedmont / Low Elevation Mixed Oak / Heath Forest** | **CEGL008521** | **S** | **gentle** | **upper slope** | **24.6** | **0** | **0** | **1** | **1** | **94** | **4** | **0** | **0** |
| Pine - Oak Forests | | | | | | | | | | | | | |
| **Coastal Plain Loblolly Pine - Oak Forest** | **CEGL004766** | **flat** | **level to gentle** | **plain/level/bottom - lower slope** | **31.5** | **0** | **0** | **0** | **1** | **96** | **4** | **0** | **1** |
| Eastern White Pine - Hardwood Forest | CEGL008539 | NNW | moderate to steep | middle slope | 25.9 | <1 | 2 | <1 | 1 | 95 | 2 | 0 | 3 |
| Mesic Acidic Forests | | | | | | | | | | | | | |
| **Mesic Mixed Hardwood Forest** | **CEGL006075** | **NNE** | **moderate** | **lower to middle slope** | **29.7** | **0** | **1** | **0** | **2** | **94** | **3** | **0** | **1** |
| **Piedmont / Coastal Plain Oak – Beech / Heath Forest** | **CEGL006919** | **N** | **steep** | **middle slope** | **26.4** | **0** | **0** | **0** | **2** | **95** | **3** | **0** | **4** |
| Oak - Hickory Forests | | | | | | | | | | | | | |
| **Acidic Oak - Hickory Forest** | **CEGL008475** | **WSW** | **moderate** | **middle slope** | **25.5** | **0** | **2** | **1** | **3** | **91** | **3** | **0** | **3** |
| Basic Oak - Hickory Forest | CEGL007232 | S | gentle to moderate | lower to middle slope | 26.5 | 0 | 3 | 0 | 7 | 87 | 3 | 0 | 1 |
| Basic Mesic and Calcareous Forests | | | | | | | | | | | | | |
| Inner Piedmont / Lower Blue Ridge Basic Mesic Forest | CEGL006186 | ESE | steep | middle slope | 32.6 | 1 | 10 | 0 | 2 | 82 | 5 | 0 | 7 |
| **Coastal Plain Mesic Calcareous Ravine Forest** | **CEGL007181** | **NE** | **moderate to steep** | **lower to middle slope** | **27.2** | **0** | **0** | **0** | **9** | **89** | **2** | **0** | **4** |
| **Coastal Plain Dry Calcareous Forest** | **CEGL007748** | **S** | **moderate to steep** | **middle to upper slope** | **19.4** | **0** | **0** | **0** | **15** | **79** | **5** | **1** | **0** |
| Seepage Wetlands | | | | | | | | | | | | | |
| Coastal Plain / Piedmont Acidic Seepage Swamp | CEGL006238 | flat | level to gentle | plain/level/bottom | 38.2 | 0 | 0 | 0 | 3 | 85 | 3 | 9 | 13 |
| Northern Piedmont / Lower New England Basic Seepage Swamp | CEGL006406 | flat | level to gentle | plain/level/bottom - toe slope | 37.6 | 0 | 2 | 0 | 15 | 68 | 3 | 6 | 1 |
| **Coastal Plain Calcareous Seepage Swamp** | **CEGL006413** | **flat** | **level** | **plain/level/bottom** | **40.8** | **1** | **0** | **0** | **5** | **89** | **2** | **4** | **2** |
| Alluvial Forests | | | | | | | | | | | | | |
| **Coastal Plain / Piedmont Small-Stream Floodplain Forest** | **CEGL004418** | **flat** | **level** | **plain/level/bottom** | **40.5** | **0** | **0** | **0** | **2** | **93** | **3** | **2** | **1** |
| Piedmont / Mountain Alluvial Forest | CEGL006492 | flat | level | plain/level/bottom | 41.2 | 0 | 0 | 0 | 14 | 82 | 4 | 0 | 0 |
| Piedmont / Mountain Floodplain Forest | CEGL006217 | flat | level to gentle | plain/level/bottom | 41.6 | 0 | <1 | 0 | 39 | 58 | 3 | 0 | <1 |
| Swamp Forests | | | | | | | | | | | | | |
| Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type) | CEGL006605 | flat | level to basin / depression | plain/level/bottom | 40.0 | 0 | 0 | 0 | 7 | 88 | 4 | 1 | 2 |
| **Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash – Red Maple Type)** | **CEGL006606** | **flat** | **level to basin / depression** | **plain/level/bottom** | **40.4** | **0** | **0** | **0** | **15** | **72** | **2** | **11** | **1** |

Table F1. Environmental variable averages by association – topographic variables and percentage substrate (continued).

| | USNVC Code | Aspect | Slope Inclination | Toporaphic Position | TRMI | %Bedrock | %Large Rocks | %Small Rocks | %Min. Soil | %Litter & Duff | %Wood | %Water | %NonVasc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nonriverine Forests | | | | | | | | | | | | | |
| Upland Depression Swamp | CEGL007403 | flat | level to basin / depression | various | 35.1 | 1 | 0 | 0 | 1 | 92 | 5 | 2 | 3 |
| **Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type)** | **CEGL006110** | **flat** | **level to basin / depression** | **various** | **37.1** | **0** | **0** | **0** | **4** | **86** | **4** | **6** | **16** |
| **Coastal Plain Depression Wetland (Swamp Tupelo Type)** | **CEGL006223** | **flat** | **level to basin / depression** | **basin/depression** | **40.0** | **0** | **0** | **0** | **1** | **98** | **2** | **0** | **0** |
| **Non-Riverine Saturated Forest** | **CEGL004644** | **flat** | **level** | **plain/level/bottom** | **40.0** | **0** | **0** | **0** | **1** | **89** | **7** | **3** | **4** |
| Tidal Herbaceous Marshes | | | | | | | | | | | | | |
| **Tidal Freshwater Marsh** | **CEGL004706** | **flat** | **level to gentle** | **plain/level/bottom** | **40.0** | **0** | **0** | **0** | **62** | **19** | **0** | **19** | **0** |
| **Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh)** | **CEGL006586** | **flat** | **level** | **plain/level/bottom** | **40.0** | **0** | **0** | **0** | **14** | **17** | **0** | **69** | **0** |
| **Tidal Mesohaline and Polyhaline Marsh (Transitional Marsh)** | **CEGL006418** | **flat** | **level to gentle** | **plain/level/bottom** | **40.0** | **0** | **0** | **0** | **43** | **28** | **0** | **28** | **0** |
| **Tidal Oligohaline Marsh (Common Reed Tidal Marsh)** | **CEGL004187** | **flat** | **level** | **plain/level/bottom** | **40.0** | | | | | | | | |
| **Tidal Oligohaline Marsh (Interior Depression Marsh)** | **CEGL006578** | **flat** | **level** | **plain/level/bottom** | **40.0** | **0** | **0** | **0** | **25** | **67** | **0** | **8** | **0** |
| **Tidal Oligohaline Marsh (Big Cordgrass Type)** | **CEGL004195** | **flat** | **level** | **plain/level/bottom** | **40.0** | | | | | | | | |
| **Tidal Oligohaline Marsh (Mixed Forbs Type)** | **CEGL006181** | **flat** | **level** | **plain/level/bottom** | **40.0** | **0** | **0** | **0** | **20** | **53** | **0** | **27** | **0** |
| **Tidal Oligohaline Marsh (Saltmeadow Cordgrass – Olney Three-Square Low Interior Marsh Type)** | **CEGL006612** | **flat** | **level to gentle** | **plain/level/bottom** | **40.0** | **0** | **0** | **0** | **5** | **71** | **0** | **24** | **0** |
| Tidal Forests and Shrublands | | | | | | | | | | | | | |
| **Salt Scrub** | **CEGL003921** | **flat** | **level** | **plain/level/bottom** | **40.0** | | | | | | | | |
| Tidal Shrub Swamp (Iva Type) | CEGL006848 | flat | level | plain/level/bottom | 40.0 | | | | | | | | |
| **Tidal Shrub Swamp (Wax Myrtle Type)** | **CEGL004656** | **flat** | **level** | **plain/level/bottom** | **40.0** | | | | | | | | |
| **Tidal Bald Cypress Forest/Woodland** | **CEGL004654** | **flat** | **level** | **plain/level/bottom** | **40.0** | **0** | **0** | **0** | **0** | **9** | **1** | **90** | **0** |

Table F2. Environmental variable averages by association – soil chemistry variables.

| | USNVC Code | pH | N | P | S | Ca | Mg | K | Na | B | Fe | Mn | Cu | Zn | Al | CEC | TBS | OM | CaMgRatio | Fertility |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oak / Heath Forests | | | | | | | | | | | | | | | | | | | | |
| Coastal Plain Mixed Oak / Heath Forest | CEGL006269 | 4.2 | 79 | 31 | 31 | 132 | 31 | 28 | 12 | 0.60 | 282 | 10 | 0.41 | 1.1 | 634 | 8.1 | 19.2 | 3.3 | 4.3 | 1.0 |
| **Piedmont / Low Elevation Mixed Oak / Heath Forest** | **CEGL008521** | **4.2** | **90** | **14** | **31** | **135** | **28** | **35** | **12** | **0.41** | **295** | **14** | **0.57** | **1.4** | **764** | **10.3** | **12.1** | **4.6** | **4.7** | **1.1** |
| Pine – Oak Forests | | | | | | | | | | | | | | | | | | | | |
| **Coastal Plain Loblolly Pine – Oak Forest** | **CEGL004766** | **4.1** | **90** | **25** | **40** | **165** | **52** | **34** | **11** | **0.80** | **324** | **64** | **0.59** | **1.5** | **697** | **12.1** | **13.5** | **4.1** | **3.3** | **1.4** |
| Eastern White Pine – Hardwood Forest | CEGL008539 | 4.2 | 95 | 13 | 35 | 205 | 44 | 47 | 12 | 0.5 | 297 | 43 | 0.6 | 1.6 | 852 | 14.4 | 10.2 | 6.1 | 5.0 | 1.5 |
| Mesic Acidic Forests | | | | | | | | | | | | | | | | | | | | |
| **Mesic Mixed Hardwood Forest** | **CEGL006075** | **4.4** | **92** | **28** | **34** | **303** | **68** | **55** | **14** | **0.46** | **186** | **66** | **0.90** | **2.3** | **776** | **11.4** | **23.3** | **4.6** | **4.9** | **2.3** |
| **Piedmont / Coastal Plain Oak – Beech / Heath Forest** | **CEGL006919** | **4.2** | **88** | **19** | **29** | **155** | **39** | **39** | **12** | **0.40** | **279** | **9** | **0.53** | **1.3** | **746** | **11.2** | **15.2** | **4.2** | **5.6** | **1.2** |
| Oak – Hickory Forests | | | | | | | | | | | | | | | | | | | | |
| **Acidic Oak – Hickory Forest** | **CEGL008475** | **4.6** | **99** | **18** | **33** | **320** | **80** | **60** | **13** | **0.39** | **204** | **80** | **1.69** | **2.4** | **908** | **10.1** | **27.1** | **5.6** | **4.3** | **2.5** |
| Basic Oak – Hickory Forest | CEGL007232 | 5.3 | 106 | 32 | 29 | 1508 | 241 | 108 | 12 | 0.62 | 175 | 215 | 2.03 | 3.0 | 740 | 14.3 | 63.5 | 6.4 | 7.3 | 9.9 |
| Basic Mesic and Calcareous Forests | | | | | | | | | | | | | | | | | | | | |
| Inner Piedmont / Lower Blue Ridge Basic Mesic Forest | CEGL006186 | 5.5 | 110 | 29 | 30 | 1712 | 281 | 139 | 11 | 0.72 | 149 | 172 | 2.24 | 4.0 | 774 | 15.2 | 69.9 | 8.9 | 6.0 | 11.2 |
| **Coastal Plain Mesic Calcareous Ravine Forest** | **CEGL007181** | **5.7** | **93** | **34** | **34** | **2246** | **96** | **75** | **18** | **0.76** | **131** | **78** | **0.86** | **2.9** | **538** | **14.7** | **81.5** | **4.5** | **24.1** | **12.3** |
| **Coastal Plain Dry Calcareous Forest** | **CEGL007748** | **6.5** | **100** | **40** | **39** | **4707** | **116** | **113** | **31** | **1.10** | **158** | **67** | **1.10** | **3.7** | **403** | **27.4** | **86.3** | **5.9** | **40.7** | **24.9** |
| Seepage Wetlands | | | | | | | | | | | | | | | | | | | | |
| Coastal Plain / Piedmont Acidic Seepage Swamp | CEGL006238 | 4.6 | 96 | 19 | 45 | 318 | 90 | 38 | 30 | 0.52 | 343 | 13 | 0.95 | 3.6 | 470 | 34.1 | 34.0 | 8.0 | 4.0 | 2.5 |
| Northern Piedmont / Lower New England Basic Seepage Swamp | CEGL006406 | 5.2 | 110 | 24 | 88 | 1071 | 195 | 58 | 33 | 0.74 | 417 | 64 | 2.50 | 7.1 | 425 | 13.0 | 56.5 | 7.3 | 6.4 | 7.3 |
| **Coastal Plain Calcareous Seepage Swamp** | **CEGL006413** | **6.1** | **114** | **29** | **104** | **3327** | **93** | **56** | **52** | **1.23** | **554** | **31** | **1.29** | **9.82** | **222** | **21.4** | **83.5** | **15** | **46.6** | **17.8** |
| Alluvial Forests | | | | | | | | | | | | | | | | | | | | |
| **Coastal Plain / Piedmont Small-Stream Floodplain Forest** | **CEGL004418** | **4.5** | **88** | **20** | **35** | **603** | **119** | **62** | **25** | **0.54** | **264** | **82** | **1.51** | **3.7** | **585** | **10.9** | **42.4** | **4.4** | **5.5** | **4.1** |
| Piedmont / Mountain Alluvial Forest | CEGL006492 | 5.3 | 94 | 32 | 23 | 1127 | 180 | 62 | 25 | 0.67 | 204 | 119 | 3.02 | 5.8 | 520 | 11.1 | 69.0 | 4.8 | 6.3 | 7.4 |
| Piedmont / Mountain Floodplain Forest | CEGL006217 | 6.7 | 79 | 44 | 42 | 2570 | 169 | 63 | 19 | 0.8 | 242 | 106 | 3.0 | 14.4 | 309 | 14.9 | 97.8 | 3.8 | 16.8 | 14.2 |
| Swamp Forests | | | | | | | | | | | | | | | | | | | | |
| Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type) | CEGL006605 | 4.5 | 91 | 27 | 47 | 388 | 82 | 53 | 18 | 0.57 | 381 | 67 | 1.57 | 4.5 | 668 | 11.6 | 27.3 | 4.7 | 5.5 | 2.8 |
| **Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash – Red Maple Type)** | **CEGL006606** | **5.2** | **101** | **28** | **99** | **1471** | **155** | **55** | **44** | **0.58** | **343** | **70** | **1.87** | **7.2** | **447** | **14.1** | **62.8** | **6.6** | **11.9** | **9.0** |

Table F2. Environmental variable averages by association – soil chemistry variables (continued).

| | USNVC Code | pH | N | P | S | Ca | Mg | K | Na | B | Fe | Mn | Cu | Zn | Al | CEC | TBS | OM | CaMgRatio | Fertility |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nonriverine Forests | | | | | | | | | | | | | | | | | | | | |
| Upland Depression Swamp | CEGL007403 | 4.3 | 110 | 47 | 61 | 501 | 130 | 55 | 39 | 0.52 | 395 | 23 | 1.29 | 4.3 | 1052 | 16.0 | 29.2 | 7.3 | 3.8 | 3.0 |
| **Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type)** | **CEGL006110** | **4.1** | **109** | **48** | **56** | **193** | **68** | **53** | **17** | **0.53** | **297** | **30** | **0.90** | **2.4** | **890** | **17.3** | **10.9** | **7.0** | **3.1** | **1.7** |
| **Coastal Plain Depression Wetland (Swamp Tupelo Type)** | **CEGL006223** | | | | | | | | | | | | | | | | | | | |
| **Non-Riverine Saturated Forest** | **CEGL004644** | **4.3** | **99** | **32** | **53** | **288** | **62** | **43** | **26** | **0.72** | **333** | **6** | **0.60** | **2.0** | **614** | **14.3** | **17.8** | **4.3** | **6.1** | **2.3** |
| Tidal Herbaceous Marshes | | | | | | | | | | | | | | | | | | | | |
| **Tidal Freshwater Marsh** | **CEGL004706** | | | | | | | | | | | | | | | | | | | |
| **Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh)** | **CEGL006586** | | | | | | | | | | | | | | | | | | | |
| **Tidal Mesohaline and Polyhaline Marsh (Transitional Marsh)** | **CEGL006418** | | | | | | | | | | | | | | | | | | | |
| **Tidal Oligohaline Marsh (Common Reed Tidal Marsh)** | **CEGL004187** | | | | | | | | | | | | | | | | | | | |
| **Tidal Oligohaline Marsh (Interior Depression Marsh)** | **CEGL006578** | **4.5** | **126** | **33** | **1189** | **986** | **990** | **249** | **1504** | **1.25** | **507** | **100** | **2.41** | **29.6** | **523** | **31.2** | **63.3** | **15.9** | **1.4** | **20.4** |
| **Tidal Oligohaline Marsh (Big Cordgrass Type)** | **CEGL004195** | | | | | | | | | | | | | | | | | | | |
| **Tidal Oligohaline Marsh (Mixed Forbs Type)** | **CEGL006181** | **4.6** | **128** | **27** | **906** | **937** | **930** | **206** | **1845** | **1.3** | **560** | **162** | **1.29** | **14.9** | **487** | **32.5** | **65.3** | **20.7** | **1.1** | **21.0** |
| **Tidal Oligohaline Marsh (Saltmeadow Cordgrass – Olney Three-Square Low Interior Marsh Type)** | **CEGL006612** | | | | | | | | | | | | | | | | | | | |
| Tidal Forests and Shrublands | | | | | | | | | | | | | | | | | | | | |
| **Salt Scrub** | **CEGL003921** | | | | | | | | | | | | | | | | | | | |
| Tidal Shrub Swamp (Iva Type) | CEGL006848 | | | | | | | | | | | | | | | | | | | |
| **Tidal Shrub Swamp (Wax Myrtle Type)** | **CEGL004656** | | | | | | | | | | | | | | | | | | | |
| **Tidal Bald Cypress Forest/Woodland** | **CEGL004654** | | | | | | | | | | | | | | | | | | | |

Appendix G. Cluster dendrograms, ordination scatterplots, and joint plots resulting from quantitative analysis of regional plot data for 11 major vegetation groups present at Colonial National Historical Park.

Major vegetation groups are presented as follows:

Oak / Heath Forests (Figures G1–G2)
Pine - Oak Forests (Figures G3–G4)
Mesic Acidic Forests (Figures G5–G7)
Oak - Hickory Forests (Figures G8–G10)
Basic Mesic and Calcarous Forests (Figures G11–G13)
Seepage Wetlands (Figures G14–G16)
Alluvial Forests (Figures G17–G19)
Swamp Forests (Figures G20–G22)
Nonriverine Forests (Figures G23–G25)
Tidal Herbaceous Marshes (Figures G26–G28)
Tidal Forests and Shrublands (Figures G29–G30)

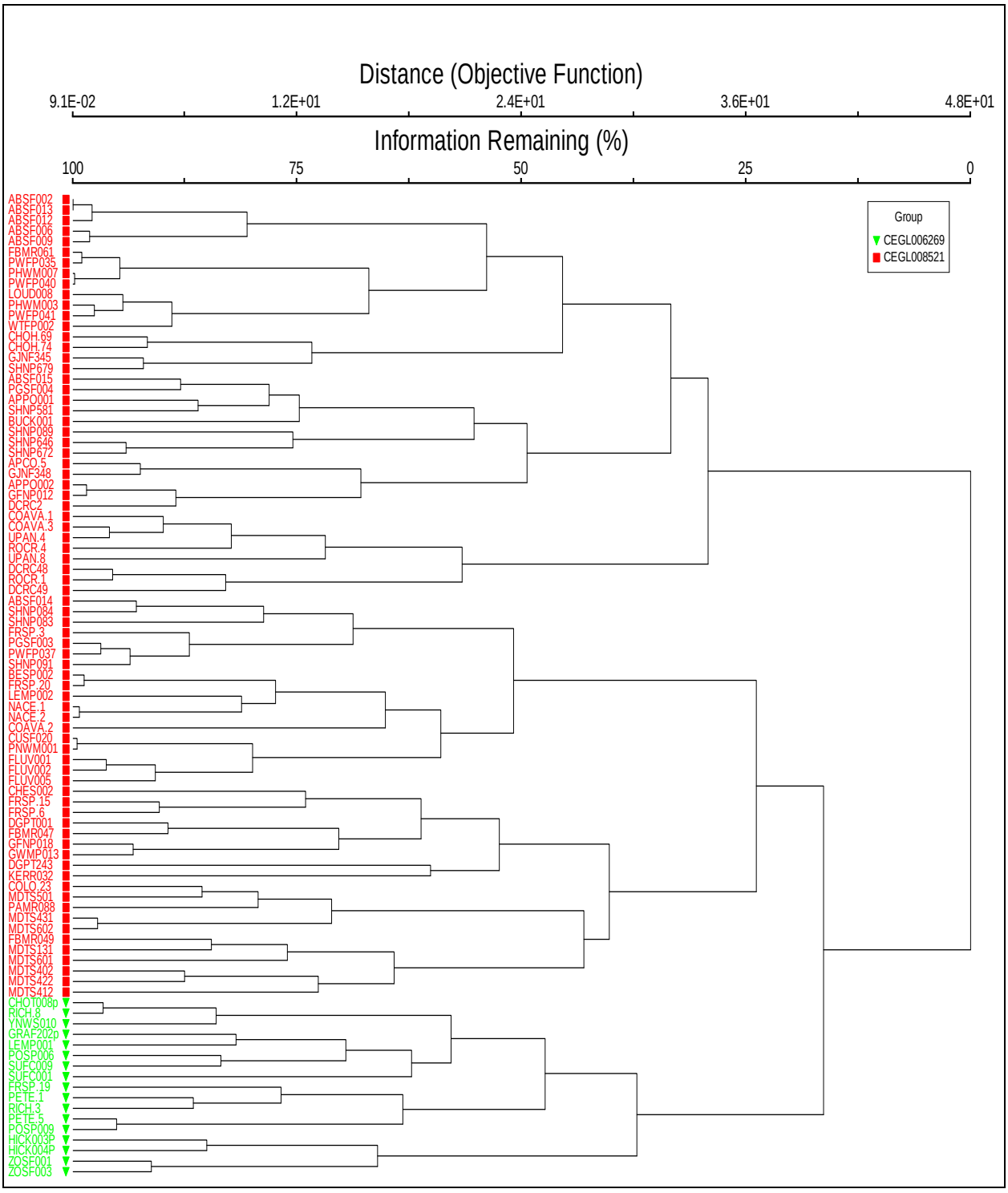



Figure G1. Dendrogram resulting from cluster analysis of species coverage data from 93 oak / heath forest plots. Plot membership in two oak / heath forest associations is shown. CEGL006269 = Coastal Plain Mixed Oak / Heath Forest; CEGL008521 = Piedmont Low Elevation Mixed Oak / Heath Forest. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

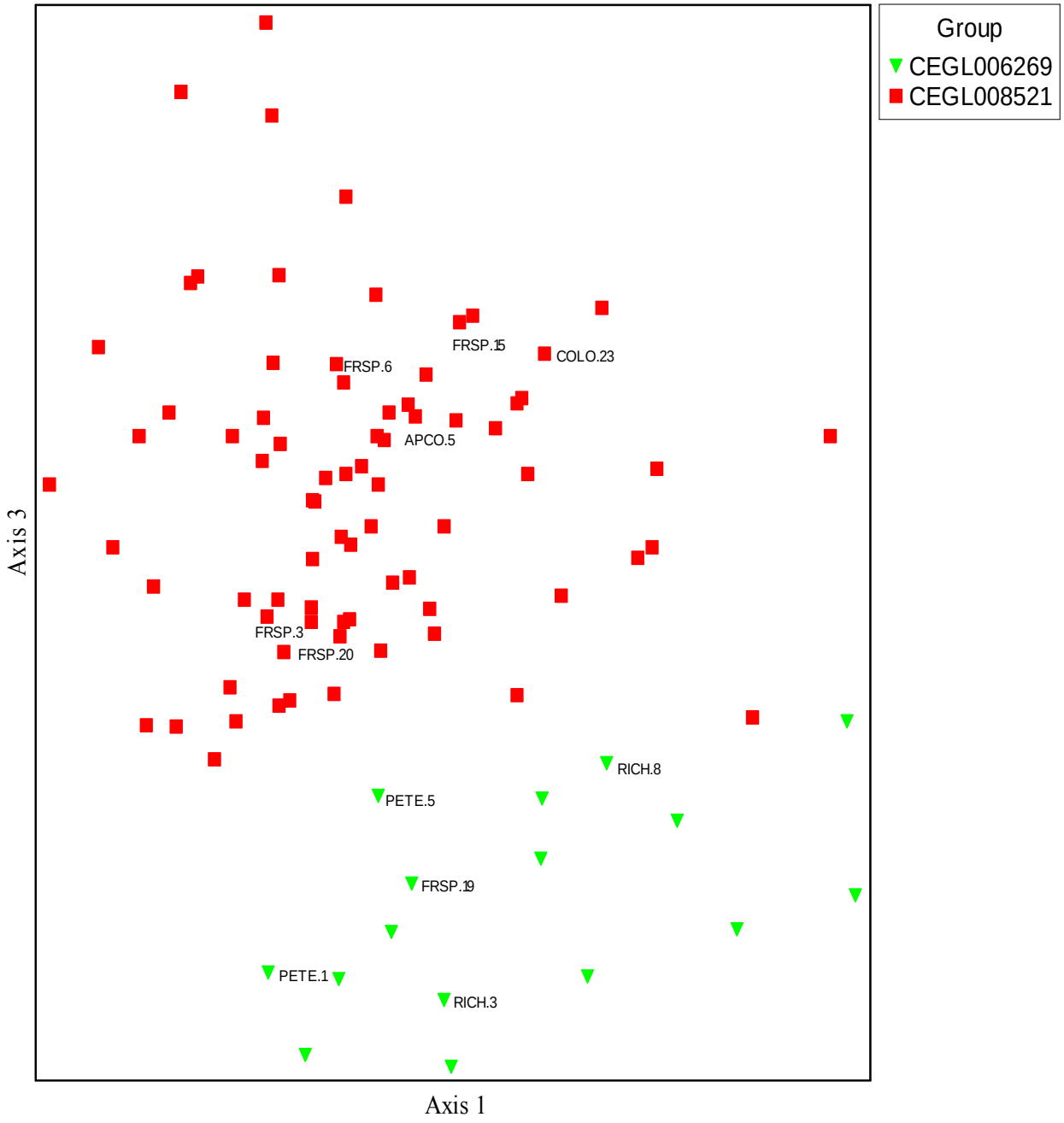



Figure G2. Scatterplot diagram for three-dimensional NMDS ordination of 92 oak/heath forest plots, showing Axis 1 and 3. Plot membership in two oak/heath forest associations is based on cluster analysis. CEGL006269 = Coastal Plain Mixed Oak / Heath Forest; CEGL008521 = Piedmont Low Elevation Mixed Oak / Heath Forest. Plots from the seven Virginia national parks are labeled to the right of or below the symbol. One plot was determined to be an outlier and eliminated from the dataset prior to ordination.

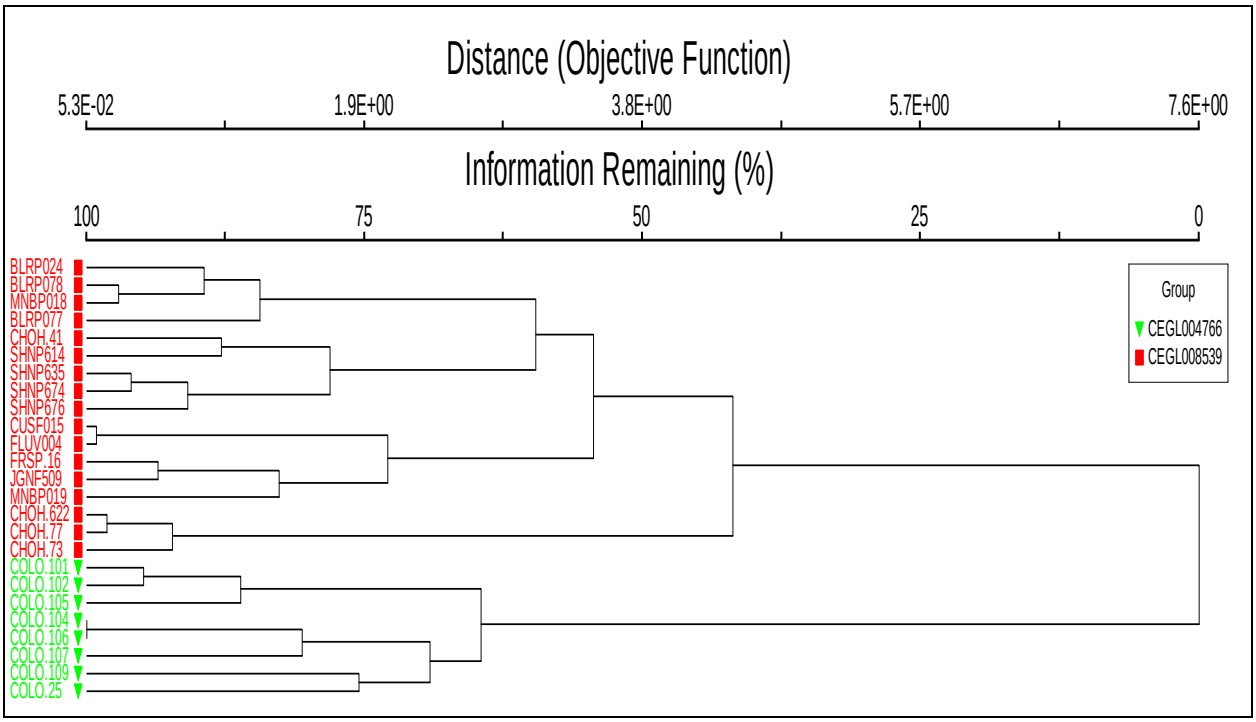



Figure G3. Dendrogram resulting from cluster analysis of species coverage data from 25 pine - oak forest plots. Plot membership in two pine - oak forest associations is shown. CEGL004766 = Coastal Plain Loblolly Pine - Oak Forest; CEGL008539 = Eastern White Pine - Hardwood Forest. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

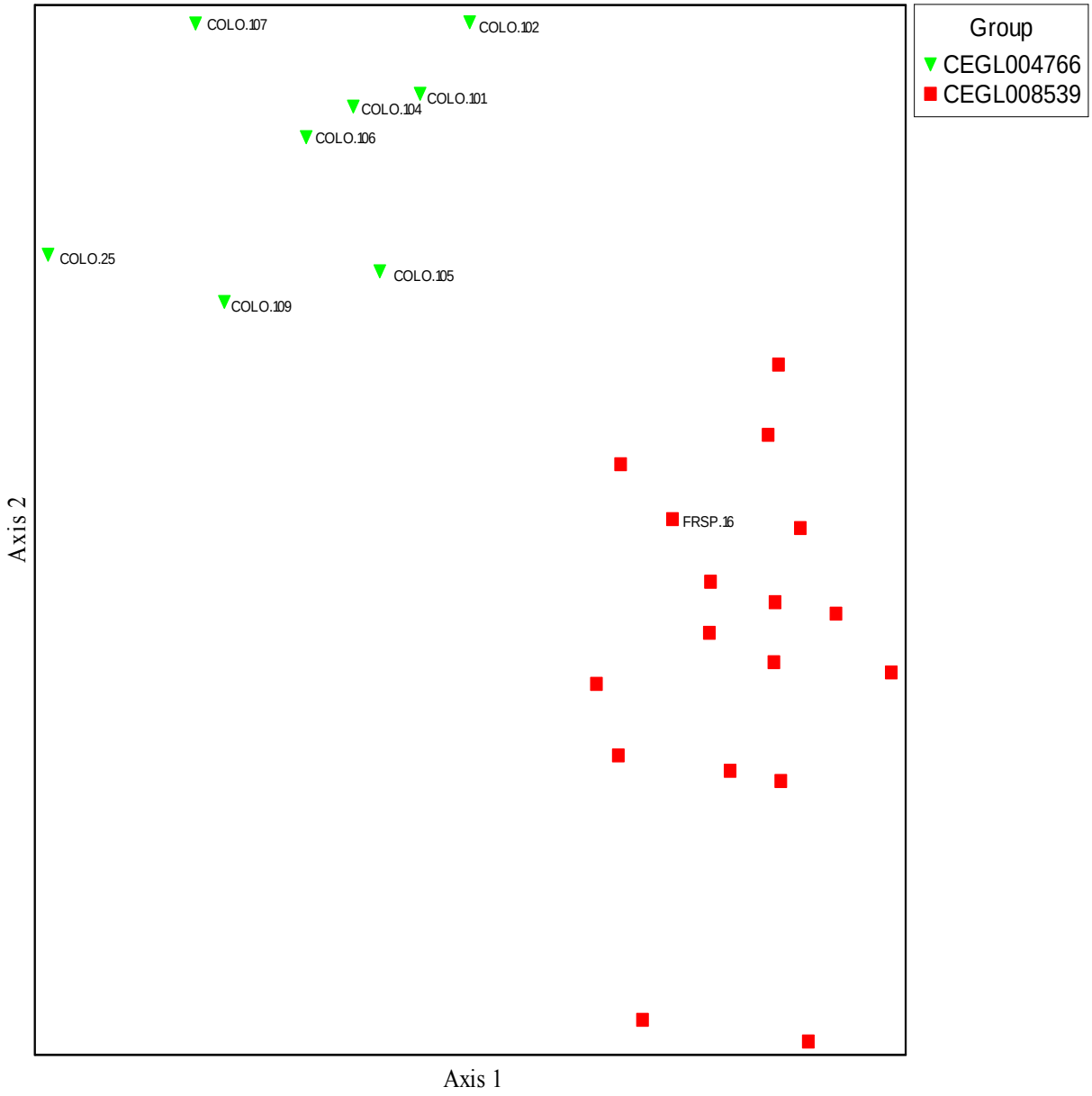



Figure G4. Scatterplot diagram for two-dimensional NMDS ordination of 25 pine - oak forest plots. Plot membership in two pine - oak forest associations is based on cluster analysis. CEGL004766 = Coastal Plain Loblolly Pine - Oak Forest; CEGL008539 = Eastern White Pine - Hardwood Forest. Plots from the seven national parks are labeled to the right of or below the symbol.

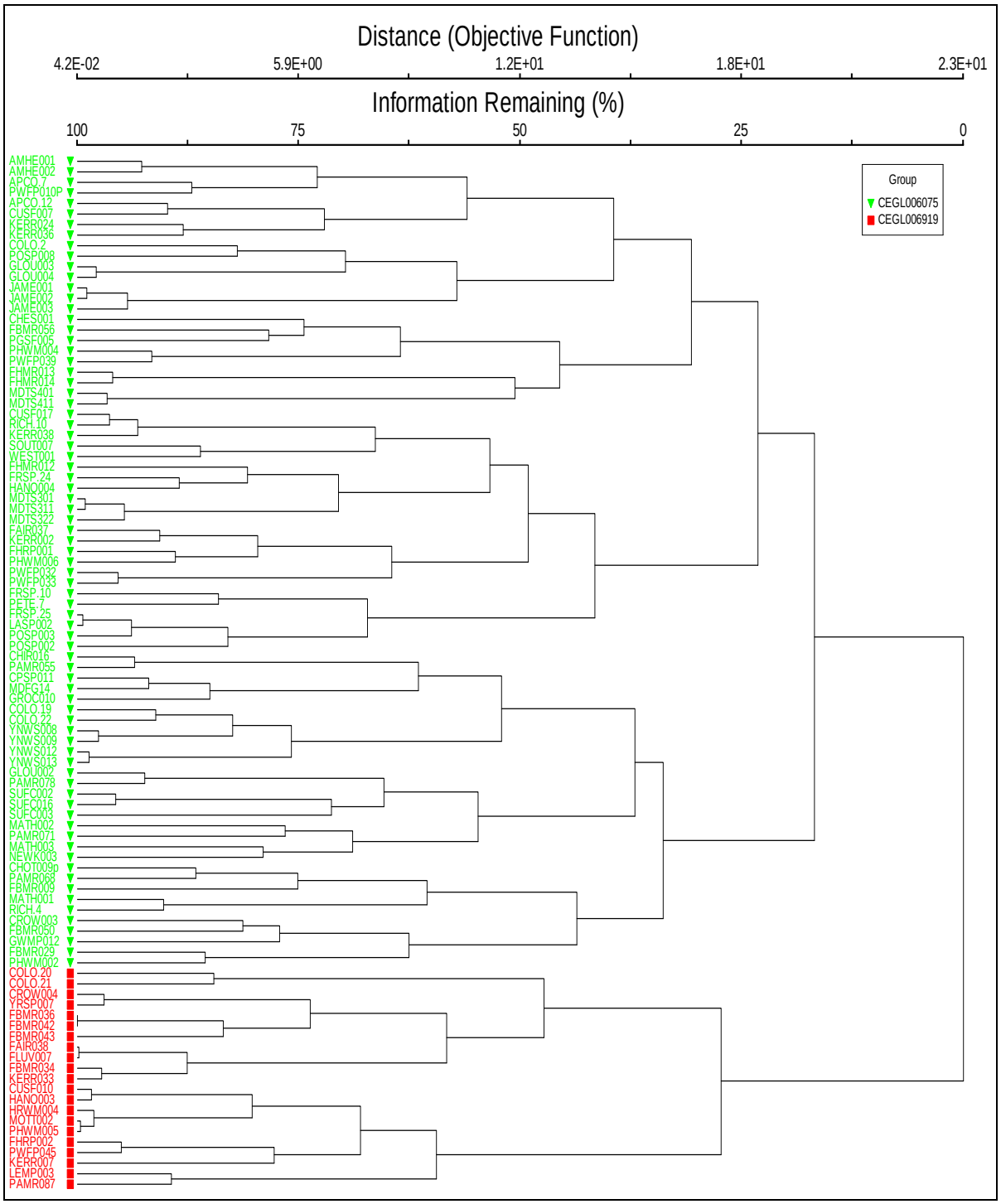



Figure G5. Dendrogram resulting from cluster analysis of species coverage data from 98 mesic acidic forest plots. Plot membership in two mesic acidic forest associations is shown. CEGL006075 = Mesic Mixed Hardwood Forest; CEGL006919 = Piedmont / Coastal Plain Oak - Beech / Heath Forest. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979). 196 plots of this type were originally identified in the regional analysis. A reduced dataset is used here for graphical depiction.

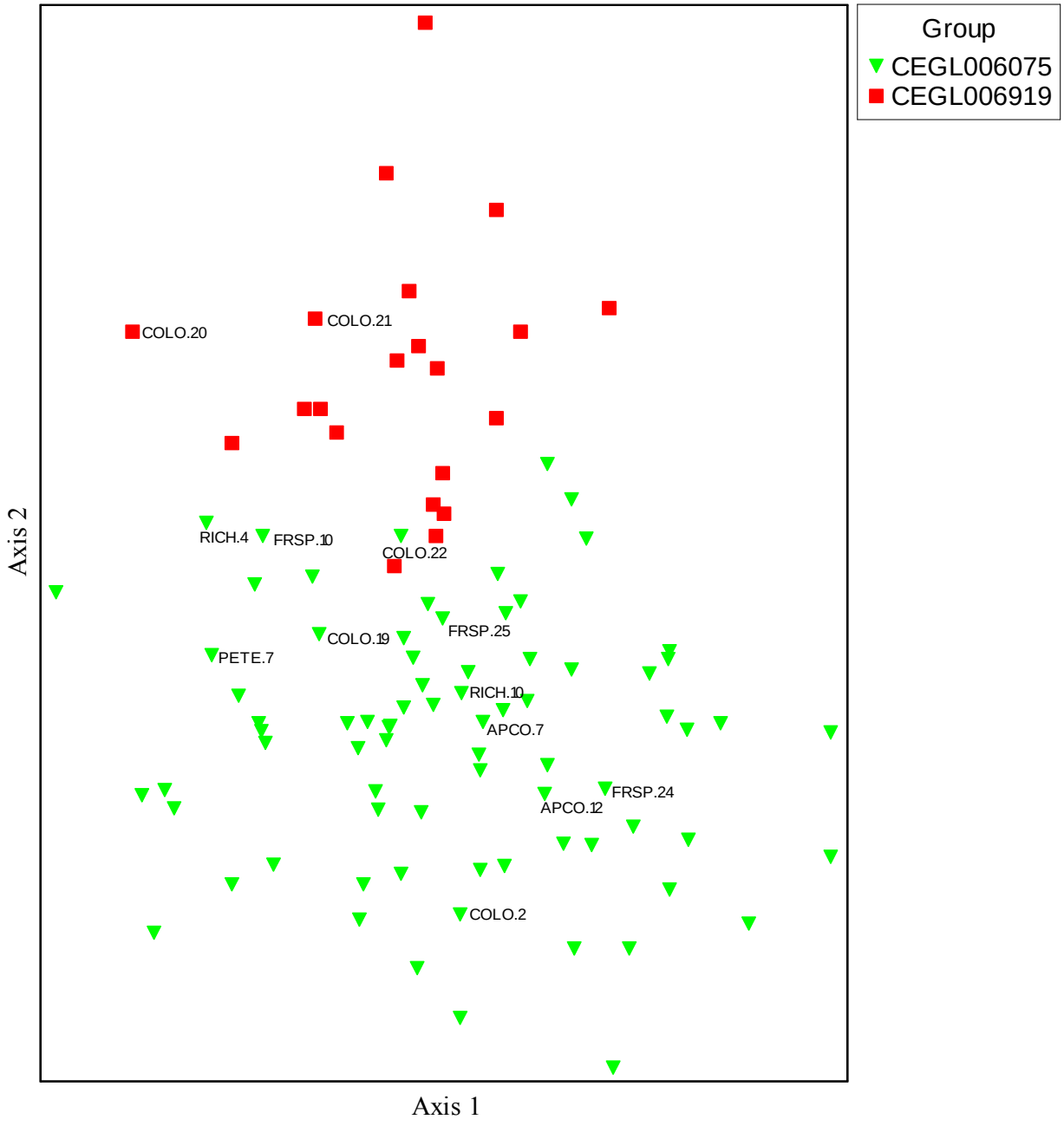



Figure G6. Scatterplot diagram for three-dimensional NMDS ordination of 98 mesic acidic forest plots, showing Axis 1 and 2. Plot membership in two mesic acidic forest associations is based on cluster analysis CEGL006075 = Mesic Mixed Hardwood Forest; CEGL006919 = Piedmont / Coastal Plain Oak – Beech / Heath Forest. Plots from the seven Virginia national parks are labeled to the right of or below the symbol.

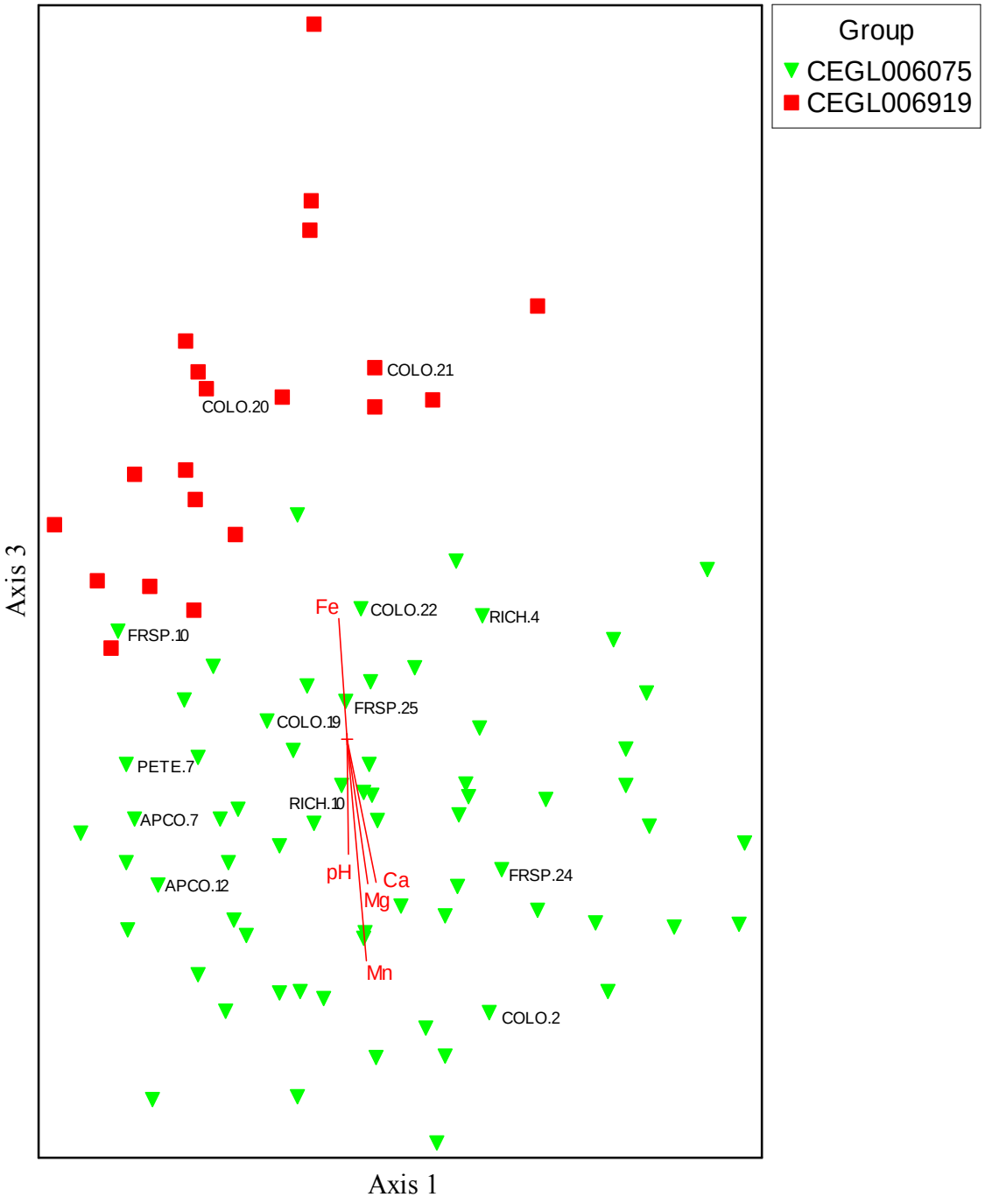



Figure G7. Joint plot showing significant correlations ($r^2 = 0.20$) of 19 soil variables with ordination scores for 87 mesic acidic forest plots on Axis 1 and Axis 3 of the NMDS ordination. The angles and lengths of the radiating lines indicate the direction and strength of the relationship. Environmental variables used in joint plots are listed in Table 5. Only the 87 plots in this group with complete soil chemistry data were included in the ordination. Plots from the seven Virginia national parks are labeled to the right of or below the symbol.

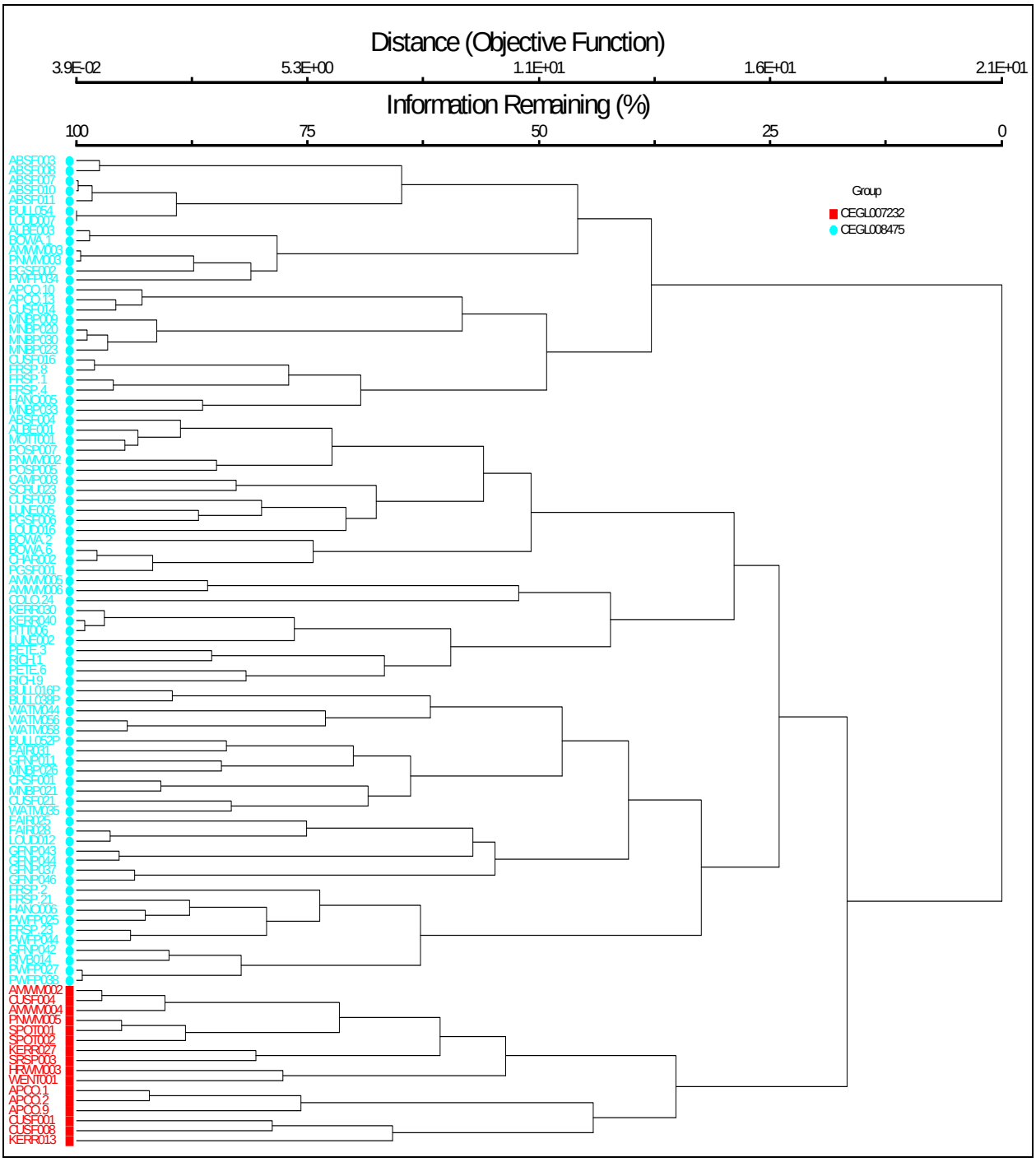



Figure G8. Dendrogram resulting from cluster analysis of species coverage data from 99 oak - hickory forest plots. Plot membership in two oak - hickory forest associations is shown. CEGL007232 = Basic Oak - Hickory Forest; CEGL008475 = Acidic Oak - Hickory Forest. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979). 137 plots of this type were originally identified in the regional analysis. A reduced dataset is used here for graphical depiction.

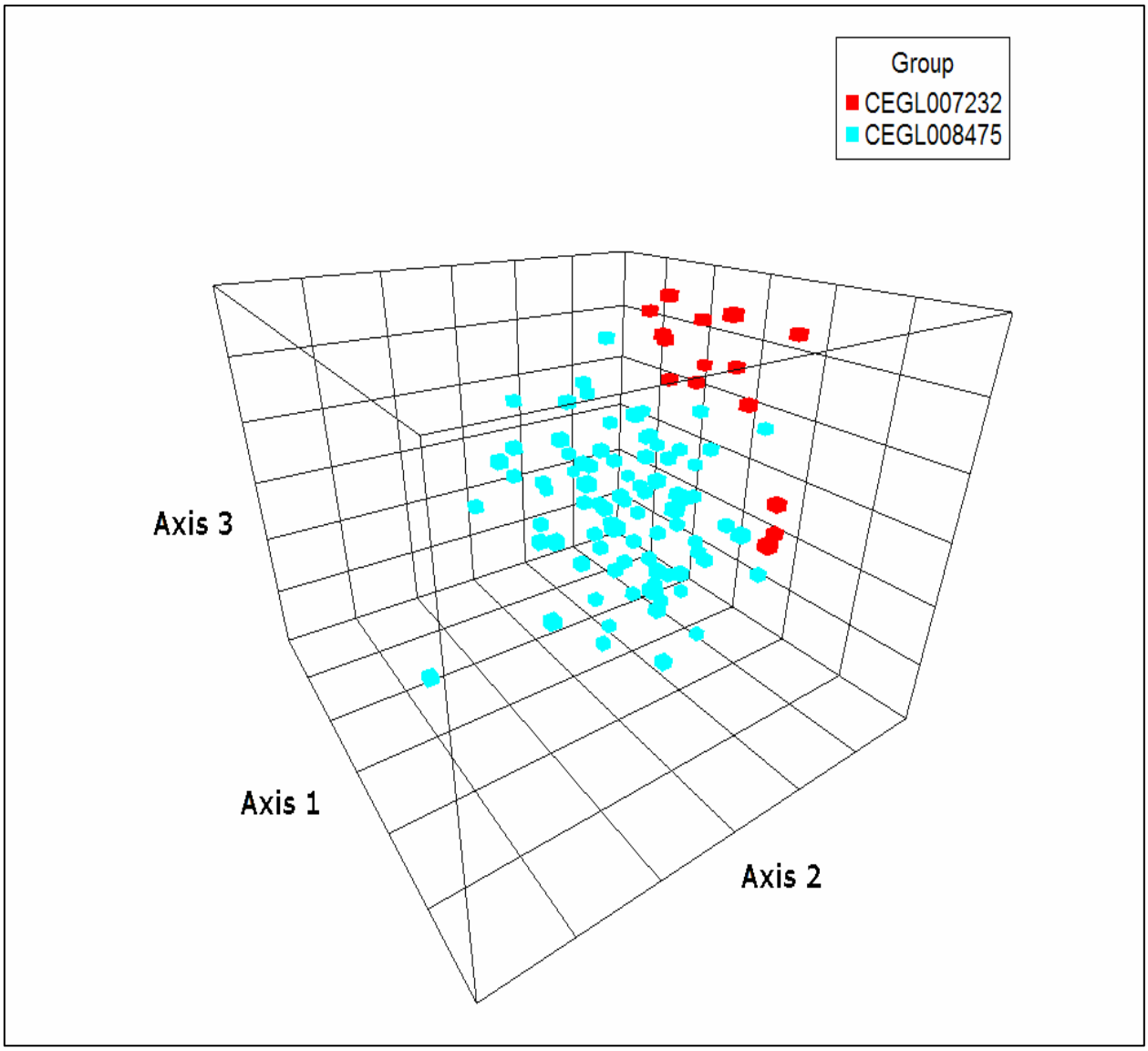



Figure G9. Scatterplot diagram for three-dimensional NMDS ordination of 98 oak - hickory forest plots. Plot membership in two oak - hickory forest associations is based on cluster analysis. CEGL007232 = Basic Oak - Hickory Forest; CEGL008475= Acidic Oak - Hickory Forest. One plot was determined to be an outlier and eliminated from the dataset prior to ordination.

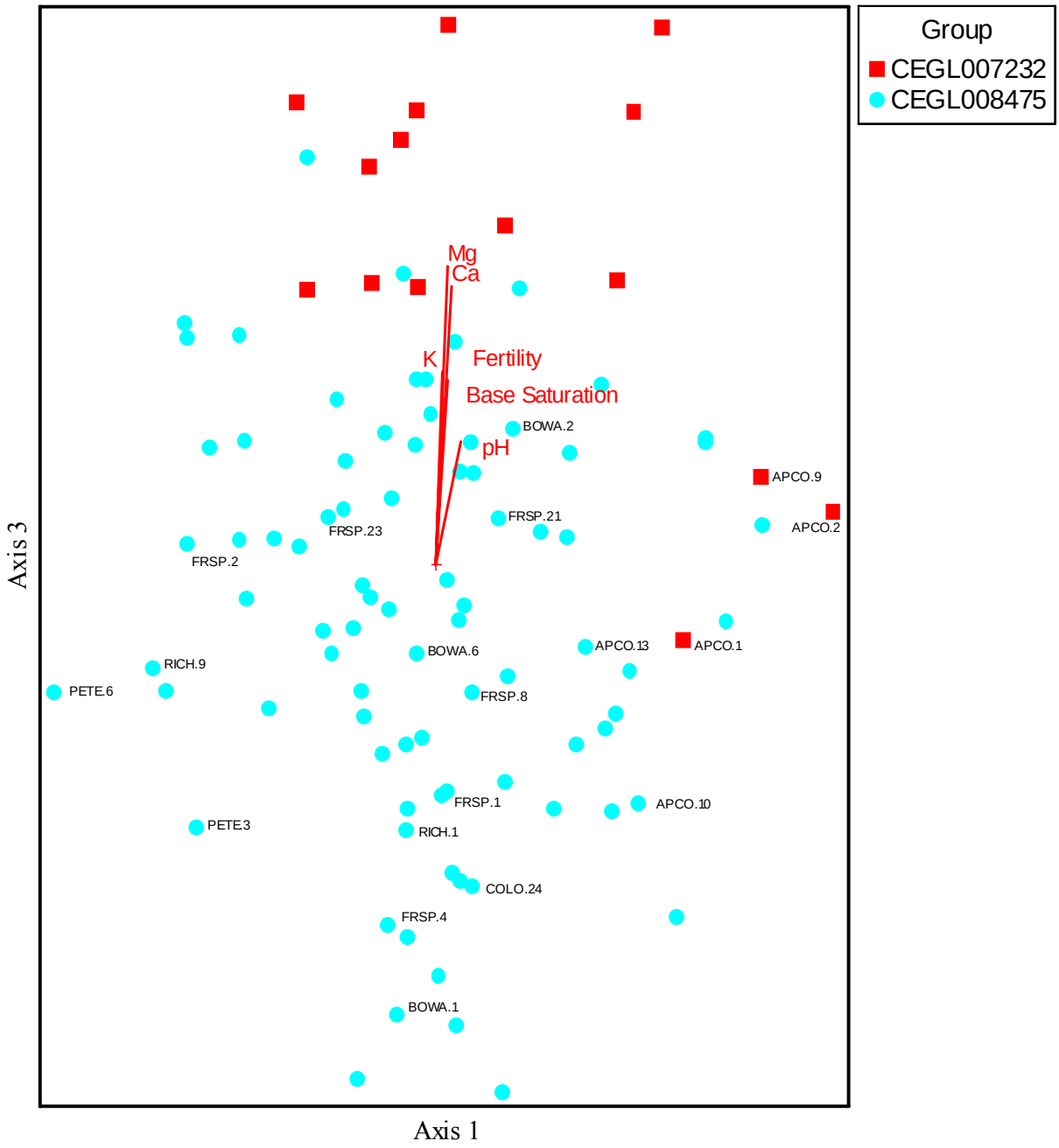



Figure G10. Joint plot showing significant correlations ($r^2 = 0.20$) of environmental variables with ordination scores for 98 oak - hickory forest plots on Axis 1 and Axis 3 of the NMDS ordination. The angles and lengths of the radiating lines indicate the direction and strength of the relationship. Environmental variables used in joint plots are listed in Table 5. Plots from the seven Virginia national parks are labeled to the right of or below the symbol.

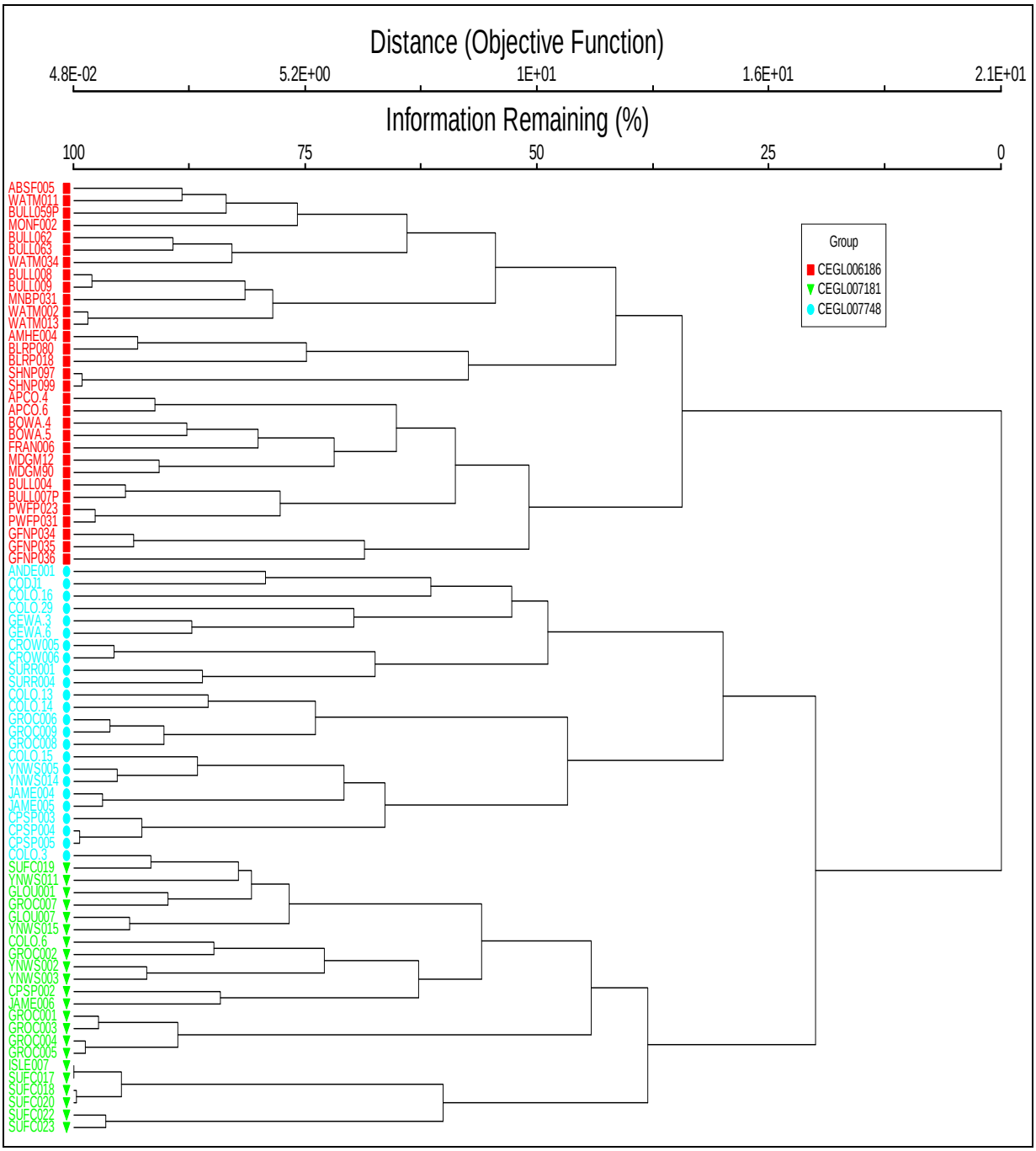



Figure G11. Dendrogram resulting from cluster analysis of species coverage data from 77 basic mesic and calcareous forest plots. Plot membership in three basic mesic and calcareous forest associations is shown. CEGL006186 = Inner Piedmont / Lower Blue Ridge Basic Mesic Forest; CEGL007181 = Coastal Plain Mesic Calcareous Ravine Forest; CEGL007748 = Coastal Plain Dry Calcareous Forest. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

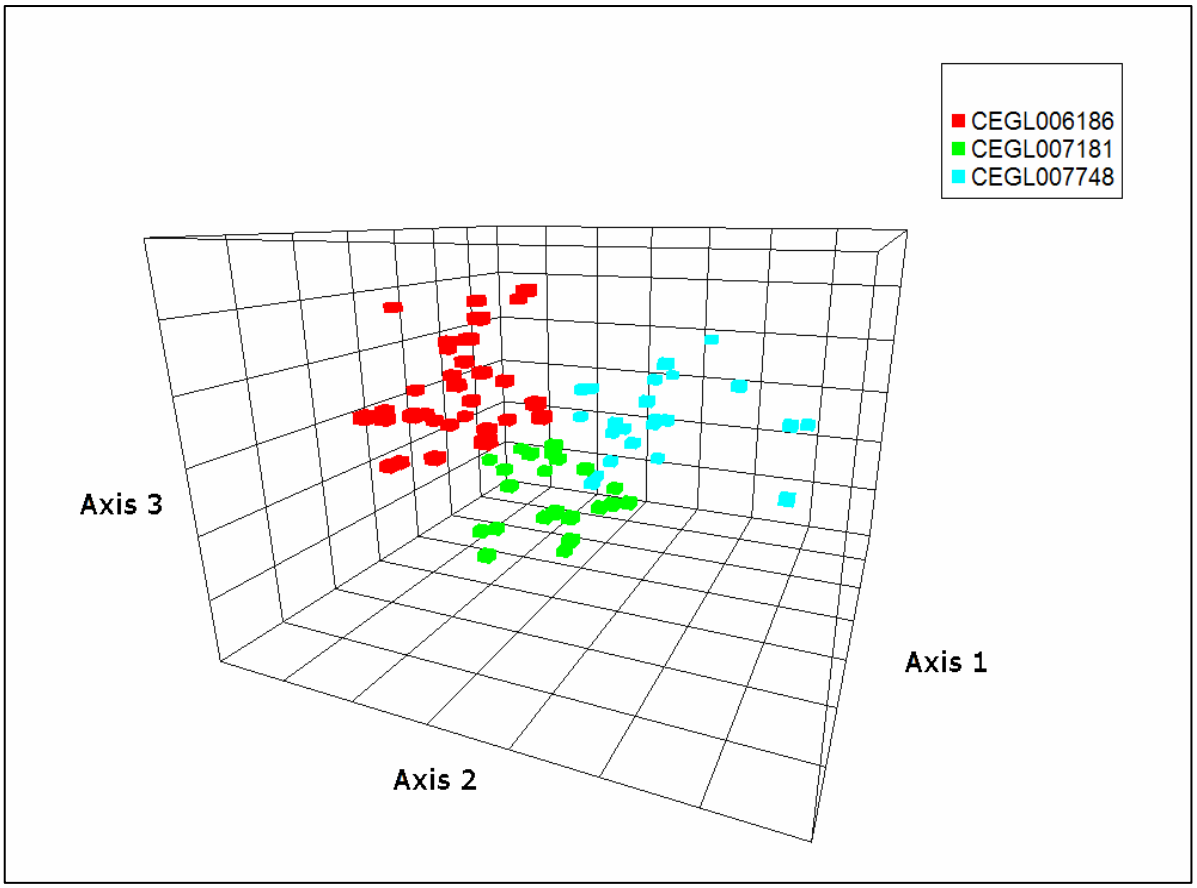



Figure G12. Scatterplot diagram for three-dimensional NMDS ordination of 76 basic mesic and calcareous forest plots. Plot membership in three basic mesic and calcareous forest associations is based on cluster analysis. CEGL006186 = Inner Piedmont / Lower Blue Ridge Basic Mesic Forest; CEGL007181 = Coastal Plain Mesic Calcareous Ravine Forest; CEGL007748 = Coastal Plain Dry Calcareous Forest. One plot was determined to be an outlier and eliminated from the dataset prior to ordination.

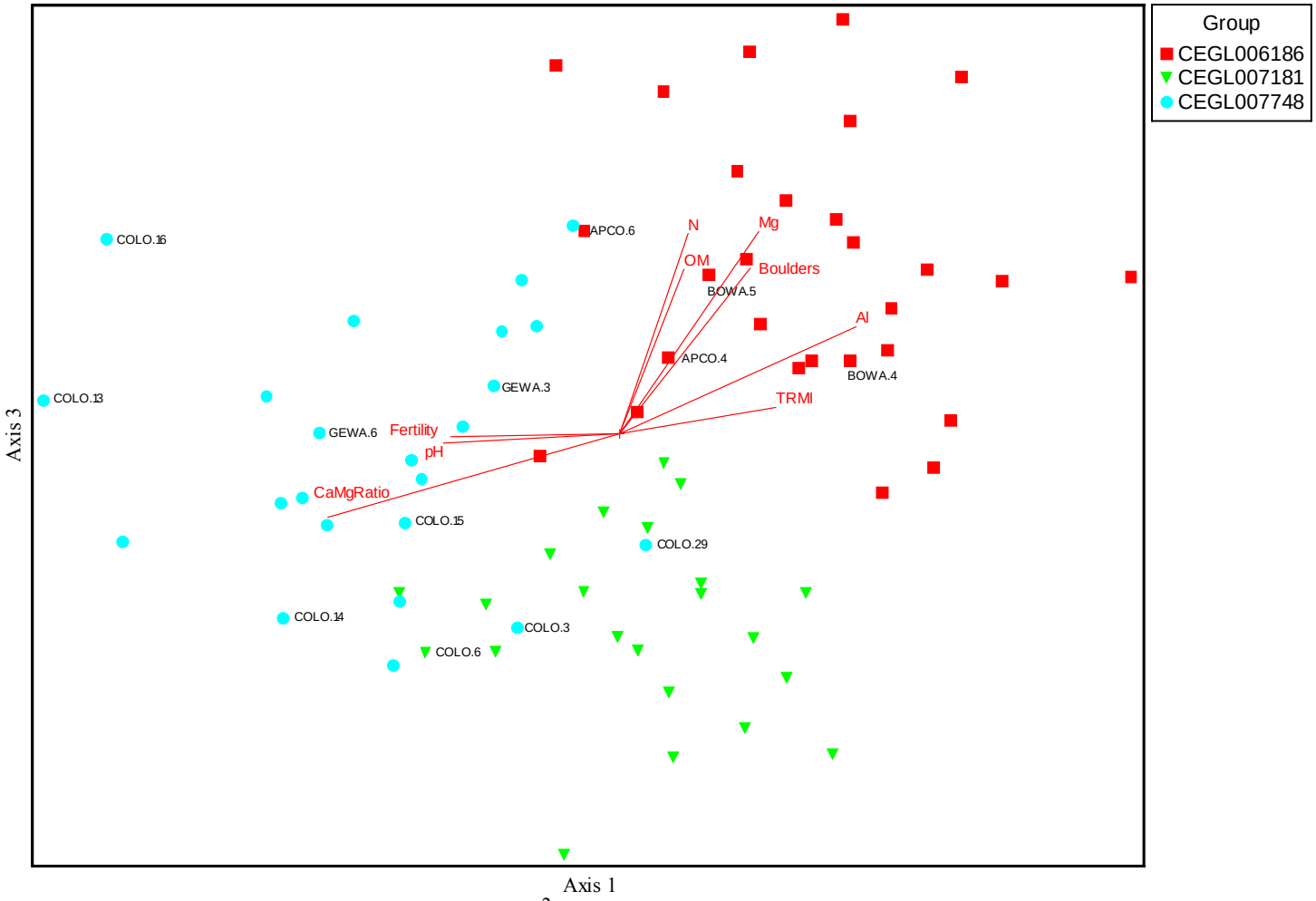



Figure G13. Joint plot showing significant correlations ($r^2 = 0.290$) of environmental variables with ordination scores for 73 basic mesic and calcareous forest plots on Axis 1 and Axis 3 of the NMDS ordination. The angles and lengths of the radiating lines indicate the direction and strength of the relationship. Boron and Na were also significantly correlated in the same direction as pH and Fertility, but were removed from the graphic for clarity. Environmental variables used in joint plots are listed in Table 5. Plots from the seven Virginia national parks are labeled to the right of or below the symbol. Only the 73 plots in this group with complete environmental data were included in the ordination.

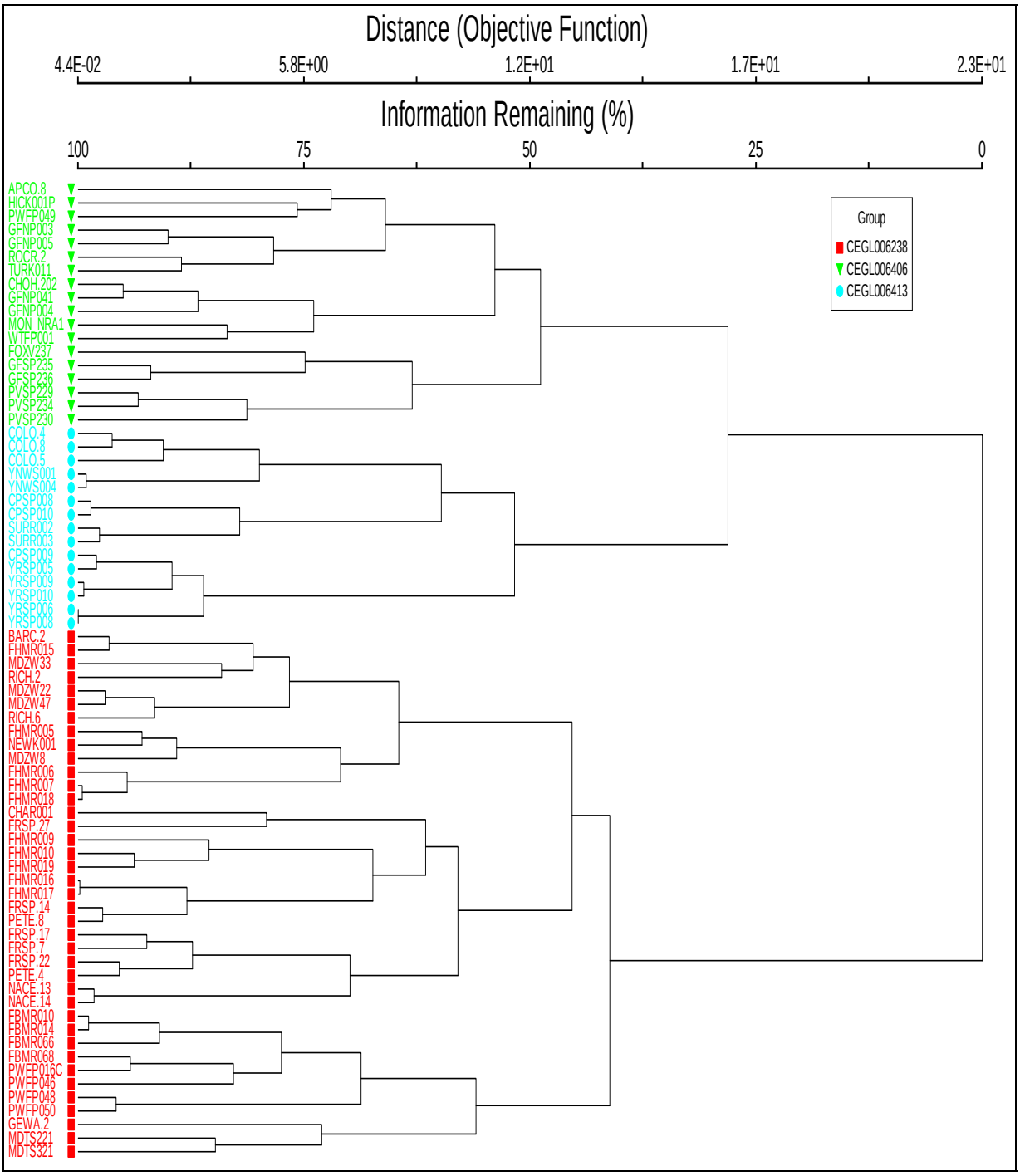



Figure G14. Dendrogram resulting from cluster analysis of species coverage data from 72 seepage wetland plots. Plot membership in three seepage wetland associations is shown. CEGL006238 = Coastal Plain / Piedmont Acidic Seepage Swamp; CEGL006406 = Northern Piedmont / Lower New England Basic Seepage Swamp; CEGL006413 = Coastal Plain Calcareous Seepage Swamp. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

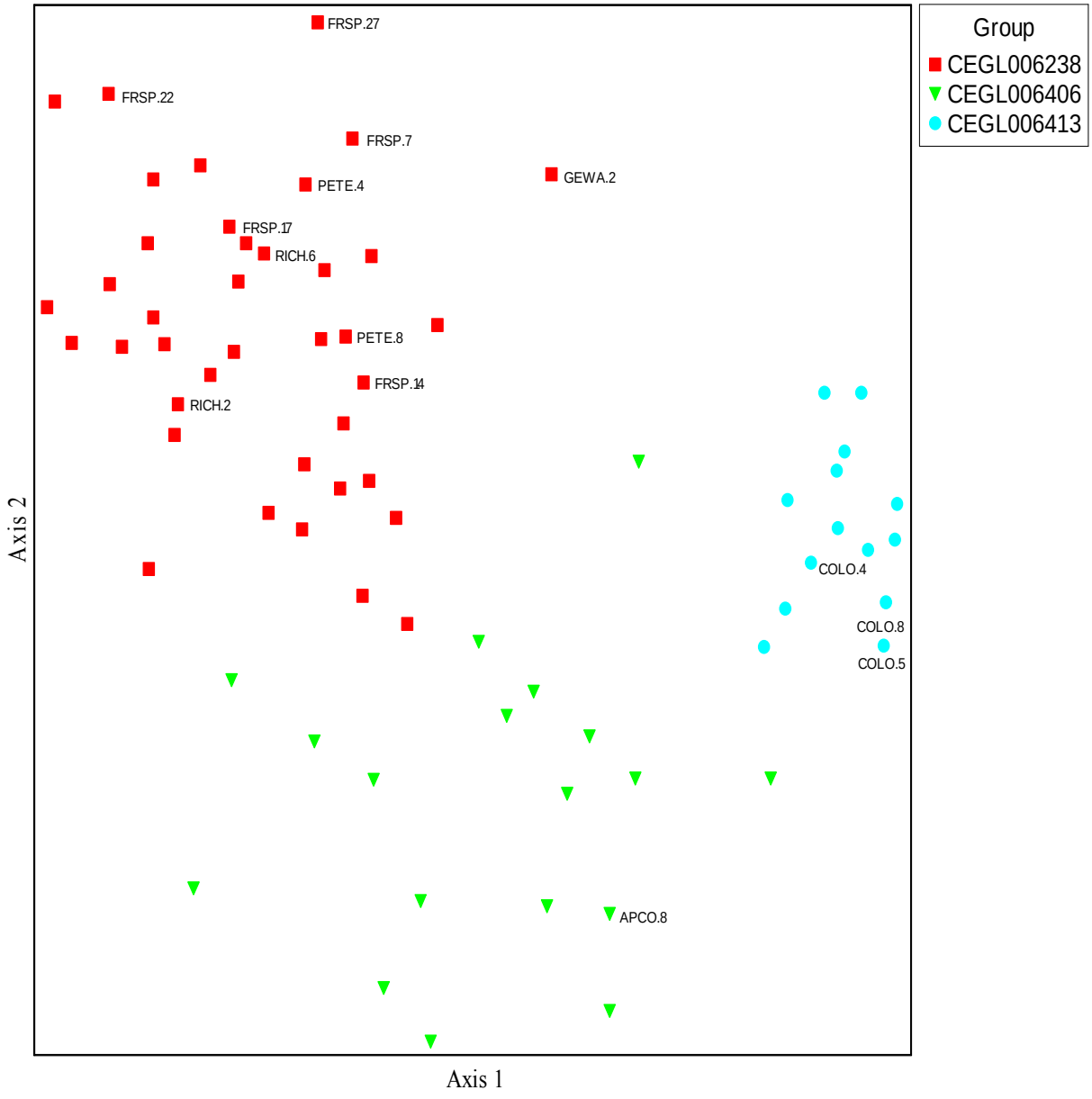



Figure G15. Scatterplot diagram for two-dimensional NMDS ordination of 71 seepage wetland plots. Plot membership in three seepage wetland associations is based on cluster analysis. CEGL006238 = Coastal Plain / Piedmont Acidic Seepage Swamp; CEGL006406 = Northern Piedmont / Lower New England Basic Seepage Swamp; CEGL006413 = Coastal Plain Calcareous Seepage Swamp. Plots from the seven Virginia national parks are labeled to the right of or below the symbol. One plot was determined to be an outlier and was eliminated from the dataset prior to ordination.

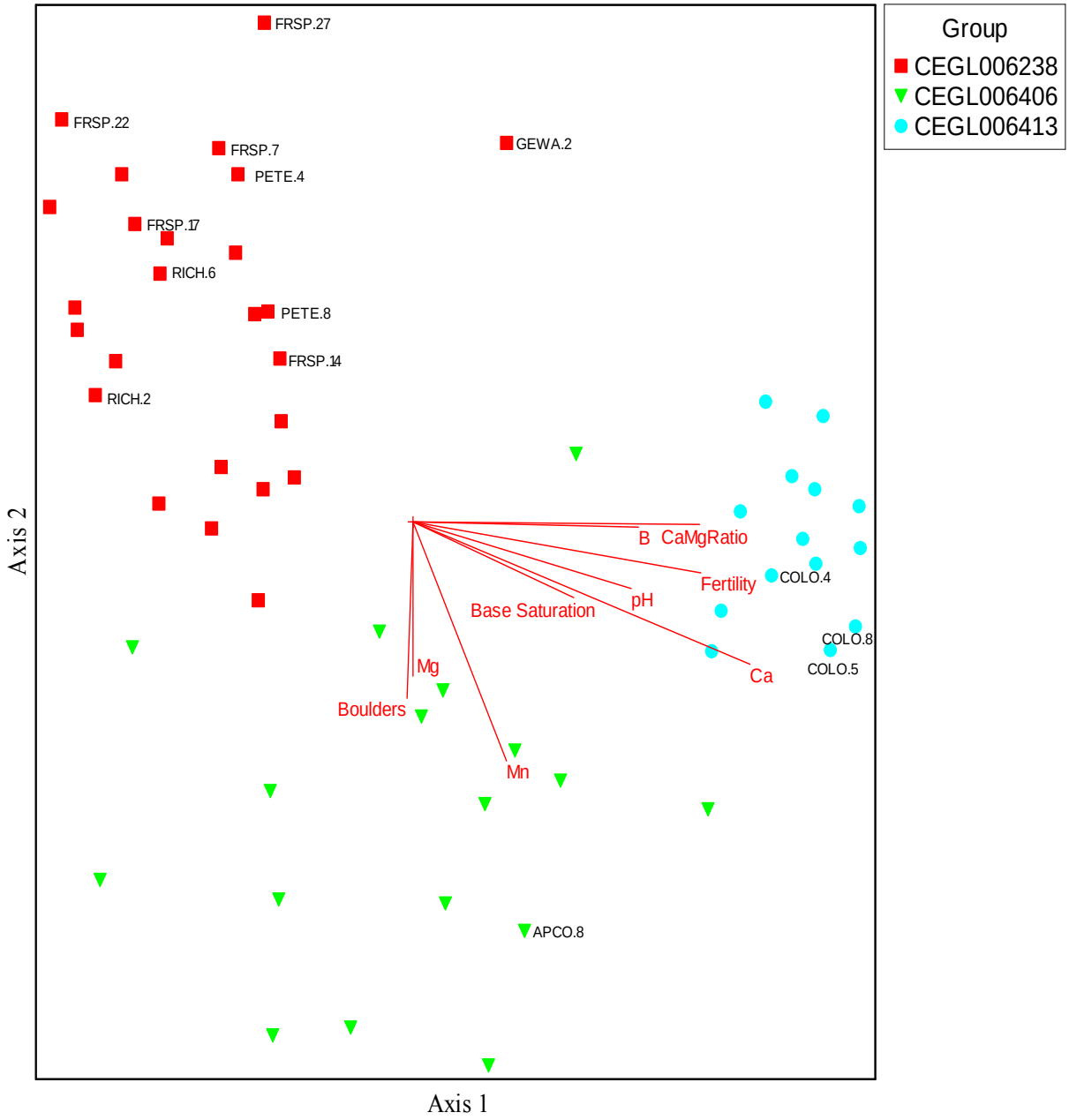



Figure G16. Joint plot showing significant correlations ($r^2 = 0.290$) of environmental variables with ordination scores for 56 seepage wetland plots on Axis 1 and Axis 2 of the NMDS ordination. The angles and lengths of the radiating lines indicate the direction and strength of the relationship. Environmental variables used in joint plots are listed in Table 5. Plots from the seven Virginia national parks are labeled to the right of or below the symbol. Only the 56 plots in this group with complete environmental data were included in the ordination.

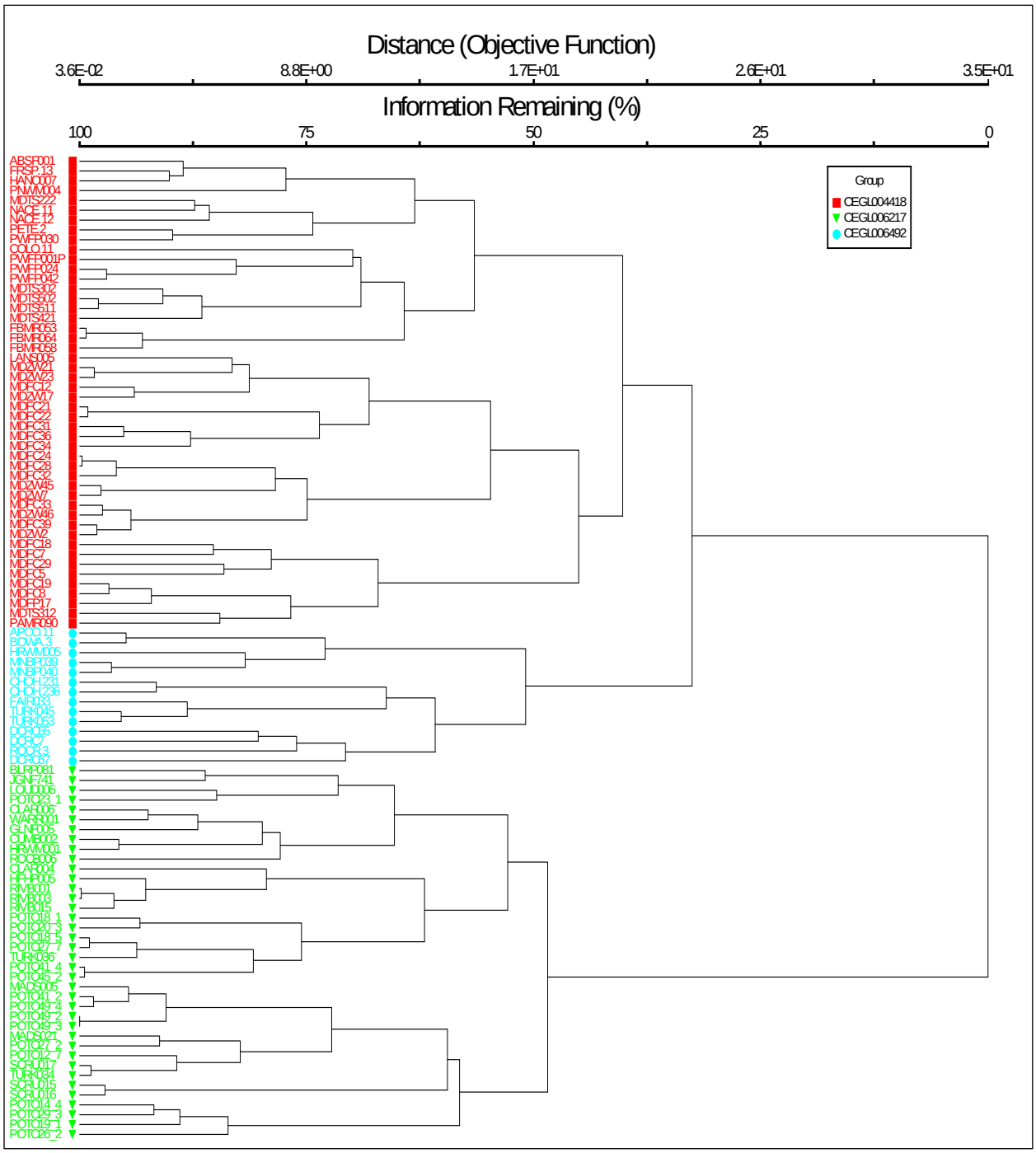



Figure G17. Dendrogram resulting from cluster analysis of species coverage data from 100 alluvial forest plots. Plot membership in three alluvial forest associations is shown. CEGL004418 = Coastal Plain / Piedmont Small-Stream Floodplain Forest; CEGL006217= Piedmont / Mountain Floodplain Forest; CEGL006492= Piedmont / Mountain Alluvial Forest. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

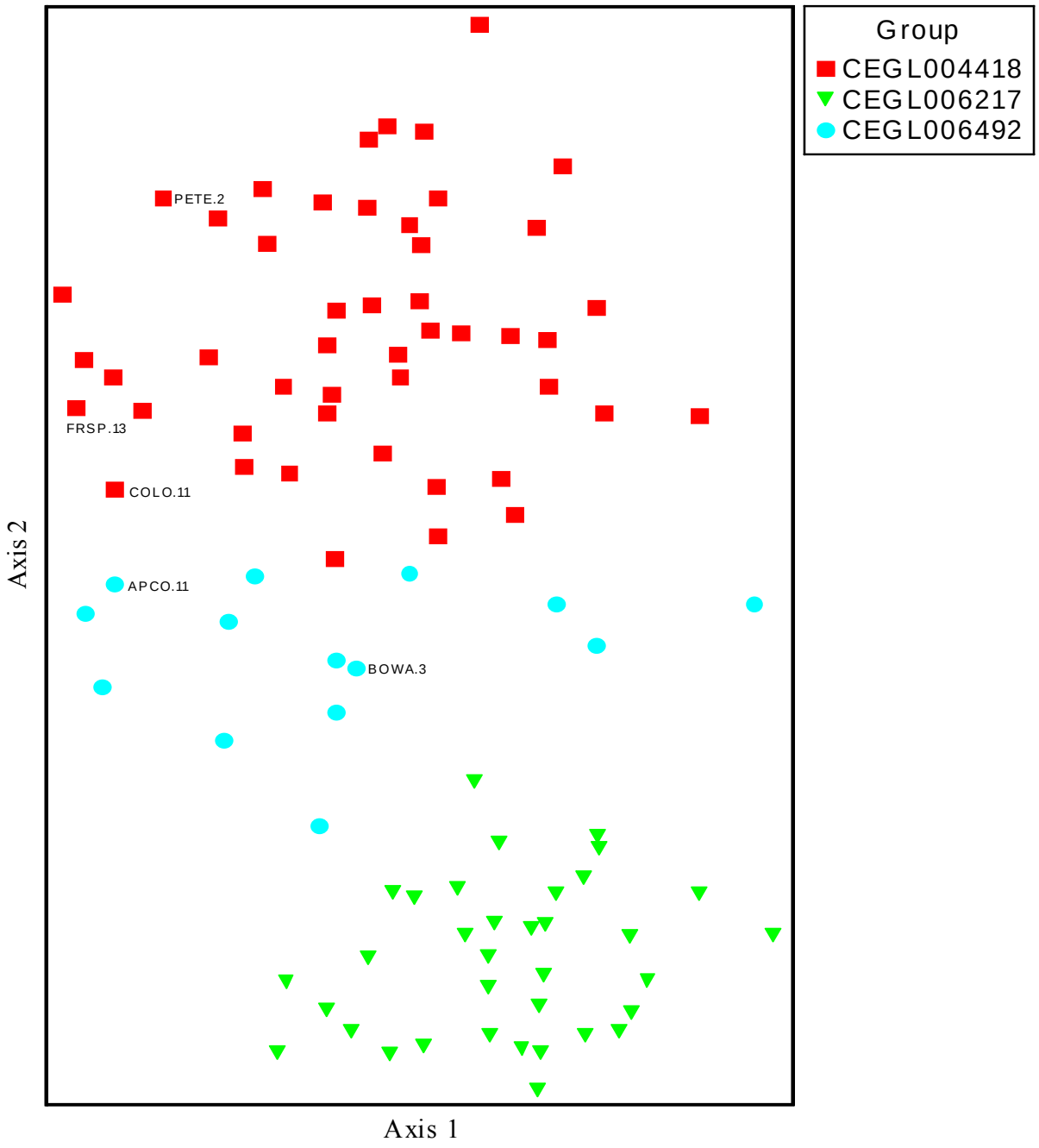



Figure G18. Scatterplot diagram for two-dimensional NMDS ordination of 97 alluvial forest plots. Plot membership in three alluvial forest associations is based on cluster analysis. CEGL004418 = Coastal Plain / Piedmont Small-Stream Floodplain Forest; CEGL006217= Piedmont / Mountain Floodplain Forest; CEGL006492 = Piedmont / Mountain Alluvial Forest. Three plots were determined to be outliers and eliminated from the dataset prior to ordination. Plots from the seven Virginia national parks are labeled to the right of or below the symbol.

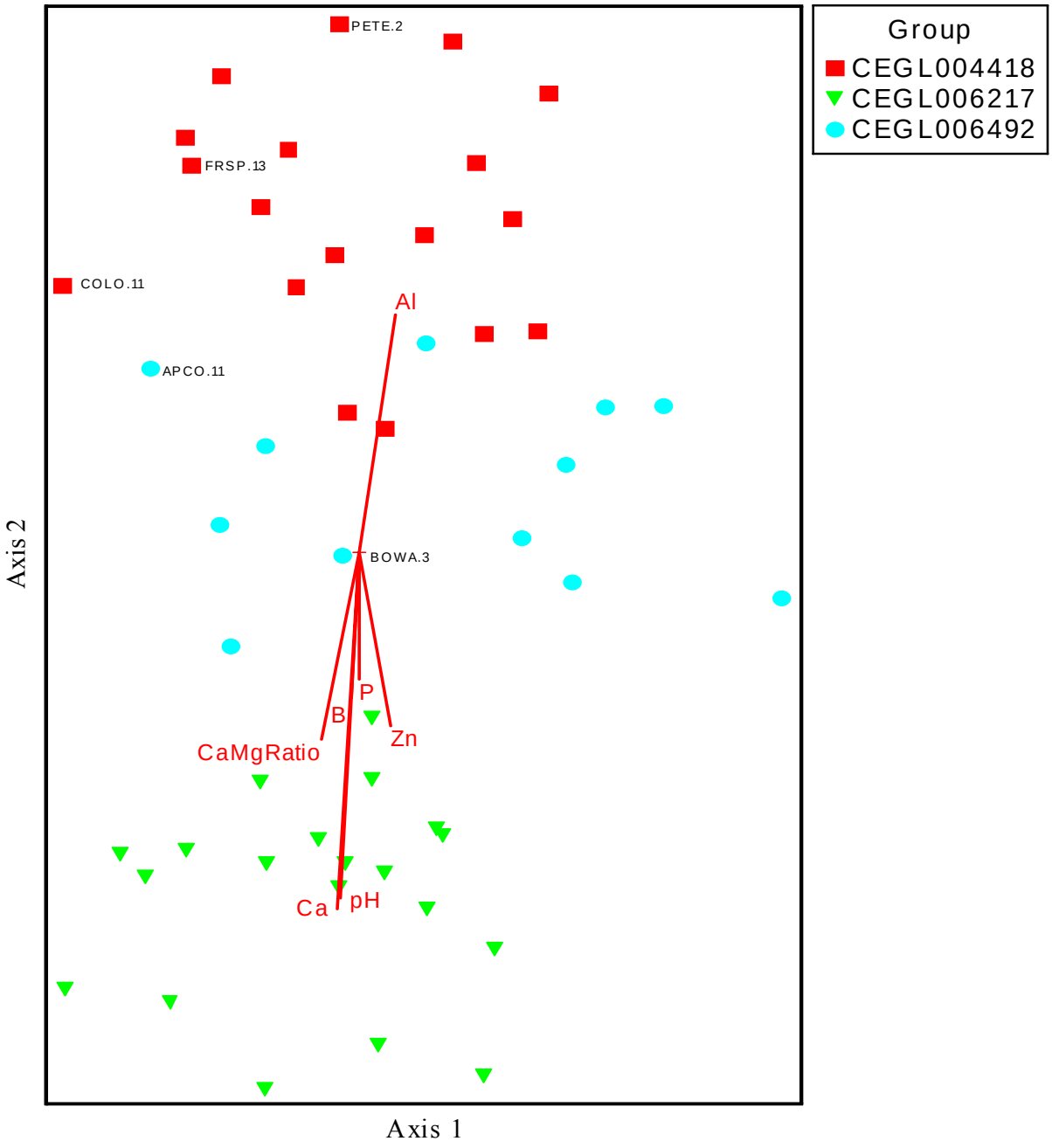



Figure G19. Joint plot showing significant correlations ($r^2 = 0.20$) of environmental variables with ordination scores for 50 alluvial forest plots on Axis 1 and Axis 2 of the NMDS ordination. The angles and lengths of the radiating lines indicate the direction and strength of the relationship. Environmental variables used in joint plots are listed in Table 5. Plots from the seven Virginia national parks are labeled to the right of the symbol. Only the 50 plots with complete environmental data were included in the ordination.

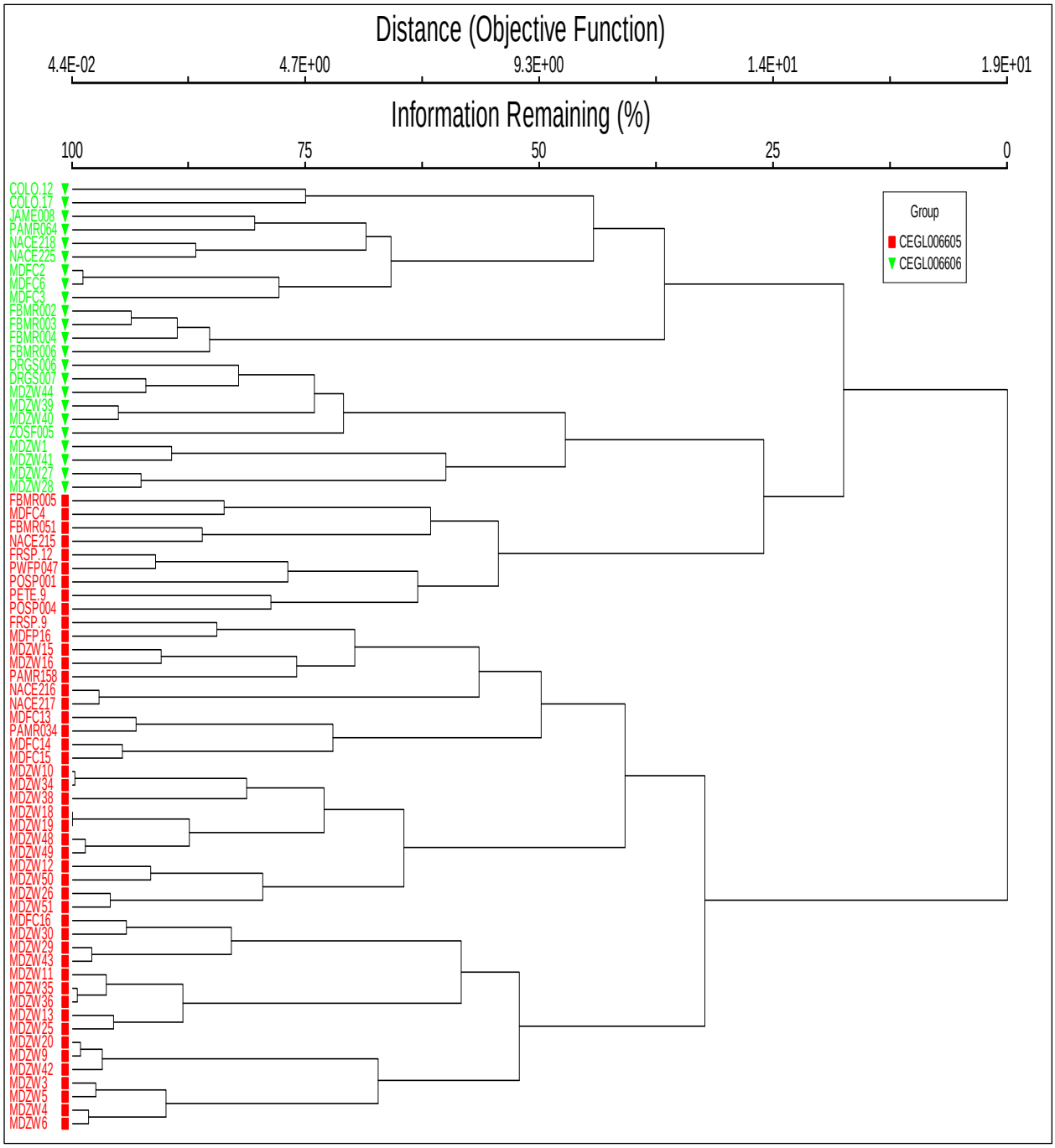



Figure G20. Dendrogram resulting from cluster analysis of species coverage data from 70 swamp forest plots. Plot membership in two swamp forest associations is shown. CEGL006605 = Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak - Red Maple Type); CEGL006606 = Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type). Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

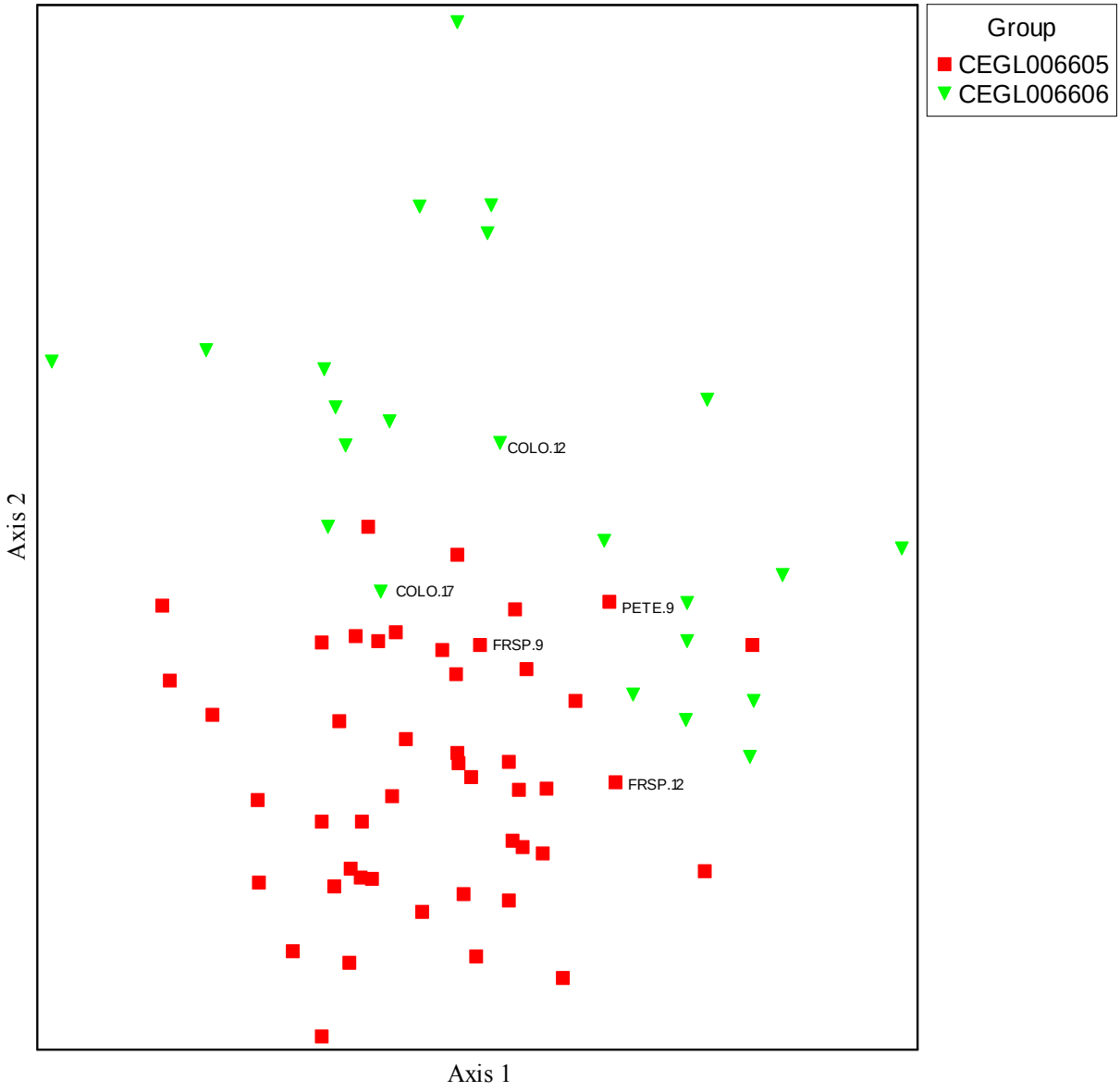



Figure G21. Scatterplot diagram for NMDS ordination of 70 swamp forest plots. Axis 1 and 2 are shown from a three-dimensional ordination. Plot membership in two swamp forest associations is based on cluster analysis. CEGL006605 = Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type); CEGL006606 = Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash – Red Maple Type). Plots from the seven Virginia national parks are labeled to the right of or below the symbol.

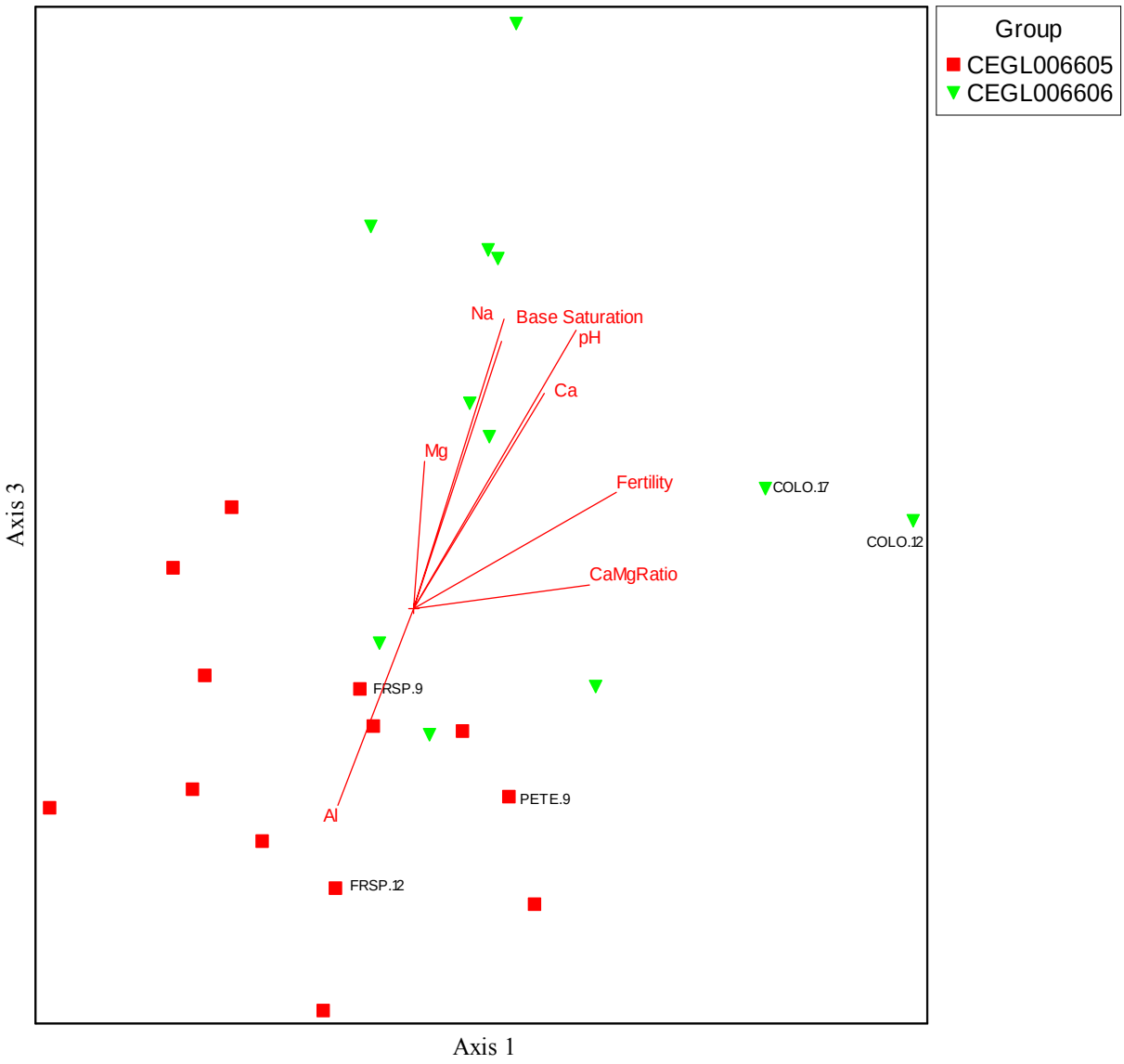



Figure G22. Joint plot showing significant correlations ($r^2 = 0.290$) of environmental variables with ordination scores for 70 swamp forest plots on Axis 1 and Axis 3 of the NMDS ordination. The angles and lengths of the radiating lines indicate the direction and strength of the relationship. Environmental variables used in joint plots are listed in Table 5. Plots from the seven Virginia national parks are labeled to the right of or below the symbol. Only the 24 plots in this group with complete environmental data were included in the ordination.

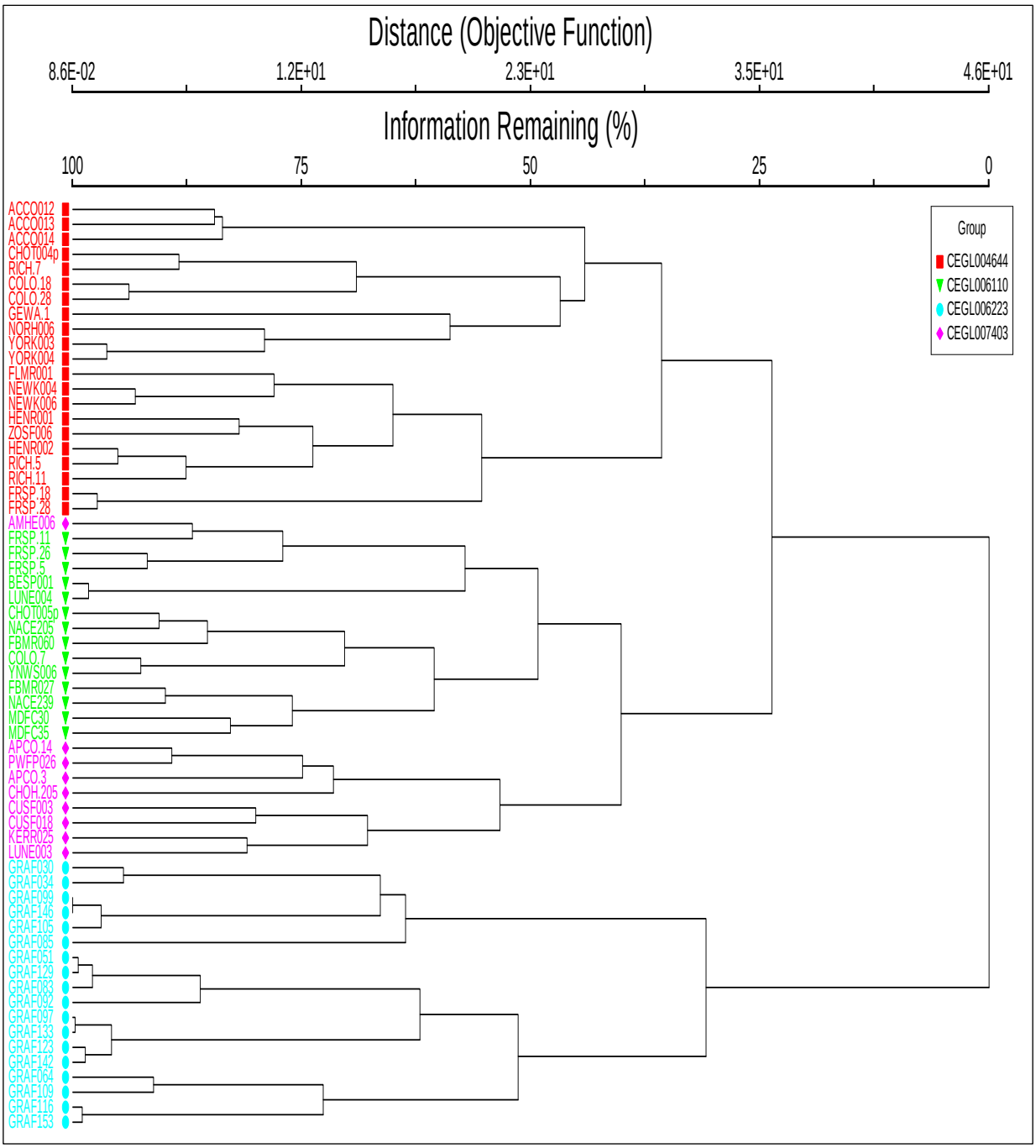



Figure G23. Dendrogram resulting from cluster analysis of species coverage data from 62 nonriverine forest plots. Plot membership in four nonriverine forest associations is shown. CEGL004644 = Non-Riverine Saturated Forest; CEGL006110 = Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type); CEGL006223 = Coastal Plain Depression Wetland (Swamp Tupelo Type); CEGL007403 = Upland Depression Swamp. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

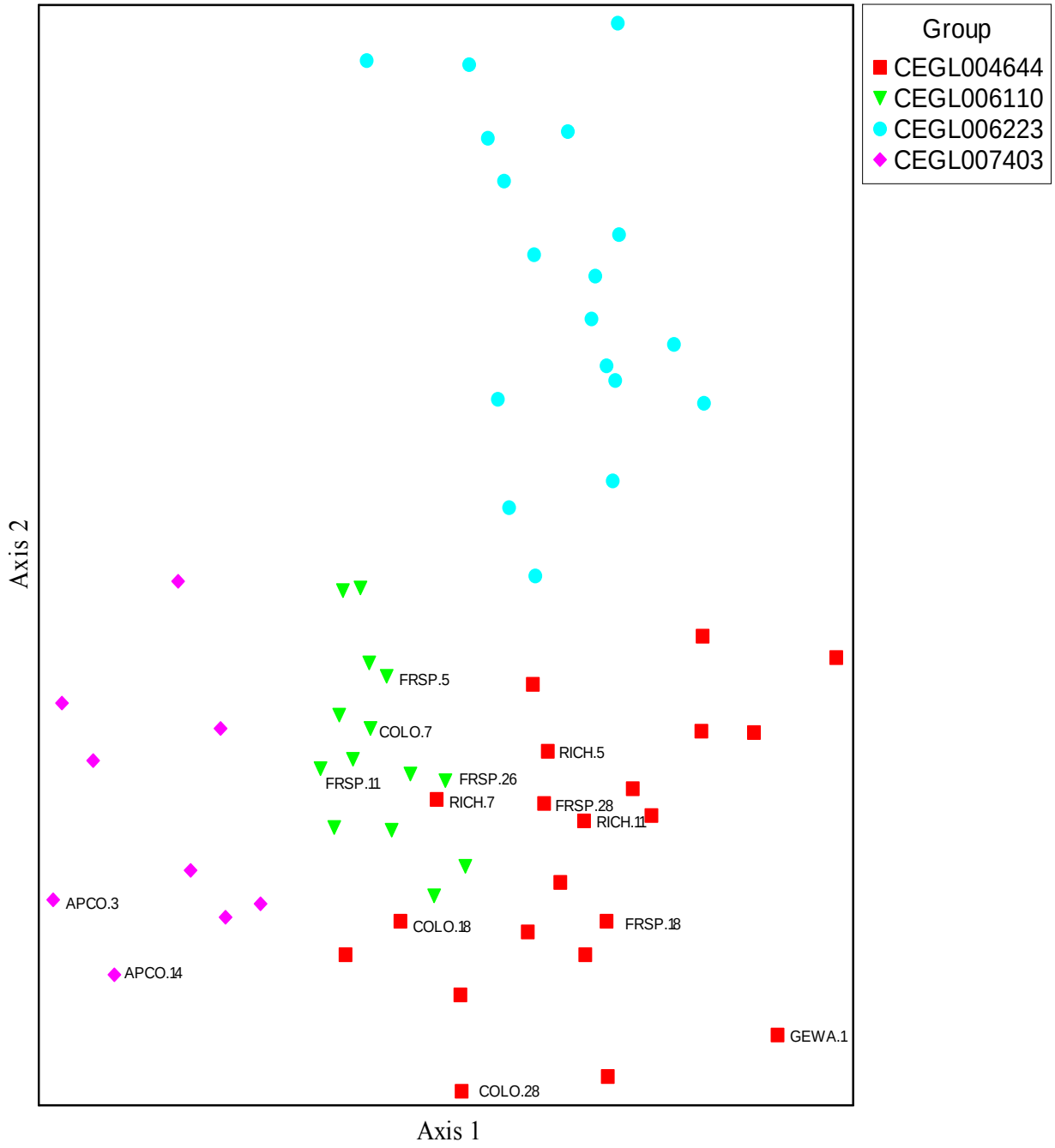



Figure G24. Scatterplot diagram for two-dimensional NMDS ordination of 62 nonriverine forest plots. Plot membership in four nonriverine forest associations is based on cluster analysis. CEGL004644 = Non-Riverine Saturated Forest; CEGL006110 = Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type); CEGL006223 = Coastal Plain Depression Wetland (Swamp Tupelo Type); CEGL007403 = Upland Depression Swamp. Plots from the seven Virginia national parks are labeled to the right of or below the symbol.

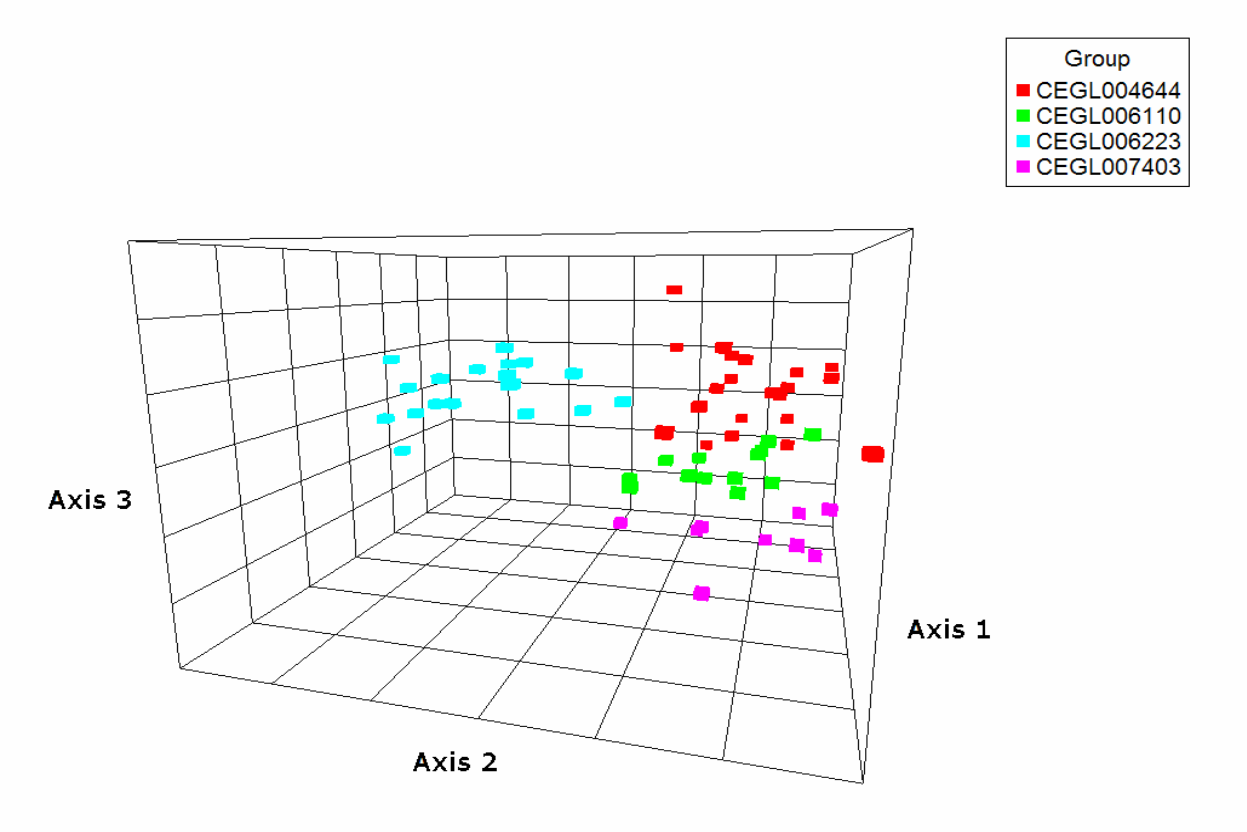
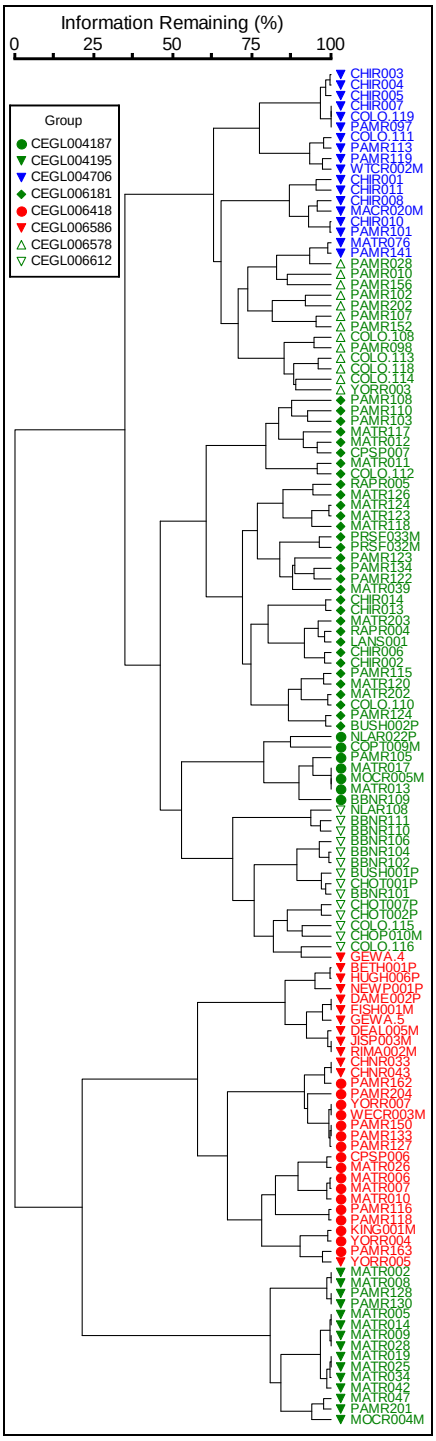



Figure G25. Scatterplot diagram for three-dimensional NMDS ordination of 62 nonriverine forest plots. Plot membership in four nonriverine forest associations is based on cluster analysis. CEGL004644 = Non-Riverine Saturated Forest; CEGL006110 = Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type); CEGL006223 = Coastal Plain Depression Wetland (Swamp Tupelo Type); CEGL007403 = Upland Depression Swamp.




**Tidal Freshwater Marshes**

CEGL004706 – Tidal Freshwater Marsh

**Tidal Oligohaline Marshes**

CEGL006578 –Tidal Oligohaline Marsh (Interior Depression Marsh)
CEGL006181 –Tidal Oligohaline Marsh (Mixed Forbs Type)
CEGL004187 –Tidal Oligohaline Marsh (Common Reed Tidal Marsh)
CEGL006612 –Tidal Oligohaline Marsh (Saltmeadow Cordgrass – Olney Three-Square Low Interior Marsh Type)
CEGL004195 –Tidal Oligohaline Marsh (Big Cordgrass Type)

**Tidal Mesohaline and Polyhaline Marshes**

CEGL006586 –Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh)
CEGL006418 –Tidal Mesohaline and Polyhaline Marsh (Transitional Marsh)

Figure G26. Dendrogram resulting from cluster analysis of species coverage data from 129 tidal herbaceous marsh plots. Plot membership in eight tidal herbaceous marsh associations is shown. Tidal herbaceous marsh map classes are color coded and represent groupings of associations with similar ecological contexts used to map herbaceous tidal vegetation. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

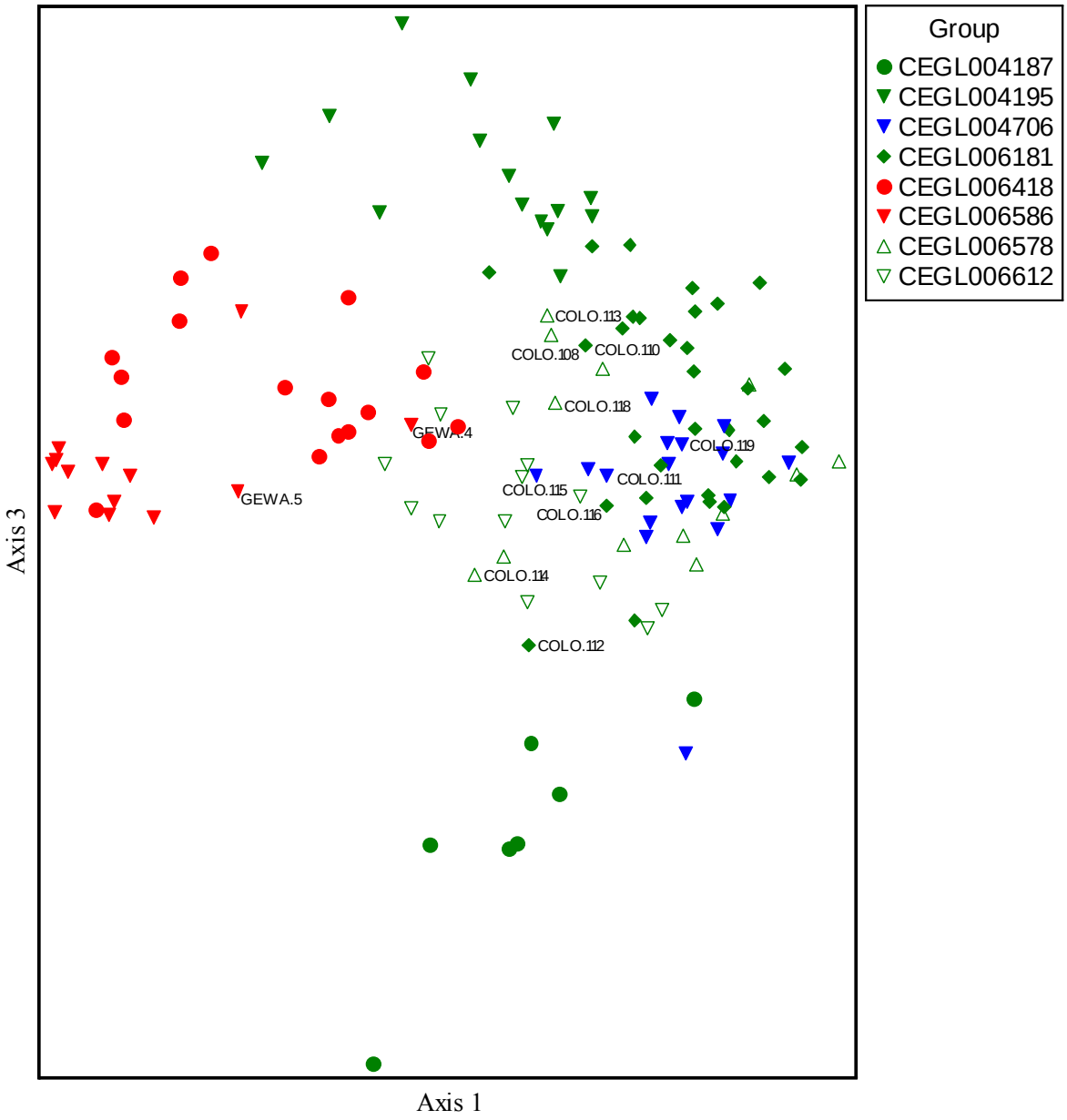



Figure G27. Scatterplot diagram for three-dimensional NMDS ordination of 129 tidal herbaceous marsh plots, showing Axis 1 and 3. Plot membership in eight tidal herbaceous marsh associations is based on cluster analysis. CEGL004187 = Tidal Oligohaline Marsh (Common Reed Tidal Marsh); CEGL004195 = Tidal Oligohaline Marsh (Big Cordgrass Type); CEGL004706 = Tidal Freshwater Marsh; CEGL006181 = Tidal Oligohaline Marsh (Mixed Forbs Type); CEGL006418 = Tidal Mesohaline and Polyhaline Marsh (Transitional Marsh); CEGL006578 = Tidal Oligohaline Marsh (Interior Depression Marsh); CEGL006586 = Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh); CEGL006612 = Tidal Oligohaline Marsh (Saltmeadow Cordgrass – Olney Three-Square Low Interior Marsh Type). Plots from the seven Virginia national parks are labeled to the right of or below the symbol.

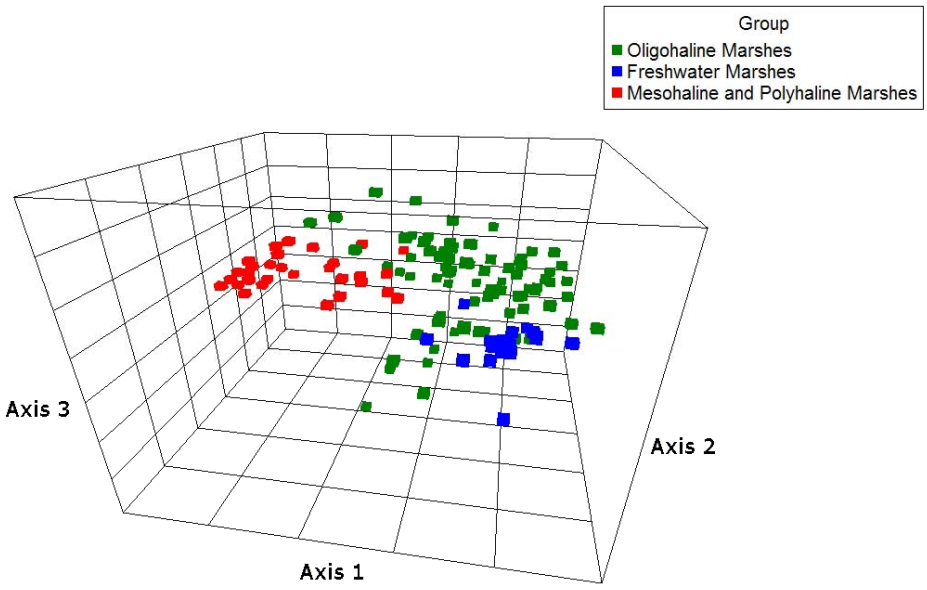



Figure G28. Scatterplot diagram for three-dimensional NMDS ordination of 129 tidal herbaceous marsh plots. Plot membership in three tidal marsh map classes is shown.

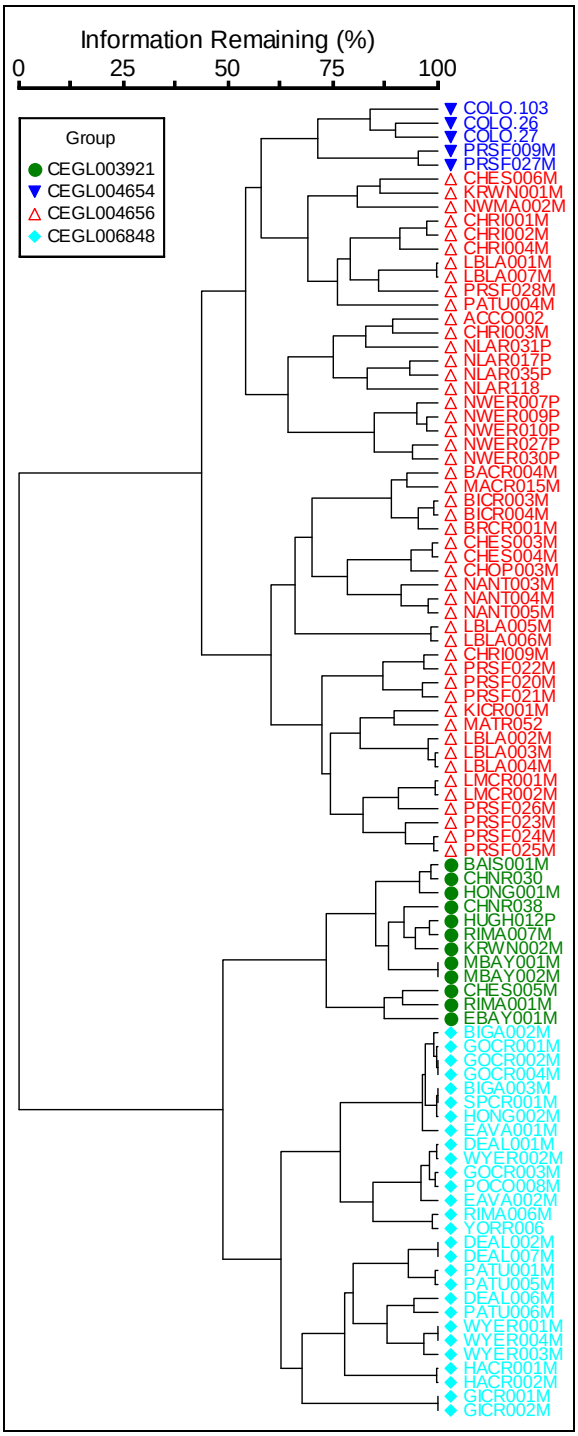



Figure G29. Dendrogram resulting from cluster analysis of species coverage data from 94 tidal forest and shrubland plots. Plot membership in four tidal forest and shrubland associations is shown. CEGL003921 = Salt Scrub; CEGL004654 = Tidal Bald Cypress Forest / Woodland; CEGL004656 = Tidal Shrub Swamp (Wax Myrtle Type); CEGL006848 = Tidal Shrub Swamp (Iva Type). Distance on the dendrogram scale is Wishart's objective function (Wishart 1979). Two plots were determined to be outliers and were eliminated from the dataset prior to ordination.

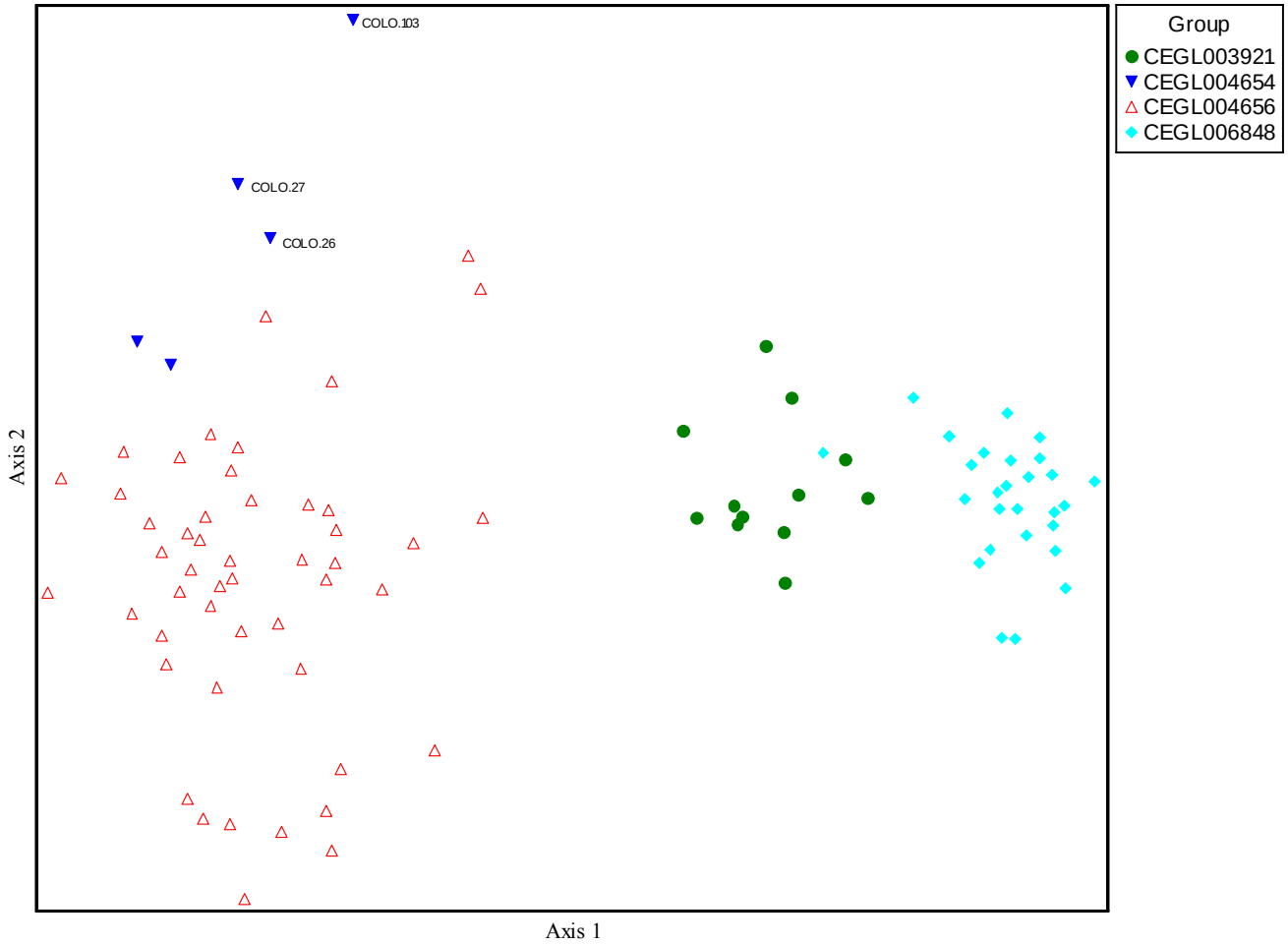



Figure G30. Scatterplot diagram for two-dimensional NMDS ordination of 94 tidal forest and shrubland plots. Plot membership in four tidal forest and shrubland associations is based on cluster analysis results. CEGL003921 = Salt Scrub; CEGL004654 = Tidal Bald Cypress Forest / Woodland; CEGL004656 = Tidal Shrub Swamp (Wax Myrtle Type); CEGL006848 = Tidal Shrub Swamp (Iva Type). Plots from seven Virginia national parks are labeled to the right of or below the symbol. Two plots were determined to be outliers and were eliminated from the dataset prior to ordination.

Appendix H. Compositional summary statistics for vegetation associations within Colonial National Historical Park derived from the analysis of regional quantitative plot data.

Compositional statistics were calculated to evaluate the adequacy of groups recognized in cluster analysis and ultimately to assist in naming and describing vegetation associations. Only associations derived from quantitative analysis of the regional plot data are shown. Total mean cover and total frequency were determined for every taxon across the entire dataset. Compositional statistics are shown only for prevalent species in each vegetation association, except for those associations where mean species richness is less than or equal to 10 species. Prevalence is an attribute assigned to a portion of the species within a vegetation type (Curtis 1959). Prevalence is determined by ranking the species of a vegetation type in order of descending constancy then, beginning with the most constant species, selecting as prevalent, a number of species equal to the mean species richness for the vegetation type. Species shaded in green were chosen as primary nominals in the association name, while those in blue are parenthetical nominals.

See Methods - Vegetation Classification and Characterization - Summary Statistics section for an explanation of variables shown in each table.

Vegetation associations are presented as follows:

Acidic Oak - Hickory Forest ..... Table H5
Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type) ..... Table H10
Coastal Plain / Piedmont Small-Stream Floodplain Forest ..... Table H9
Coastal Plain Calcareous Seepage Swamp ..... Table H8
Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type) ..... Table H11
Coastal Plain Depression Wetland (Swamp Tupelo Type) ..... Table H12
Coastal Plain Dry Calcareous Forest ..... Table H7
Coastal Plain Loblolly Pine - Oak Forest ..... Table H2
Coastal Plain Mesic Calcareous Ravine Forest ..... Table H6
Mesic Mixed Hardwood Forest ..... Table H3
Non-Riverine Saturated Forest ..... Table H13
Piedmont / Coastal Plain Oak - Beech / Heath Forest ..... Table H4
Piedmont / Low Elevation Mixed Oak / Heath Forest ..... Table H1
Salt Scrub ..... Table H22
Tidal Bald Cypress Forest / Woodland ..... Table H24
Tidal Freshwater Marsh Table H14
Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) ..... Table H15
Tidal Mesohaline and Polyhaline Marsh (Transitional Marsh) ..... Table H16
Tidal Oligohaline Marsh (Big Cordgrass Type) ..... Table H19
Tidal Oligohaline Marsh (Common Reed Tidal Marsh) ..... Table H17
Tidal Oligohaline Marsh (Interior Depression Marsh) ..... Table H18
Tidal Oligohaline Marsh (Mixed Forbs Type) ..... Table H20
Tidal Oligohaline Marsh (Saltmeadow Cordgrass - Olney Three-Square Low Interior Marsh Type) ..... Table H21
Tidal Shrub Swamp (Wax Myrtle Type) ..... Table H23

Table H1. Compositional summary statistics from the regional analysis of Piedmont / Low Elevation Mixed Oak / Heath Forest (CEGL008521).

| | |
|---|---|
| Mean Species Richness | 25 |
| Homoteneity | 0.663 |
| Number of Plots | 75 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Nyssa sylvatica* | 810 | 5 | 6 | + | 99 | 9 | 9 | 6 | 18 |
| *Vaccinium pallidum* | 528 | 4 | 6 | ++ | 97 | 14 | 13 | 9 | 53 |
| *Acer rubrum* | 1090 | 6 | 6 | 0 | 97 | 7 | 6 | 4 | 6 |
| *Quercus alba* | 721 | 6 | 7 | + | 93 | 10 | 9 | 7 | 18 |
| *Gaylussacia baccata* | 225 | 4 | 7 | +++ | 89 | 29 | 26 | 20 | 209 |
| *Sassafras albidum* | 521 | 3 | 4 | + | 85 | 12 | 10 | 5 | 21 |
| *Vaccinium stamineum* | 373 | 2 | 5 | +++ | 82 | 16 | 13 | 7 | 108 |
| *Quercus velutina* | 429 | 4 | 5 | + | 82 | 14 | 12 | 7 | 23 |
| *Chimaphila maculata* | 412 | 2 | 2 | 0 | 74 | 13 | 10 | 2 | 10 |
| *Quercus coccinea* | 212 | 4 | 6 | ++ | 70 | 25 | 17 | 11 | 69 |
| *Quercus prinus* | 396 | 5 | 7 | ++ | 69 | 13 | 9 | 7 | 36 |
| *Smilax glauca* | 528 | 2 | 2 | 0 | 66 | 9 | 6 | 1 | 6 |
| *Amelanchier arborea* | 388 | 2 | 4 | ++ | 61 | 12 | 7 | 3 | 28 |
| *Pinus virginiana* | 182 | 2 | 4 | ++ | 59 | 24 | 14 | 6 | 57 |
| *Carya glabra* | 437 | 4 | 4 | 0 | 58 | 10 | 6 | 3 | 6 |
| *Smilax rotundifolia* | 798 | 3 | 2 | - | 54 | 5 | 3 | 1 | 1 |
| *Carya alba* | 411 | 4 | 4 | 0 | 50 | 9 | 5 | 2 | 5 |
| *Prunus serotina* var. *serotina* | 620 | 2 | 2 | 0 | 50 | 6 | 3 | 1 | 3 |
| *Ilex opaca* var. *opaca* | 576 | 4 | 4 | 0 | 47 | 6 | 3 | 1 | 3 |
| *Fagus grandifolia* | 631 | 6 | 4 | - - | 47 | 6 | 3 | 1 | 1 |
| *Rhododendron periclymenoides* | 275 | 2 | 3 | + | 46 | 12 | 6 | 2 | 11 |
| *Cornus florida* | 627 | 4 | 3 | - | 46 | 5 | 2 | 1 | 1 |
| *Diospyros virginiana* | 293 | 2 | 2 | 0 | 46 | 12 | 5 | 1 | 5 |
| *Quercus falcata* | 178 | 3 | 4 | + | 45 | 19 | 8 | 4 | 17 |
| *Kalmia latifolia* | 281 | 4 | 4 | 0 | 42 | 11 | 5 | 2 | 5 |

Table H2. Compositional summary statistics from the regional analysis of Coastal Plain Loblolly Pine - Oak Forest (CEGL004766).

| | |
|---|---|
| Mean Species Richness | 21 |
| Homoteneity | 0.714 |
| Number of Plots | 8 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Liquidambar styraciflua* | 472 | 4 | 6 | ++ | 100 | 2 | 2 | 1 | 7 |
| *Smilax bona-nox* | 87 | 1 | 2 | + | 100 | 9 | 9 | 2 | 18 |
| *Smilax rotundifolia* | 797 | 3 | 2 | - | 100 | 1 | 1 | 0 | 1 |
| *Pinus taeda* | 112 | 2 | 6 | ++++ | 88 | 6 | 5 | 4 | 88 |
| *Ilex opaca* var. *opaca* | 575 | 4 | 4 | 0 | 88 | 1 | 1 | 0 | 1 |
| *Chasmanthium laxum* | 76 | 2 | 2 | 0 | 88 | 9 | 8 | 2 | 8 |
| *Juniperus virginiana* var. *virginiana* | 353 | 2 | 2 | 0 | 88 | 2 | 2 | 0 | 2 |
| *Sassafras albidum* | 520 | 3 | 2 | - | 88 | 1 | 1 | 0 | 1 |
| *Toxicodendron radicans* | 747 | 3 | 1 | - - | 88 | 1 | 1 | 0 | 0 |
| *Microstegium vimineum* | 255 | 2 | 2 | 0 | 75 | 2 | 2 | 0 | 2 |
| *Quercus alba* | 720 | 6 | 6 | 0 | 63 | 1 | 0 | 0 | 0 |
| *Nyssa sylvatica* | 810 | 5 | 5 | 0 | 63 | 1 | 0 | 0 | 0 |
| *Quercus stellata* | 85 | 2 | 4 | ++ | 63 | 6 | 4 | 2 | 15 |
| *Prunus serotina* var. *serotina* | 619 | 2 | 3 | + | 63 | 1 | 1 | 0 | 1 |
| *Acer rubrum* | 1090 | 6 | 1 | - - - - | 63 | 0 | 0 | 0 | 0 |
| *Quercus velutina* | 428 | 4 | 6 | ++ | 50 | 1 | 0 | 0 | 2 |
| *Danthonia spicata* | 255 | 2 | 2 | 0 | 50 | 2 | 1 | 0 | 1 |
| *Carex hirsutella* | 98 | 1 | 1 | 0 | 50 | 4 | 2 | 0 | 2 |
| *Dichanthelium dichotomum* | 270 | 2 | 1 | - | 50 | 1 | 1 | 0 | 0 |
| *Parthenocissus quinquefolia* | 899 | 2 | 1 | - | 50 | 0 | 0 | 0 | 0 |
| *Quercus pagoda* | 39 | 2 | 6 | ++++ | 38 | 8 | 3 | 2 | 46 |
| *Quercus falcata* | 178 | 3 | 5 | ++ | 38 | 2 | 1 | 0 | 3 |

Table H3. Compositional summary statistics from the regional analysis of Mesic Mixed Hardwood Forest (CEGL006075).

| | |
|---|---|
| Mean Species Richness | 42 |
| Homoteneity | 0.573 |
| Number of Plots | 170 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Fagus grandifolia* | 630 | 6 | 7 | + | 97 | 26 | 25 | 20 | 51 |
| *Acer rubrum* | 1090 | 6 | 6 | 0 | 92 | 14 | 13 | 9 | 13 |
| *Liriodendron tulipifera* | 753 | 5 | 6 | + | 92 | 21 | 19 | 13 | 38 |
| *Parthenocissus quinquefolia* | 899 | 2 | 2 | 0 | 89 | 17 | 15 | 3 | 15 |
| *Quercus alba* | 720 | 6 | 6 | 0 | 84 | 20 | 16 | 11 | 16 |
| *Cornus florida* | 626 | 4 | 5 | + | 82 | 22 | 18 | 10 | 37 |
| *Quercus rubra* | 668 | 5 | 6 | + | 77 | 20 | 15 | 10 | 30 |
| *Nyssa sylvatica* | 810 | 5 | 5 | 0 | 77 | 16 | 12 | 7 | 12 |
| *Prunus serotina* var. *serotina* | 619 | 2 | 2 | 0 | 75 | 21 | 15 | 3 | 15 |
| *Toxicodendron radicans* | 747 | 3 | 2 | - | 75 | 17 | 13 | 3 | 6 |
| *Ilex opaca* var. *opaca* | 575 | 4 | 5 | + | 73 | 22 | 16 | 9 | 31 |
| *Polystichum acrostichoides* | 414 | 3 | 4 | + | 71 | 29 | 20 | 9 | 41 |
| *Maianthemum racemosum* ssp. *racemosum* | 481 | 2 | 2 | 0 | 64 | 23 | 15 | 3 | 15 |
| *Polygonatum biflorum* | 462 | 2 | 2 | 0 | 63 | 23 | 15 | 3 | 15 |
| *Smilax rotundifolia* | 797 | 3 | 2 | - | 62 | 13 | 8 | 2 | 4 |
| *Asimina triloba* | 519 | 5 | 4 | - | 61 | 20 | 12 | 5 | 6 |
| *Euonymus americanus* | 433 | 2 | 2 | 0 | 61 | 24 | 15 | 3 | 15 |
| *Smilax glauca* | 528 | 2 | 2 | 0 | 60 | 19 | 12 | 3 | 12 |
| *Carya alba* | 410 | 4 | 4 | 0 | 58 | 24 | 14 | 6 | 14 |
| *Carpinus caroliniana* | 497 | 4 | 4 | 0 | 58 | 20 | 12 | 5 | 12 |
| *Mitchella repens* | 395 | 2 | 2 | 0 | 55 | 24 | 13 | 3 | 13 |
| *Vaccinium pallidum* | 527 | 4 | 2 | - - | 52 | 17 | 9 | 2 | 2 |
| *Carya glabra* | 437 | 4 | 4 | 0 | 51 | 20 | 10 | 5 | 10 |
| *Carex digitalis* | 268 | 2 | 2 | 0 | 51 | 32 | 16 | 4 | 16 |
| *Chimaphila maculata* | 412 | 2 | 2 | 0 | 49 | 20 | 10 | 2 | 10 |
| *Sassafras albidum* | 520 | 3 | 2 | - | 49 | 16 | 8 | 2 | 4 |
| *Desmodium nudiflorum* | 307 | 2 | 2 | 0 | 48 | 27 | 13 | 3 | 13 |
| *Viburnum acerifolium* | 319 | 2 | 3 | + | 46 | 24 | 11 | 4 | 22 |
| *Galium circaezans* | 384 | 2 | 2 | 0 | 45 | 20 | 9 | 2 | 9 |
| *Dioscorea quaternata* | 339 | 2 | 2 | 0 | 45 | 22 | 10 | 2 | 10 |
| *Fraxinus americana* | 509 | 4 | 2 | - - | 45 | 15 | 7 | 1 | 2 |
| *Lonicera japonica* | 516 | 2 | 2 | 0 | 44 | 14 | 6 | 1 | 6 |
| *Liquidambar styraciflua* | 472 | 4 | 4 | 0 | 42 | 15 | 6 | 3 | 6 |
| *Quercus velutina* | 428 | 4 | 4 | 0 | 42 | 17 | 7 | 3 | 7 |
| *Vitis vulpina* | 384 | 2 | 2 | 0 | 40 | 18 | 7 | 2 | 7 |
| *Lindera benzoin* | 456 | 4 | 3 | - | 39 | 14 | 6 | 2 | 3 |
| *Amelanchier arborea* | 387 | 2 | 2 | 0 | 36 | 16 | 6 | 1 | 6 |
| *Quercus prinus* | 396 | 5 | 5 | 0 | 34 | 15 | 5 | 3 | 5 |
| *Epifagus virginiana* | 107 | 1 | 2 | + | 34 | 54 | 18 | 4 | 37 |
| *Carex albicans* | 290 | 2 | 2 | 0 | 33 | 19 | 6 | 1 | 6 |
| *Medeola virginiana* | 175 | 1 | 2 | + | 29 | 28 | 8 | 2 | 16 |
| *Eurybia divaricata* | 236 | 2 | 2 | 0 | 28 | 20 | 6 | 1 | 6 |

Table H4. Compositional summary statistics from the regional analysis of Piedmont / Coastal Plain Oak - Beech / Heath Forest (CEGL006919).

| | |
|---|---|
| Mean Species Richness | 27 |
| Homoteneity | 0.610 |
| Number of Plots | 26 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Acer rubrum* | 1090 | 6 | 6 | 0 | 100 | 2 | 2 | 2 | 2 |
| *Kalmia latifolia* | 281 | 4 | 7 | +++ | 96 | 9 | 9 | 7 | 68 |
| *Fagus grandifolia* | 630 | 6 | 7 | + | 96 | 4 | 4 | 3 | 8 |
| *Nyssa sylvatica* | 810 | 5 | 5 | 0 | 88 | 3 | 3 | 1 | 3 |
| *Liriodendron tulipifera* | 753 | 5 | 3 | - - | 85 | 3 | 2 | 1 | 1 |
| *Ilex opaca* var. *opaca* | 575 | 4 | 5 | + | 77 | 3 | 3 | 1 | 5 |
| *Sassafras albidum* | 520 | 3 | 4 | + | 77 | 4 | 3 | 1 | 6 |
| *Quercus alba* | 720 | 6 | 6 | 0 | 73 | 3 | 2 | 1 | 2 |
| *Vaccinium pallidum* | 527 | 4 | 4 | 0 | 73 | 4 | 3 | 1 | 3 |
| *Rhododendron periclymenoides* | 275 | 2 | 4 | ++ | 65 | 6 | 4 | 2 | 16 |
| *Cornus florida* | 626 | 4 | 4 | 0 | 65 | 3 | 2 | 1 | 2 |
| *Chimaphila maculata* | 412 | 2 | 2 | 0 | 65 | 4 | 3 | 1 | 3 |
| *Liquidambar styraciflua* | 472 | 4 | 3 | - | 58 | 3 | 2 | 1 | 1 |
| *Smilax glauca* | 528 | 2 | 2 | 0 | 58 | 3 | 2 | 0 | 2 |
| *Quercus prinus* | 396 | 5 | 6 | + | 54 | 4 | 2 | 1 | 4 |
| *Quercus rubra* | 668 | 5 | 5 | 0 | 54 | 2 | 1 | 1 | 1 |
| *Amelanchier arborea* | 387 | 2 | 2 | 0 | 50 | 3 | 2 | 0 | 2 |
| *Quercus velutina* | 428 | 4 | 4 | 0 | 46 | 3 | 1 | 1 | 1 |
| *Carya glabra* | 437 | 4 | 4 | 0 | 46 | 3 | 1 | 1 | 1 |
| *Epifagus virginiana* | 107 | 1 | 2 | + | 46 | 11 | 5 | 1 | 10 |
| *Prunus serotina* var. *serotina* | 619 | 2 | 2 | 0 | 46 | 2 | 1 | 0 | 1 |
| *Smilax rotundifolia* | 797 | 3 | 2 | - | 46 | 2 | 1 | 0 | 0 |
| *Mitchella repens* | 395 | 2 | 2 | 0 | 42 | 3 | 1 | 0 | 1 |
| *Viburnum acerifolium* | 319 | 2 | 3 | + | 35 | 3 | 1 | 0 | 2 |
| *Hexastylis virginica* | 46 | 1 | 2 | + | 35 | 20 | 7 | 2 | 14 |
| *Desmodium nudiflorum* | 307 | 2 | 2 | 0 | 35 | 3 | 1 | 0 | 1 |
| *Juniperus virginiana* var. *virginiana* | 353 | 2 | 2 | 0 | 35 | 3 | 1 | 0 | 1 |

Table H5. Compositional summary statistics from the regional analysis of Acidic Oak - Hickory Forest (CEGL008475).

| | |
|---|---|
| Mean Species Richness | 53 |
| Homoteneity | 0.598 |
| Number of Plots | 121 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Quercus alba* | 720 | 6 | 7 | + | 98 | 16 | 16 | 13 | 32 |
| *Acer rubrum* | 1090 | 6 | 6 | 0 | 96 | 11 | 10 | 7 | 10 |
| *Cornus florida* | 626 | 4 | 6 | ++ | 94 | 18 | 17 | 11 | 68 |
| *Parthenocissus quinquefolia* | 899 | 2 | 2 | 0 | 90 | 12 | 11 | 2 | 11 |
| *Nyssa sylvatica* | 810 | 5 | 5 | 0 | 88 | 13 | 11 | 6 | 11 |
| *Vaccinium pallidum* | 527 | 4 | 4 | 0 | 87 | 20 | 17 | 8 | 17 |
| *Polygonatum biflorum* | 462 | 2 | 2 | 0 | 85 | 22 | 19 | 4 | 19 |
| *Quercus rubra* | 668 | 5 | 6 | + | 83 | 15 | 12 | 8 | 25 |
| *Vaccinium stamineum* | 373 | 2 | 4 | ++ | 83 | 27 | 22 | 10 | 88 |
| *Maianthemum racemosum* ssp. *racemosum* | 481 | 2 | 2 | 0 | 81 | 20 | 16 | 4 | 16 |
| *Prunus serotina* var. *serotina* | 619 | 2 | 2 | 0 | 80 | 16 | 12 | 3 | 12 |
| *Liriodendron tulipifera* | 753 | 5 | 5 | 0 | 79 | 13 | 10 | 6 | 10 |
| *Desmodium nudiflorum* | 307 | 2 | 4 | ++ | 79 | 31 | 24 | 11 | 98 |
| *Chimaphila maculata* | 412 | 2 | 2 | 0 | 79 | 23 | 18 | 4 | 18 |
| *Carya alba* | 410 | 4 | 6 | ++ | 78 | 23 | 18 | 12 | 72 |
| *Fraxinus americana* | 509 | 4 | 4 | 0 | 77 | 18 | 14 | 6 | 14 |
| *Quercus velutina* | 428 | 4 | 5 | + | 76 | 21 | 16 | 9 | 32 |
| *Sassafras albidum* | 520 | 3 | 3 | 0 | 76 | 18 | 13 | 4 | 13 |
| *Galium circaezans* | 384 | 2 | 2 | 0 | 71 | 22 | 16 | 3 | 16 |
| *Carya glabra* | 437 | 4 | 5 | + | 66 | 18 | 12 | 7 | 24 |
| *Juniperus virginiana* var. *virginiana* | 353 | 2 | 2 | 0 | 65 | 22 | 14 | 3 | 14 |
| *Carex albicans* | 290 | 2 | 2 | 0 | 61 | 25 | 15 | 3 | 15 |
| *Vitis vulpina* | 384 | 2 | 2 | 0 | 61 | 19 | 12 | 3 | 12 |
| *Smilax glauca* | 528 | 2 | 2 | 0 | 61 | 14 | 8 | 2 | 8 |
| *Amelanchier arborea* | 387 | 2 | 3 | + | 59 | 18 | 11 | 4 | 22 |
| *Rubus flagellaris* | 329 | 2 | 2 | 0 | 56 | 20 | 11 | 3 | 11 |
| *Fagus grandifolia* | 630 | 6 | 5 | - | 53 | 10 | 5 | 3 | 3 |
| *Danthonia spicata* | 255 | 2 | 2 | 0 | 53 | 25 | 13 | 3 | 13 |
| *Viburnum prunifolium* | 361 | 2 | 2 | 0 | 52 | 17 | 9 | 2 | 9 |
| *Toxicodendron radicans* | 747 | 3 | 2 | - | 52 | 8 | 4 | 1 | 2 |
| *Viburnum acerifolium* | 319 | 2 | 4 | ++ | 51 | 19 | 10 | 4 | 39 |
| *Dioscorea quaternata* | 339 | 2 | 2 | 0 | 51 | 18 | 9 | 2 | 9 |
| *Smilax rotundifolia* | 797 | 3 | 2 | - | 48 | 7 | 3 | 1 | 2 |
| *Solidago caesia* | 232 | 2 | 2 | 0 | 47 | 24 | 11 | 3 | 11 |
| *Euonymus americanus* | 433 | 2 | 2 | 0 | 47 | 13 | 6 | 1 | 6 |
| *Carya ovalis* | 160 | 4 | 5 | + | 43 | 33 | 14 | 8 | 28 |
| *Dichanthelium boscii* | 248 | 2 | 3 | + | 43 | 21 | 9 | 3 | 18 |
| *Uvularia perfoliata* | 219 | 2 | 2 | 0 | 43 | 24 | 10 | 2 | 10 |
| *Carex digitalis* | 268 | 2 | 2 | 0 | 43 | 19 | 8 | 2 | 8 |
| *Dichanthelium dichotomum* | 270 | 2 | 2 | 0 | 43 | 19 | 8 | 2 | 8 |
| *Rhododendron periclymenoides* | 275 | 2 | 2 | 0 | 43 | 19 | 8 | 2 | 8 |
| *Diospyros virginiana* | 292 | 2 | 2 | 0 | 43 | 18 | 8 | 2 | 8 |
| *Carpinus caroliniana* | 497 | 4 | 4 | 0 | 42 | 10 | 4 | 2 | 4 |
| *Quercus prinus* | 396 | 5 | 5 | 0 | 41 | 12 | 5 | 3 | 5 |
| *Rosa carolina* var. *carolina* | 138 | 1 | 2 | + | 39 | 34 | 13 | 3 | 27 |
| *Quercus coccinea* | 212 | 4 | 4 | 0 | 38 | 21 | 8 | 4 | 8 |

Table H5. Compositional summary statistics from the regional analysis of Acidic Oak - Hickory Forest (CEGL008475) (continued).

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Polystichum acrostichoides* | 414 | 3 | 2 | - | 38 | 11 | 4 | 1 | 2 |
| *Cercis canadensis* var. *canadensis* | 248 | 3 | 3 | 0 | 36 | 17 | 6 | 2 | 6 |
| *Houstonia purpurea* var. *purpurea* | 125 | 1 | 2 | + | 36 | 34 | 12 | 3 | 25 |
| *Scutellaria elliptica* | 135 | 1 | 2 | + | 36 | 32 | 11 | 3 | 23 |
| *Ilex opaca* var. *opaca* | 575 | 4 | 2 | - - | 36 | 7 | 3 | 1 | 1 |
| *Gaylussacia baccata* | 224 | 4 | 3 | - | 34 | 18 | 6 | 2 | 3 |
| *Aristolochia serpentaria* | 153 | 1 | 2 | + | 33 | 26 | 9 | 2 | 17 |
| *Vitis aestivalis* | 151 | 2 | 2 | 0 | 33 | 26 | 9 | 2 | 9 |

Table H6. Compositional summary statistics from the regional analysis of Coastal Plain Mesic Calcareous Ravine Forest (CEGL007181).

| | |
|---|---|
| Mean Species Richness | 60 |
| Homoteneity | 0.655 |
| Number of Plots | 22 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Fagus grandifolia* | 630 | 6 | 7 | + | 100 | 3 | 3 | 3 | 7 |
| *Ilex opaca* var. *opaca* | 575 | 4 | 3 | - | 100 | 4 | 4 | 1 | 2 |
| *Polystichum acrostichoides* | 414 | 3 | 6 | +++ | 95 | 5 | 5 | 3 | 39 |
| *Liriodendron tulipifera* | 753 | 5 | 6 | + | 95 | 3 | 3 | 2 | 5 |
| *Carya cordiformis* | 289 | 3 | 6 | +++ | 91 | 7 | 6 | 4 | 50 |
| *Toxicodendron radicans* | 747 | 3 | 3 | 0 | 91 | 3 | 2 | 1 | 2 |
| *Galium triflorum* | 258 | 2 | 2 | 0 | 91 | 8 | 7 | 2 | 7 |
| *Mitchella repens* | 395 | 2 | 2 | 0 | 91 | 5 | 5 | 1 | 5 |
| *Prunus serotina* var. *serotina* | 619 | 2 | 2 | 0 | 91 | 3 | 3 | 1 | 3 |
| *Lonicera japonica* | 516 | 2 | 3 | + | 86 | 4 | 3 | 1 | 6 |
| *Galium circaezans* | 384 | 2 | 2 | 0 | 86 | 5 | 4 | 1 | 4 |
| *Vitis vulpina* | 384 | 2 | 2 | 0 | 86 | 5 | 4 | 1 | 4 |
| *Cornus florida* | 626 | 4 | 5 | + | 82 | 3 | 2 | 1 | 5 |
| *Arisaema triphyllum* | 405 | 2 | 4 | ++ | 82 | 4 | 4 | 2 | 15 |
| *Euonymus americanus* | 433 | 2 | 2 | 0 | 82 | 4 | 3 | 1 | 3 |
| *Parthenocissus quinquefolia* | 899 | 2 | 2 | 0 | 82 | 2 | 2 | 0 | 2 |
| *Ulmus rubra* | 189 | 2 | 4 | ++ | 77 | 9 | 7 | 3 | 28 |
| *Sanicula canadensis* | 307 | 2 | 2 | 0 | 77 | 6 | 4 | 1 | 4 |
| *Quercus muhlenbergii* | 65 | 3 | 6 | +++ | 73 | 25 | 18 | 12 | 143 |
| *Liquidambar styraciflua* | 472 | 4 | 4 | 0 | 73 | 3 | 2 | 1 | 2 |
| *Viola sororia* | 252 | 2 | 2 | 0 | 73 | 6 | 5 | 1 | 5 |
| *Maianthemum racemosum* ssp. *racemosum* | 481 | 2 | 2 | 0 | 73 | 3 | 2 | 1 | 2 |
| *Acer barbatum* | 56 | 3 | 7 | ++++ | 68 | 27 | 18 | 14 | 292 |
| *Carpinus caroliniana* | 497 | 4 | 5 | + | 68 | 3 | 2 | 1 | 4 |
| *Circaea lutetiana* ssp. *canadensis* | 247 | 2 | 4 | ++ | 68 | 6 | 4 | 2 | 17 |
| *Cercis canadensis* var. *canadensis* | 248 | 3 | 4 | + | 68 | 6 | 4 | 2 | 8 |
| *Acer rubrum* | 1090 | 6 | 3 | - - - | 68 | 1 | 1 | 0 | 0 |
| *Botrychium virginianum* | 206 | 1 | 2 | + | 68 | 7 | 5 | 1 | 10 |
| *Geum canadense* | 170 | 2 | 2 | 0 | 68 | 9 | 6 | 1 | 6 |
| *Polygonum virginianum* | 203 | 2 | 2 | 0 | 68 | 7 | 5 | 1 | 5 |
| *Festuca subverticillata* | 268 | 2 | 2 | 0 | 68 | 6 | 4 | 1 | 4 |
| *Asimina triloba* | 519 | 5 | 6 | + | 64 | 3 | 2 | 1 | 3 |
| *Polygonatum biflorum* | 462 | 2 | 2 | 0 | 64 | 3 | 2 | 0 | 2 |
| *Sanguinaria canadensis* | 115 | 2 | 4 | ++ | 59 | 11 | 7 | 3 | 27 |
| *Phegopteris hexagonoptera* | 81 | 2 | 3 | + | 59 | 16 | 9 | 3 | 19 |
| *Phryma leptostachya* | 149 | 1 | 2 | + | 59 | 9 | 5 | 1 | 10 |
| *Carex albicans* | 290 | 2 | 2 | 0 | 59 | 4 | 3 | 1 | 3 |
| *Smilax rotundifolia* | 797 | 3 | 2 | - | 59 | 2 | 1 | 0 | 0 |
| *Lindera benzoin* | 456 | 4 | 4 | 0 | 55 | 3 | 1 | 1 | 1 |
| *Fraxinus americana* | 509 | 4 | 4 | 0 | 55 | 2 | 1 | 1 | 1 |
| *Dichanthelium boscii* | 248 | 2 | 3 | + | 55 | 5 | 3 | 1 | 5 |
| *Sassafras albidum* | 520 | 3 | 2 | - | 55 | 2 | 1 | 0 | 1 |
| *Quercus alba* | 720 | 6 | 5 | - | 50 | 2 | 1 | 0 | 0 |
| *Cynoglossum virginianum* var. *virginianum* | 50 | 1 | 4 | +++ | 50 | 22 | 11 | 5 | 88 |
| *Carex rosea* | 152 | 1 | 2 | + | 50 | 7 | 4 | 1 | 7 |
| *Carex digitalis* | 268 | 2 | 2 | 0 | 50 | 4 | 2 | 0 | 2 |
| *Podophyllum peltatum* | 207 | 2 | 5 | +++ | 45 | 5 | 2 | 1 | 18 |
| *Quercus velutina* | 428 | 4 | 4 | 0 | 45 | 2 | 1 | 0 | 1 |
| *Luzula acuminata* var. *carolinae* | 32 | 1 | 2 | + | 45 | 31 | 14 | 3 | 28 |
| *Hepatica americana* | 81 | 1 | 2 | + | 45 | 12 | 6 | 1 | 11 |

Table H6. Compositional summary statistics from the regional analysis of Coastal Plain Mesic Calcareous Ravine Forest (CEGL007181) (continued).

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Asarum canadense* | 53 | 2 | 2 | 0 | 45 | 19 | 9 | 2 | 9 |
| *Morus rubra* | 120 | 1 | 2 | + | 45 | 8 | 4 | 1 | 8 |
| *Carex blanda* | 156 | 2 | 2 | 0 | 45 | 6 | 3 | 1 | 3 |
| *Vitis rotundifolia* | 169 | 2 | 2 | 0 | 45 | 6 | 3 | 1 | 3 |
| *Brachyelytrum erectum* | 156 | 2 | 4 | ++ | 41 | 6 | 2 | 1 | 9 |
| *Quercus rubra* | 668 | 5 | 4 | - | 41 | 1 | 1 | 0 | 0 |
| *Nyssa sylvatica* | 810 | 5 | 3 | - - | 41 | 1 | 0 | 0 | 0 |
| *Smilax bona-nox* | 87 | 1 | 2 | + | 41 | 10 | 4 | 1 | 8 |
| *Galearis spectabilis* | 41 | 1 | 2 | + | 36 | 20 | 7 | 2 | 14 |
| *Prenanthes altissima* | 74 | 1 | 2 | + | 36 | 11 | 4 | 1 | 8 |

Table H7. Compositional summary statistics from the regional analysis of Coastal Plain Dry Calcareous Forest (CEGL007748).

| | |
|---|---|
| Mean Species Richness | 67 |
| Homoteneity | 0.595 |
| Number of Plots | 24 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Quercus muhlenbergii* | 66 | 3 | 7 | ++++ | 100 | 36 | 36 | 28 | 582 |
| *Cornus florida* | 627 | 4 | 6 | ++ | 96 | 4 | 4 | 2 | 14 |
| *Juniperus virginiana* var. *virginiana* | 354 | 2 | 4 | ++ | 96 | 6 | 6 | 3 | 25 |
| *Toxicodendron radicans* | 748 | 3 | 4 | + | 92 | 3 | 3 | 1 | 5 |
| *Ilex opaca* var. *opaca* | 576 | 4 | 4 | 0 | 88 | 4 | 3 | 1 | 3 |
| *Parthenocissus quinquefolia* | 900 | 2 | 3 | + | 88 | 2 | 2 | 1 | 4 |
| *Prunus serotina* var. *serotina* | 620 | 2 | 2 | 0 | 88 | 3 | 3 | 1 | 3 |
| *Carya cordiformis* | 289 | 3 | 6 | +++ | 83 | 7 | 6 | 4 | 46 |
| *Cercis canadensis* var. *canadensis* | 249 | 3 | 5 | ++ | 83 | 8 | 7 | 4 | 27 |
| *Liriodendron tulipifera* | 754 | 5 | 5 | 0 | 83 | 3 | 2 | 1 | 2 |
| *Asimina triloba* | 519 | 5 | 6 | + | 79 | 4 | 3 | 2 | 6 |
| *Liquidambar styraciflua* | 473 | 4 | 4 | 0 | 79 | 4 | 3 | 1 | 3 |
| *Lonicera japonica* | 517 | 2 | 3 | + | 79 | 4 | 3 | 1 | 6 |
| *Sanicula canadensis* | 308 | 2 | 2 | 0 | 79 | 6 | 5 | 1 | 5 |
| *Galium circaezans* | 385 | 2 | 2 | 0 | 79 | 5 | 4 | 1 | 4 |
| *Smilax rotundifolia* | 798 | 3 | 2 | - | 79 | 2 | 2 | 0 | 1 |
| *Dichanthelium boscii* | 249 | 2 | 5 | +++ | 75 | 7 | 5 | 3 | 43 |
| *Carex albicans* | 291 | 2 | 4 | ++ | 75 | 6 | 5 | 2 | 19 |
| *Campsis radicans* | 209 | 2 | 2 | 0 | 75 | 9 | 6 | 1 | 6 |
| *Celtis occidentalis* | 205 | 2 | 2 | 0 | 71 | 8 | 6 | 1 | 6 |
| *Diospyros virginiana* | 293 | 2 | 2 | 0 | 71 | 6 | 4 | 1 | 4 |
| *Fagus grandifolia* | 631 | 6 | 5 | - | 67 | 3 | 2 | 1 | 1 |
| *Viburnum prunifolium* | 362 | 2 | 4 | ++ | 67 | 4 | 3 | 1 | 12 |
| *Phryma leptostachya* | 150 | 1 | 2 | + | 67 | 11 | 7 | 2 | 14 |
| *Vitis vulpina* | 385 | 2 | 2 | 0 | 67 | 4 | 3 | 1 | 3 |
| *Smilax bona-nox* | 88 | 1 | 2 | + | 63 | 17 | 11 | 2 | 21 |
| *Geum virginianum* | 101 | 1 | 2 | + | 63 | 15 | 9 | 2 | 19 |
| *Erigeron pulchellus* var. *pulchellus* | 35 | 1 | 4 | +++ | 58 | 40 | 23 | 10 | 187 |
| *Ulmus rubra* | 190 | 2 | 3 | + | 58 | 7 | 4 | 1 | 9 |
| *Carex blanda* | 156 | 2 | 2 | 0 | 58 | 9 | 5 | 1 | 5 |
| *Bromus pubescens* | 103 | 2 | 4 | ++ | 54 | 13 | 7 | 3 | 27 |
| *Agrimonia rostellata* | 124 | 1 | 2 | + | 54 | 10 | 6 | 1 | 11 |
| *Carex laxiflora* var. *laxiflora* | 141 | 1 | 2 | + | 54 | 9 | 5 | 1 | 10 |
| *Aristolochia serpentaria* | 154 | 1 | 2 | + | 54 | 8 | 5 | 1 | 9 |
| *Vitis rotundifolia* | 170 | 2 | 2 | 0 | 54 | 8 | 4 | 1 | 4 |
| *Polygonatum biflorum* | 463 | 2 | 2 | 0 | 54 | 3 | 2 | 0 | 2 |
| *Acer rubrum* | 1090 | 6 | 2 | - - - - | 54 | 1 | 1 | 0 | 0 |
| *Carpinus caroliniana* | 498 | 4 | 5 | + | 50 | 2 | 1 | 1 | 2 |
| *Fraxinus americana* | 510 | 4 | 4 | 0 | 50 | 2 | 1 | 1 | 1 |
| *Polystichum acrostichoides* | 415 | 3 | 3 | 0 | 50 | 3 | 1 | 0 | 1 |
| *Salvia lyrata* | 38 | 1 | 2 | + | 50 | 32 | 16 | 4 | 32 |
| *Asplenium platyneuron* | 156 | 1 | 2 | + | 50 | 8 | 4 | 1 | 8 |
| *Mitchella repens* | 396 | 2 | 2 | 0 | 50 | 3 | 2 | 0 | 2 |
| *Sassafras albidum* | 521 | 3 | 2 | - | 50 | 2 | 1 | 0 | 1 |
| *Arisaema triphyllum* | 405 | 2 | 4 | ++ | 46 | 3 | 1 | 1 | 5 |

Table H7. Compositional summary statistics from the regional analysis of Coastal Plain Dry Calcareous Forest (CEGL007748) (continued).

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Arnoglossum atriplicifolium* | 14 | 1 | 2 | + | 46 | 79 | 36 | 8 | 72 |
| *Aquilegia canadensis* | 24 | 1 | 2 | + | 46 | 46 | 21 | 5 | 42 |
| *Cynoglossum virginianum* var. *virginianum* | 50 | 1 | 2 | + | 46 | 22 | 10 | 2 | 20 |
| *Galium triflorum* | 258 | 2 | 2 | 0 | 46 | 4 | 2 | 0 | 2 |
| *Symphyotrichum lateriflorum* | 309 | 2 | 2 | 0 | 46 | 4 | 2 | 0 | 2 |
| *Smallanthus uvedalius* | 12 | 1 | 3 | ++ | 42 | 83 | 35 | 12 | 139 |
| *Dichanthelium commutatum* | 113 | 1 | 2 | + | 42 | 9 | 4 | 1 | 7 |
| *Sanguinaria canadensis* | 116 | 2 | 2 | 0 | 42 | 9 | 4 | 1 | 4 |
| *Ageratina altissima* var. *altissima* | 128 | 2 | 2 | 0 | 42 | 8 | 3 | 1 | 3 |
| *Solidago caesia* | 233 | 2 | 2 | 0 | 42 | 4 | 2 | 0 | 2 |
| *Amphicarpaea bracteata* | 262 | 2 | 2 | 0 | 42 | 4 | 2 | 0 | 2 |
| *Chimaphila maculata* | 412 | 2 | 2 | 0 | 42 | 2 | 1 | 0 | 1 |
| *Euonymus americanus* | 434 | 2 | 2 | 0 | 42 | 2 | 1 | 0 | 1 |
| *Quercus velutina* | 429 | 4 | 2 | - - | 42 | 2 | 1 | 0 | 0 |
| *Quercus rubra* | 669 | 5 | 4 | - | 38 | 1 | 1 | 0 | 0 |
| *Anemone virginiana* var. *virginiana* | 16 | 1 | 2 | + | 38 | 56 | 21 | 5 | 42 |
| *Desmodium pauciflorum* | 18 | 1 | 2 | + | 38 | 50 | 19 | 4 | 38 |
| *Ruellia caroliniensis* | 31 | 1 | 2 | + | 38 | 29 | 11 | 2 | 22 |
| *Oxalis dillenii* | 120 | 1 | 2 | + | 38 | 8 | 3 | 1 | 6 |
| *Packera aurea* | 68 | 2 | 2 | 0 | 38 | 13 | 5 | 1 | 5 |
| *Juglans nigra* | 98 | 2 | 2 | 0 | 38 | 9 | 3 | 1 | 3 |
| *Viola sororia* | 253 | 2 | 2 | 0 | 38 | 4 | 1 | 0 | 1 |

Table H8. Compositional summary statistics from the regional analysis of Coastal Plain Calcareous Seepage Swamp (CEGL006413).

| | |
|---|---|
| Mean Species Richness | 49 |
| Homoteneity | 0.690 |
| Number of Plots | 15 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Fraxinus pennsylvanica* | 238 | 4 | 7 | +++ | 100 | 6 | 6 | 5 | 50 |
| *Acer rubrum* | 1090 | 6 | 7 | + | 100 | 1 | 1 | 1 | 3 |
| *Saururus cernuus* | 91 | 2 | 6 | ++++ | 100 | 16 | 16 | 11 | 264 |
| *Decumaria barbara* | 27 | 1 | 4 | +++ | 100 | 56 | 56 | 25 | 444 |
| *Cinna arundinacea* | 229 | 3 | 4 | + | 100 | 7 | 7 | 3 | 13 |
| *Cicuta maculata* var. *maculata* | 47 | 2 | 5 | +++ | 93 | 30 | 28 | 15 | 222 |
| *Boehmeria cylindrica* | 226 | 2 | 3 | + | 93 | 6 | 6 | 2 | 12 |
| *Galium triflorum* | 258 | 2 | 2 | 0 | 93 | 5 | 5 | 1 | 5 |
| *Impatiens capensis* | 203 | 2 | 6 | ++++ | 87 | 6 | 6 | 4 | 89 |
| *Pilea fontana* | 25 | 1 | 5 | ++++ | 87 | 52 | 45 | 25 | 721 |
| *Ulmus americana* | 238 | 3 | 5 | ++ | 87 | 5 | 5 | 3 | 19 |
| *Glyceria striata* | 152 | 2 | 4 | ++ | 87 | 9 | 7 | 3 | 30 |
| *Toxicodendron radicans* | 747 | 3 | 3 | 0 | 87 | 2 | 2 | 1 | 2 |
| *Geum canadense* | 170 | 2 | 2 | 0 | 87 | 8 | 7 | 1 | 7 |
| *Ilex opaca* var. *opaca* | 575 | 4 | 2 | - - | 87 | 2 | 2 | 0 | 0 |
| *Packera aurea* | 68 | 2 | 6 | ++++ | 80 | 18 | 14 | 9 | 226 |
| *Lindera benzoin* | 456 | 4 | 5 | + | 80 | 3 | 2 | 1 | 4 |
| *Leersia virginica* | 201 | 2 | 4 | ++ | 80 | 6 | 5 | 2 | 19 |
| *Symphyotrichum lateriflorum* | 308 | 2 | 2 | 0 | 80 | 4 | 3 | 1 | 3 |
| *Carex bromoides* ssp. *bromoides* | 38 | 2 | 6 | ++++ | 73 | 29 | 21 | 14 | 340 |
| *Bidens laevis* | 16 | 2 | 5 | +++ | 73 | 69 | 50 | 28 | 403 |
| *Cornus foemina* | 33 | 1 | 4 | +++ | 73 | 33 | 24 | 11 | 196 |
| *Amphicarpaea bracteata* | 261 | 2 | 2 | 0 | 73 | 4 | 3 | 1 | 3 |
| *Arisaema triphyllum* | 405 | 2 | 2 | 0 | 73 | 3 | 2 | 0 | 2 |
| *Smilax rotundifolia* | 797 | 3 | 2 | - | 73 | 1 | 1 | 0 | 1 |
| *Ranunculus recurvatus* | 101 | 1 | 2 | + | 67 | 10 | 7 | 1 | 13 |
| *Juncus effusus* | 121 | 1 | 2 | + | 67 | 8 | 6 | 1 | 11 |
| *Lonicera japonica* | 516 | 2 | 2 | 0 | 67 | 2 | 1 | 0 | 1 |
| *Scirpus lineatus* | 9 | 1 | 4 | +++ | 60 | 100 | 60 | 27 | 480 |
| *Thelypteris palustris* var. *pubescens* | 45 | 1 | 3 | ++ | 60 | 20 | 12 | 4 | 48 |
| *Liquidambar styraciflua* | 472 | 4 | 3 | - | 60 | 2 | 1 | 0 | 1 |
| *Poa autumnalis* | 70 | 2 | 2 | 0 | 60 | 13 | 8 | 2 | 8 |
| *Sanicula canadensis* | 307 | 2 | 2 | 0 | 60 | 3 | 2 | 0 | 2 |
| *Carpinus caroliniana* | 497 | 4 | 6 | ++ | 53 | 2 | 1 | 1 | 3 |
| *Microstegium vimineum* | 255 | 2 | 4 | ++ | 53 | 3 | 2 | 1 | 7 |
| *Polygonum setaceum* | 12 | 1 | 2 | + | 53 | 67 | 36 | 8 | 71 |
| *Carex blanda* | 156 | 2 | 2 | 0 | 53 | 5 | 3 | 1 | 3 |
| *Asimina triloba* | 519 | 5 | 4 | - | 47 | 1 | 1 | 0 | 0 |
| *Myrica cerifera* var. *cerifera* | 29 | 1 | 3 | ++ | 47 | 24 | 11 | 4 | 45 |
| *Carex laevivaginata* | 46 | 1 | 2 | + | 47 | 15 | 7 | 2 | 14 |
| *Polygonum virginianum* | 203 | 2 | 2 | 0 | 47 | 3 | 2 | 0 | 2 |
| *Campsis radicans* | 208 | 2 | 2 | 0 | 47 | 3 | 2 | 0 | 2 |
| *Mitchella repens* | 395 | 2 | 2 | 0 | 47 | 2 | 1 | 0 | 1 |
| *Parthenocissus quinquefolia* | 899 | 2 | 2 | 0 | 47 | 1 | 0 | 0 | 0 |
| *Nyssa biflora* | 12 | 2 | 6 | ++++ | 40 | 50 | 20 | 13 | 320 |
| *Rudbeckia laciniata* | 35 | 1 | 2 | + | 40 | 17 | 7 | 2 | 14 |
| *Carex styloflexa* | 39 | 1 | 2 | + | 40 | 15 | 6 | 1 | 12 |
| *Carex crinita* | 85 | 1 | 2 | + | 40 | 7 | 3 | 1 | 6 |
| *Taxodium distichum* | 11 | 2 | 6 | ++++ | 33 | 45 | 15 | 10 | 242 |

Table H9. Compositional summary statistics from the regional analysis of Coastal Plain / Piedmont Small-Stream Floodplain Forest (CEGL004418).

| | |
|---|---|
| Mean Species Richness | 45 |
| Homoteneity | 0.527 |
| Number of Plots | 48 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Liriodendron tulipifera* | 753 | 5 | 7 | ++ | 96 | 6 | 6 | 5 | 23 |
| *Lindera benzoin* | 456 | 4 | 6 | ++ | 94 | 10 | 9 | 6 | 37 |
| *Toxicodendron radicans* | 747 | 3 | 4 | + | 94 | 6 | 6 | 3 | 11 |
| *Liquidambar styraciflua* | 472 | 4 | 6 | ++ | 92 | 9 | 9 | 6 | 34 |
| *Parthenocissus quinquefolia* | 899 | 2 | 4 | ++ | 92 | 5 | 4 | 2 | 18 |
| *Ilex opaca* var. *opaca* | 575 | 4 | 5 | + | 90 | 7 | 7 | 4 | 13 |
| *Smilax rotundifolia* | 797 | 3 | 3 | 0 | 88 | 5 | 5 | 2 | 5 |
| *Acer rubrum* | 1090 | 6 | 6 | 0 | 85 | 4 | 3 | 2 | 3 |
| *Arisaema triphyllum* | 405 | 2 | 4 | ++ | 81 | 10 | 8 | 3 | 31 |
| *Asimina triloba* | 519 | 5 | 5 | 0 | 73 | 7 | 5 | 3 | 5 |
| *Thelypteris noveboracensis* | 157 | 3 | 6 | +++ | 71 | 22 | 15 | 10 | 123 |
| *Carpinus caroliniana* | 497 | 4 | 5 | + | 71 | 7 | 5 | 3 | 10 |
| *Euonymus americanus* | 433 | 2 | 2 | 0 | 69 | 8 | 5 | 1 | 5 |
| *Polystichum acrostichoides* | 414 | 3 | 3 | 0 | 65 | 7 | 5 | 2 | 5 |
| *Mitchella repens* | 395 | 2 | 2 | 0 | 56 | 7 | 4 | 1 | 4 |
| *Fagus grandifolia* | 630 | 6 | 5 | - | 54 | 4 | 2 | 1 | 1 |
| *Lonicera japonica* | 516 | 2 | 3 | + | 54 | 5 | 3 | 1 | 5 |
| *Boehmeria cylindrica* | 226 | 2 | 3 | + | 52 | 11 | 6 | 2 | 12 |
| *Carex debilis* | 130 | 2 | 2 | 0 | 48 | 18 | 8 | 2 | 8 |
| *Nyssa sylvatica* | 810 | 5 | 5 | 0 | 46 | 3 | 1 | 1 | 1 |
| *Athyrium filix-femina* var. *asplenioides* | 157 | 2 | 4 | ++ | 46 | 14 | 6 | 3 | 26 |
| *Cinna arundinacea* | 229 | 3 | 3 | 0 | 46 | 10 | 4 | 1 | 4 |
| *Platanus occidentalis* | 85 | 2 | 4 | ++ | 44 | 25 | 11 | 5 | 43 |
| *Cornus florida* | 626 | 4 | 4 | 0 | 42 | 3 | 1 | 1 | 1 |
| *Onoclea sensibilis* | 95 | 1 | 2 | + | 42 | 21 | 9 | 2 | 18 |
| *Polygonum virginianum* | 203 | 2 | 2 | 0 | 42 | 10 | 4 | 1 | 4 |
| *Circaea lutetiana* ssp. *canadensis* | 247 | 2 | 2 | 0 | 42 | 8 | 3 | 1 | 3 |
| *Carex intumescens* var. *intumescens* | 111 | 2 | 2 | 0 | 40 | 17 | 7 | 2 | 7 |
| *Carex radiata* | 146 | 2 | 2 | 0 | 40 | 13 | 5 | 1 | 5 |
| *Festuca subverticillata* | 268 | 2 | 2 | 0 | 40 | 7 | 3 | 1 | 3 |
| *Impatiens capensis* | 203 | 2 | 2 | 0 | 38 | 9 | 3 | 1 | 3 |
| *Viburnum dentatum* | 236 | 2 | 2 | 0 | 38 | 8 | 3 | 1 | 3 |
| *Smilax glauca* | 528 | 2 | 2 | 0 | 38 | 3 | 1 | 0 | 1 |
| *Carya cordiformis* | 289 | 3 | 3 | 0 | 33 | 6 | 2 | 1 | 2 |
| *Medeola virginiana* | 175 | 1 | 2 | + | 33 | 9 | 3 | 1 | 6 |
| *Amphicarpaea bracteata* | 261 | 2 | 2 | 0 | 33 | 6 | 2 | 0 | 2 |
| *Betula nigra* | 60 | 2 | 5 | +++ | 31 | 25 | 8 | 4 | 63 |
| *Lycopus virginicus* | 179 | 1 | 2 | + | 31 | 8 | 3 | 1 | 5 |
| *Sanicula canadensis* | 307 | 2 | 2 | 0 | 31 | 5 | 2 | 0 | 2 |
| *Ulmus americana* | 238 | 3 | 3 | 0 | 29 | 6 | 2 | 1 | 2 |
| *Sambucus nigra* ssp. *canadensis* | 94 | 1 | 2 | + | 29 | 15 | 4 | 1 | 9 |
| *Carex swanii* | 124 | 1 | 2 | + | 29 | 11 | 3 | 1 | 7 |
| *Woodwardia areolata* | 73 | 2 | 2 | 0 | 29 | 19 | 6 | 1 | 6 |
| *Campsis radicans* | 208 | 2 | 2 | 0 | 29 | 7 | 2 | 0 | 2 |
| *Galium triflorum* | 258 | 2 | 2 | 0 | 29 | 5 | 2 | 0 | 2 |

Table H10. Compositional summary statistics from the regional analysis of Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type) (CEGL006606).

| | |
|---|---|
| Mean Species Richness | 38 |
| Homoteneity | 0.532 |
| Number of Plots | 23 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Fraxinus pennsylvanica* | 238 | 4 | 7 | +++ | 95 | 9 | 8 | 7 | 67 |
| *Saururus cernuus* | 91 | 2 | 6 | ++++ | 91 | 22 | 20 | 13 | 320 |
| *Boehmeria cylindrica* | 226 | 2 | 4 | ++ | 91 | 9 | 8 | 4 | 32 |
| *Peltandra virginica* | 52 | 1 | 3 | ++ | 91 | 38 | 35 | 12 | 140 |
| *Acer rubrum* | 1090 | 6 | 6 | 0 | 82 | 2 | 1 | 1 | 1 |
| *Cinna arundinacea* | 229 | 3 | 5 | ++ | 82 | 8 | 6 | 4 | 26 |
| *Toxicodendron radicans* | 748 | 3 | 4 | + | 82 | 2 | 2 | 1 | 4 |
| *Impatiens capensis* | 203 | 2 | 3 | + | 82 | 9 | 7 | 2 | 15 |
| *Smilax rotundifolia* | 798 | 3 | 4 | + | 73 | 2 | 1 | 1 | 3 |
| *Parthenocissus quinquefolia* | 900 | 2 | 2 | 0 | 68 | 2 | 1 | 0 | 1 |
| *Ilex verticillata* | 194 | 2 | 5 | +++ | 59 | 7 | 4 | 2 | 32 |
| *Viburnum dentatum* | 236 | 2 | 3 | + | 59 | 6 | 3 | 1 | 7 |
| *Lindera benzoin* | 456 | 4 | 4 | 0 | 55 | 3 | 1 | 1 | 1 |
| *Glyceria striata* | 152 | 2 | 3 | + | 55 | 8 | 4 | 1 | 9 |
| *Symphyotrichum lateriflorum* | 309 | 2 | 2 | 0 | 55 | 4 | 2 | 0 | 2 |
| *Carex crinita* | 85 | 1 | 3 | ++ | 50 | 13 | 6 | 2 | 26 |
| *Polygonum arifolium* | 55 | 2 | 3 | + | 50 | 20 | 10 | 3 | 20 |
| *Ulmus americana* | 238 | 3 | 4 | + | 45 | 4 | 2 | 1 | 4 |
| *Triadenum walteri* | 20 | 1 | 2 | + | 45 | 50 | 23 | 5 | 45 |
| *Lobelia cardinalis* | 55 | 1 | 2 | + | 45 | 18 | 8 | 2 | 17 |
| *Lycopus virginicus* | 179 | 1 | 2 | + | 45 | 6 | 3 | 1 | 5 |
| *Campsis radicans* | 209 | 2 | 2 | 0 | 45 | 5 | 2 | 0 | 2 |
| *Liquidambar styraciflua* | 473 | 4 | 5 | + | 41 | 2 | 1 | 0 | 2 |
| *Leucothoe racemosa* | 88 | 2 | 4 | ++ | 41 | 10 | 4 | 2 | 17 |
| *Pilea pumila* | 106 | 2 | 3 | + | 41 | 8 | 3 | 1 | 7 |
| *Carex lurida* | 60 | 1 | 2 | + | 41 | 15 | 6 | 1 | 12 |
| *Carex tribuloides* | 90 | 2 | 2 | 0 | 41 | 10 | 4 | 1 | 4 |
| *Polygonum punctatum* | 55 | 2 | 4 | ++ | 36 | 15 | 5 | 2 | 21 |
| *Betula nigra* | 60 | 2 | 4 | ++ | 36 | 13 | 5 | 2 | 19 |
| *Lonicera japonica* | 517 | 2 | 2 | 0 | 36 | 2 | 1 | 0 | 1 |
| *Ilex opaca* var. *opaca* | 576 | 4 | 2 | - - | 36 | 1 | 1 | 0 | 0 |
| *Asimina triloba* | 519 | 5 | 2 | - - - | 36 | 2 | 1 | 0 | 0 |
| *Quercus lyrata* | 33 | 2 | 5 | +++ | 32 | 21 | 7 | 4 | 54 |
| *Carpinus caroliniana* | 498 | 4 | 4 | 0 | 32 | 1 | 0 | 0 | 0 |
| *Nyssa sylvatica* | 810 | 5 | 4 | - | 32 | 1 | 0 | 0 | 0 |
| *Quercus michauxii* | 91 | 2 | 3 | + | 32 | 8 | 2 | 1 | 5 |
| *Cornus amomum* ssp. *amomum* | 26 | 1 | 2 | + | 32 | 27 | 9 | 2 | 17 |
| *Galium obtusum* | 69 | 1 | 2 | + | 32 | 10 | 3 | 1 | 6 |

Table H11. Compositional summary statistics from the regional analysis of Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type) (CEGL006110).

| | |
|---|---|
| Mean Species Richness | 28 |
| Homoteneity | 0.526 |
| Number of Plots | 14 |

| Species | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Quercus phellos* | 238 | 4 | 7 | +++ | 100 | 6 | 6 | 5 | 50 |
| *Liquidambar styraciflua* | 472 | 4 | 6 | ++ | 100 | 3 | 3 | 2 | 13 |
| *Nyssa sylvatica* | 810 | 5 | 6 | + | 100 | 2 | 2 | 1 | 4 |
| *Acer rubrum* | 1090 | 6 | 6 | 0 | 100 | 1 | 1 | 1 | 1 |
| *Smilax rotundifolia* | 797 | 3 | 5 | ++ | 100 | 2 | 2 | 1 | 8 |
| *Toxicodendron radicans* | 747 | 3 | 2 | - | 67 | 1 | 1 | 0 | 0 |
| *Chasmanthium laxum* | 76 | 2 | 5 | +++ | 60 | 12 | 7 | 4 | 57 |
| *Ilex opaca* var. *opaca* | 575 | 4 | 3 | - | 60 | 2 | 1 | 0 | 0 |
| *Mitchella repens* | 395 | 2 | 2 | 0 | 60 | 2 | 1 | 0 | 1 |
| *Juncus effusus* | 121 | 1 | 2 | + | 53 | 7 | 4 | 1 | 7 |
| *Leucothoe racemosa* | 88 | 2 | 4 | ++ | 47 | 8 | 4 | 2 | 15 |
| *Vaccinium corymbosum* | 136 | 2 | 3 | + | 47 | 5 | 2 | 1 | 5 |
| *Liriodendron tulipifera* | 753 | 5 | 3 | - - | 47 | 1 | 0 | 0 | 0 |
| *Parthenocissus quinquefolia* | 899 | 2 | 2 | 0 | 47 | 1 | 0 | 0 | 0 |
| *Quercus palustris* | 126 | 4 | 4 | 0 | 40 | 5 | 2 | 1 | 2 |
| *Carex albolutescens* | 31 | 1 | 2 | + | 40 | 19 | 8 | 2 | 15 |
| *Euonymus americanus* | 433 | 2 | 2 | 0 | 40 | 1 | 1 | 0 | 1 |
| *Quercus alba* | 720 | 6 | 2 | - - - - | 40 | 1 | 0 | 0 | 0 |
| *Carex debilis* | 130 | 2 | 4 | ++ | 33 | 4 | 1 | 1 | 5 |
| *Betula nigra* | 60 | 2 | 3 | + | 33 | 8 | 3 | 1 | 6 |
| *Pinus taeda* | 112 | 2 | 3 | + | 33 | 4 | 1 | 0 | 3 |
| *Cinna arundinacea* | 229 | 3 | 3 | 0 | 33 | 2 | 1 | 0 | 1 |
| *Osmunda regalis* var. *spectabilis* | 78 | 2 | 2 | 0 | 33 | 6 | 2 | 0 | 2 |
| *Magnolia virginiana* | 87 | 2 | 2 | 0 | 33 | 6 | 2 | 0 | 2 |
| *Carex intumescens* var. *intumescens* | 111 | 2 | 2 | 0 | 33 | 5 | 2 | 0 | 2 |
| *Dichanthelium dichotomum* | 270 | 2 | 2 | 0 | 33 | 2 | 1 | 0 | 1 |
| *Fraxinus pennsylvanica* | 238 | 4 | 2 | - - | 33 | 2 | 1 | 0 | 0 |
| *Carex joorii* | 5 | 1 | 4 | +++ | 27 | 80 | 21 | 9 | 171 |

Table H12. Compositional summary statistics from the regional analysis of Coastal Plain Depression Wetland (Swamp Tupelo Type) (CEGL006223).

| | |
|---|---|
| Mean Species Richness | 12 |
| Homoteneity | 0.588 |
| Number of Plots | 18 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Nyssa biflora* | 114 | 3 | 7 | ++++ | 100 | 16 | 16 | 12 | 253 |
| *Liquidambar styraciflua* | 514 | 4 | 6 | ++ | 94 | 3 | 3 | 2 | 12 |
| *Leucothoe racemosa* | 141 | 2 | 3 | + | 78 | 10 | 8 | 3 | 15 |
| *Smilax rotundifolia* | 697 | 3 | 2 | - | 78 | 2 | 2 | 0 | 1 |
| *Acer rubrum* | 861 | 6 | 6 | 0 | 67 | 1 | 1 | 1 | 1 |
| *Carex joorii* | 100 | 2 | 5 | +++ | 50 | 9 | 5 | 3 | 36 |
| *Vaccinium corymbosum* | 193 | 3 | 5 | ++ | 50 | 5 | 2 | 1 | 9 |
| *Diospyros virginiana* | 314 | 2 | 4 | ++ | 44 | 3 | 1 | 1 | 5 |
| *Clethra alnifolia* | 93 | 2 | 2 | 0 | 44 | 9 | 4 | 1 | 4 |
| *Pinus taeda* | 154 | 3 | 4 | + | 33 | 4 | 1 | 1 | 3 |
| *Ilex opaca* var. *opaca* | 441 | 4 | 2 | - - | 33 | 1 | 0 | 0 | 0 |
| *Asimina triloba* | 506 | 5 | 2 | - - - | 33 | 1 | 0 | 0 | 0 |

Table H13. Compositional summary statistics from the regional analysis of Non-Riverine Saturated Forest (CEGL004644).

| | |
|---|---|
| Mean Species Richness | 35 |
| Homoteneity | 0.574 |
| Number of Plots | 21 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Liquidambar styraciflua* | 472 | 4 | 6 | ++ | 100 | 4 | 4 | 3 | 18 |
| *Acer rubrum* | 1090 | 6 | 6 | 0 | 100 | 2 | 2 | 1 | 2 |
| *Nyssa sylvatica* | 810 | 5 | 5 | 0 | 90 | 2 | 2 | 1 | 2 |
| *Smilax rotundifolia* | 797 | 3 | 4 | + | 90 | 2 | 2 | 1 | 4 |
| *Quercus phellos* | 238 | 4 | 6 | ++ | 86 | 8 | 6 | 4 | 26 |
| *Ilex opaca* var. *opaca* | 575 | 4 | 6 | ++ | 81 | 3 | 2 | 2 | 10 |
| *Mitchella repens* | 395 | 2 | 2 | 0 | 76 | 4 | 3 | 1 | 3 |
| *Toxicodendron radicans* | 747 | 3 | 2 | - | 76 | 2 | 2 | 0 | 1 |
| *Woodwardia areolata* | 73 | 2 | 5 | +++ | 71 | 21 | 15 | 8 | 117 |
| *Quercus michauxii* | 91 | 2 | 6 | ++++ | 67 | 15 | 10 | 7 | 164 |
| *Pinus taeda* | 112 | 2 | 4 | ++ | 67 | 13 | 8 | 4 | 33 |
| *Clethra alnifolia* | 52 | 2 | 6 | ++++ | 62 | 25 | 15 | 10 | 248 |
| *Quercus pagoda* | 39 | 2 | 6 | ++++ | 57 | 31 | 18 | 12 | 281 |
| *Carex debilis* | 130 | 2 | 4 | ++ | 57 | 9 | 5 | 2 | 21 |
| *Magnolia virginiana* | 87 | 2 | 3 | + | 57 | 14 | 8 | 3 | 16 |
| *Vitis rotundifolia* | 169 | 2 | 2 | 0 | 57 | 7 | 4 | 1 | 4 |
| *Viburnum nudum* | 73 | 2 | 4 | ++ | 52 | 15 | 8 | 4 | 32 |
| *Parthenocissus quinquefolia* | 899 | 2 | 2 | 0 | 52 | 1 | 1 | 0 | 1 |
| *Chasmanthium laxum* | 76 | 2 | 4 | ++ | 48 | 13 | 6 | 3 | 25 |
| *Leucothoe racemosa* | 88 | 2 | 3 | + | 48 | 11 | 5 | 2 | 11 |
| *Euonymus americanus* | 433 | 2 | 2 | 0 | 48 | 2 | 1 | 0 | 1 |
| *Quercus alba* | 720 | 6 | 5 | - | 43 | 1 | 1 | 0 | 0 |
| *Osmunda regalis* var. *spectabilis* | 78 | 2 | 4 | ++ | 43 | 12 | 5 | 2 | 20 |
| *Osmunda cinnamomea* | 129 | 2 | 4 | ++ | 43 | 7 | 3 | 1 | 12 |
| *Vaccinium corymbosum* | 136 | 2 | 4 | ++ | 43 | 7 | 3 | 1 | 11 |
| *Carex intumescens* var. *intumescens* | 111 | 2 | 3 | + | 43 | 8 | 3 | 1 | 7 |
| *Ilex verticillata* | 194 | 2 | 2 | 0 | 43 | 5 | 2 | 0 | 2 |
| *Liriodendron tulipifera* | 753 | 5 | 2 | - - - | 43 | 1 | 1 | 0 | 0 |
| *Carex seorsa* | 38 | 2 | 5 | +++ | 38 | 21 | 8 | 4 | 64 |
| *Carpinus caroliniana* | 497 | 4 | 5 | + | 38 | 2 | 1 | 0 | 1 |
| *Fraxinus pennsylvanica* | 238 | 4 | 4 | 0 | 38 | 3 | 1 | 1 | 1 |
| *Vaccinium fuscatum* | 134 | 2 | 3 | + | 38 | 6 | 2 | 1 | 5 |
| *Campsis radicans* | 208 | 2 | 2 | 0 | 38 | 4 | 1 | 0 | 1 |
| *Viburnum dentatum* | 236 | 2 | 2 | 0 | 38 | 3 | 1 | 0 | 1 |
| *Fagus grandifolia* | 630 | 6 | 2 | - - - - | 38 | 1 | 0 | 0 | 0 |

Table H14. Compositional summary statistics from the regional analysis of Tidal Freshwater Marsh (CEGL004706).

| | |
|---|---|
| Mean Species Richness | 5 |
| Homoteneity | 0.589 |
| Number of Plots | 18 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Peltandra virginica* | 444 | 5 | 7 | ++ | 94 | 4 | 4 | 3 | 14 |
| *Zizania aquatica* var. *aquatica* | 229 | 4 | 5 | + | 78 | 6 | 5 | 3 | 10 |
| *Pontederia cordata* | 253 | 4 | 6 | ++ | 56 | 4 | 2 | 1 | 9 |
| *Polygonum punctatum* | 401 | 4 | 2 | - - | 39 | 2 | 1 | 0 | 0 |
| *Amaranthus cannabinus* | 193 | 2 | 2 | 0 | 28 | 3 | 1 | 0 | 1 |

Table H15. Compositional summary statistics from the regional analysis of Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) (CEGL006586).

| | |
|---|---|
| Mean Species Richness | 4 |
| Homoteneity | 0.688 |
| Number of Plots | 13 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Spartina alterniflora* | 108 | 4 | 7 | +++ | 100 | 11 | 11 | 9 | 89 |
| *Distichlis spicata* | 102 | 4 | 6 | ++ | 92 | 11 | 10 | 7 | 40 |
| *Spartina patens* | 142 | 5 | 5 | 0 | 50 | 4 | 2 | 1 | 2 |
| *Limonium carolinianum* | 28 | 1 | 2 | + | 33 | 14 | 5 | 1 | 10 |

Table H16. Compositional summary statistics from the regional analysis of Tidal Mesohaline and Polyhaline Marsh (Transitional Marsh) (CEGL006418).

| | |
|---|---|
| Mean Species Richness | 5 |
| Homoteneity | 0.600 |
| Number of Plots | 18 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Spartina alterniflora* | 108 | 4 | 8 | ++++ | 100 | 17 | 17 | 15 | 267 |
| *Spartina cynosuroides* | 156 | 4 | 4 | 0 | 83 | 10 | 8 | 4 | 8 |
| *Polygonum punctatum* | 401 | 4 | 4 | 0 | 44 | 2 | 1 | 0 | 1 |
| *Schoenoplectus robustus* | 60 | 3 | 3 | 0 | 39 | 12 | 5 | 2 | 5 |
| *Peltandra virginica* | 444 | 5 | 4 | - | 33 | 1 | 0 | 0 | 0 |
| *Amaranthus cannabinus* | 193 | 2 | 2 | 0 | 28 | 3 | 1 | 0 | 1 |

Table H17. Compositional summary statistics from the regional analysis of Tidal Oligohaline Marsh (Common Reed Tidal Marsh) (CEGL004187).

| | |
|---|---|
| Mean Species Richness | 6 |
| Homoteneity | 0.405 |
| Number of Plots | 7 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Phragmites australis* | 84 | 3 | 9 | ++++++ | 100 | 8 | 8 | 8 | 533 |
| *Hibiscus moscheutos* ssp. *moscheutos* | 298 | 3 | 2 | - | 43 | 1 | 0 | 0 | 0 |
| *Phyla lanceolata* | 36 | 2 | 2 | 0 | 29 | 6 | 2 | 0 | 2 |
| *Amaranthus cannabinus* | 193 | 2 | 2 | 0 | 29 | 1 | 0 | 0 | 0 |
| *Peltandra virginica* | 444 | 5 | 2 | - - - | 29 | 0 | 0 | 0 | 0 |
| *Ammannia latifolia* | 7 | 1 | 1 | 0 | 14 | 14 | 2 | 0 | 2 |

Table H18. Compositional summary statistics from the regional analysis of Tidal Oligohaline Marsh (Interior Depression Marsh) (CEGL006578).

| | |
|---|---|
| Mean Species Richness | 11 |
| Homoteneity | 0.559 |
| Number of Plots | 13 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Peltandra virginica* | 444 | 5 | 6 | + | 100 | 3 | 3 | 2 | 6 |
| *Polygonum punctatum* | 401 | 4 | 4 | 0 | 77 | 2 | 2 | 1 | 2 |
| *Zizania aquatica* var. *aquatica* | 229 | 4 | 5 | + | 69 | 4 | 3 | 2 | 5 |
| *Schoenoplectus pungens* var. *pungens* | 54 | 2 | 6 | ++++ | 62 | 15 | 9 | 6 | 146 |
| *Echinochloa walteri* | 84 | 2 | 4 | ++ | 62 | 10 | 6 | 3 | 23 |
| *Schoenoplectus tabernaemontani* | 80 | 2 | 4 | ++ | 46 | 8 | 3 | 2 | 14 |
| *Hibiscus moscheutos* ssp. *moscheutos* | 298 | 3 | 4 | + | 46 | 2 | 1 | 0 | 2 |
| *Leersia oryzoides* | 287 | 4 | 2 | - - | 46 | 2 | 1 | 0 | 0 |
| *Pluchea odorata* | 70 | 2 | 2 | 0 | 38 | 7 | 3 | 1 | 3 |
| *Amaranthus cannabinus* | 193 | 2 | 1 | - | 38 | 3 | 1 | 0 | 0 |
| *Rumex verticillatus* | 71 | 2 | 1 | - | 31 | 6 | 2 | 0 | 1 |

Table H19. Compositional summary statistics from the regional analysis of Tidal Oligohaline Marsh (Big Cordgrass Type) (CEGL004195).

| | |
|---|---|
| Mean Species Richness | 5 |
| Homoteneity | 0.578 |
| Number of Plots | 18 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Spartina cynosuroides* | 156 | 4 | 9 | +++++ | 100 | 12 | 12 | 12 | 369 |
| *Peltandra virginica* | 444 | 5 | 3 | - - | 67 | 3 | 2 | 1 | 0 |
| *Polygonum punctatum* | 401 | 4 | 3 | - | 50 | 2 | 1 | 0 | 1 |
| *Hibiscus moscheutos* ssp. *moscheutos* | 298 | 3 | 3 | 0 | 39 | 2 | 1 | 0 | 1 |
| *Polygonum arifolium* | 329 | 4 | 2 | - - | 33 | 2 | 1 | 0 | 0 |

Table H20. Compositional summary statistics from the regional analysis of Tidal Oligohaline Marsh (Mixed Forbs Type) (CEGL006181).

| | |
|---|---|
| Mean Species Richness | 15 |
| Homoteneity | 0.546 |
| Number of Plots | 32 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Polygonum punctatum* | 401 | 4 | 6 | ++ | 89 | 8 | 7 | 5 | 28 |
| *Peltandra virginica* | 444 | 5 | 6 | + | 83 | 7 | 6 | 4 | 11 |
| *Hibiscus moscheutos* ssp. *moscheutos* | 298 | 3 | 5 | ++ | 83 | 10 | 8 | 5 | 34 |
| *Polygonum arifolium* | 329 | 4 | 4 | 0 | 72 | 8 | 6 | 3 | 6 |
| *Leersia oryzoides* | 287 | 4 | 5 | + | 64 | 8 | 5 | 3 | 10 |
| *Typha angustifolia* | 181 | 4 | 6 | ++ | 61 | 12 | 7 | 5 | 30 |
| *Spartina cynosuroides* | 156 | 4 | 6 | ++ | 58 | 13 | 8 | 5 | 31 |
| *Pontederia cordata* | 253 | 4 | 4 | 0 | 53 | 8 | 4 | 2 | 4 |
| *Amaranthus cannabinus* | 193 | 2 | 2 | 0 | 53 | 10 | 5 | 1 | 5 |
| *Mikania scandens* | 215 | 2 | 3 | + | 44 | 7 | 3 | 1 | 7 |
| *Kosteletzkya virginica* | 88 | 2 | 3 | + | 42 | 17 | 7 | 2 | 14 |
| *Schoenoplectus robustus* | 60 | 3 | 5 | ++ | 31 | 18 | 6 | 3 | 22 |
| *Echinochloa walteri* | 84 | 2 | 3 | + | 31 | 13 | 4 | 1 | 8 |
| *Thelypteris palustris* var. *pubescens* | 160 | 2 | 3 | + | 28 | 6 | 2 | 1 | 3 |
| *Asclepias incarnata* | 82 | 1 | 2 | + | 28 | 12 | 3 | 1 | 7 |

Table H21. Compositional summary statistics from the regional analysis of Tidal Oligohaline Marsh (Saltmeadow Cordgrass – Olney Three-Square Low Interior Marsh Type) (CEGL006612).

| | |
|---|---|
| Mean Species Richness | 13 |
| Homoteneity | 0.621 |
| Number of Plots | 14 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Schoenoplectus americanus* | 108 | 4 | 7 | +++ | 100 | 13 | 13 | 10 | 104 |
| *Hibiscus moscheutos* ssp. *moscheutos* | 298 | 3 | 5 | ++ | 100 | 5 | 5 | 3 | 19 |
| *Spartina patens* | 142 | 5 | 7 | ++ | 86 | 8 | 7 | 6 | 29 |
| *Polygonum punctatum* | 401 | 4 | 6 | ++ | 79 | 3 | 2 | 1 | 9 |
| *Typha angustifolia* | 181 | 4 | 6 | ++ | 64 | 5 | 3 | 2 | 13 |
| *Kosteletzkya virginica* | 88 | 2 | 4 | ++ | 64 | 10 | 7 | 3 | 26 |
| *Amaranthus cannabinus* | 193 | 2 | 2 | 0 | 64 | 5 | 3 | 1 | 3 |
| *Eleocharis fallax* | 111 | 4 | 5 | + | 50 | 6 | 3 | 2 | 6 |
| *Schoenoplectus tabernaemontani* | 80 | 2 | 3 | + | 43 | 8 | 3 | 1 | 6 |
| *Juncus roemerianus* | 58 | 4 | 3 | - | 43 | 10 | 4 | 1 | 2 |
| *Spartina alterniflora* | 108 | 4 | 3 | - | 43 | 6 | 2 | 1 | 1 |
| *Sagittaria lancifolia* ssp. *media* | 82 | 2 | 5 | +++ | 36 | 6 | 2 | 1 | 17 |
| *Lythrum lineare* | 40 | 1 | 2 | + | 36 | 13 | 4 | 1 | 9 |

Table H22. Compositional summary statistics from the regional analysis of Salt Scrub (CEGL003921).

| | |
|---|---|
| Mean Species Richness | 12 |
| Homoteneity | 0.679 |
| Number of Plots | 13 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Iva frutescens* | 94 | 4 | 7 | +++ | 100 | 14 | 14 | 11 | 111 |
| *Toxicodendron radicans* | 253 | 3 | 5 | ++ | 100 | 5 | 5 | 3 | 21 |
| *Spartina patens* | 142 | 5 | 7 | ++ | 85 | 8 | 7 | 5 | 26 |
| *Baccharis halimifolia* | 71 | 3 | 6 | +++ | 85 | 15 | 13 | 9 | 105 |
| *Distichlis spicata* | 102 | 4 | 6 | ++ | 77 | 10 | 8 | 5 | 30 |
| *Myrica cerifera* var. *cerifera* | 158 | 4 | 5 | + | 77 | 6 | 5 | 3 | 10 |
| *Panicum virgatum* var. *virgatum* | 78 | 2 | 3 | + | 62 | 10 | 6 | 2 | 13 |
| *Solidago sempervirens* | 61 | 2 | 2 | 0 | 62 | 13 | 8 | 2 | 8 |
| *Juniperus virginiana* var. *virginiana* | 36 | 2 | 4 | ++ | 46 | 17 | 8 | 3 | 31 |
| *Hibiscus moscheutos* ssp. *moscheutos* | 298 | 3 | 4 | + | 46 | 2 | 1 | 0 | 2 |
| *Pinus taeda* | 64 | 2 | 4 | ++ | 38 | 8 | 3 | 1 | 12 |
| *Schoenoplectus americanus* | 108 | 4 | 2 | - - | 38 | 5 | 2 | 0 | 0 |

Table H23. Compositional summary statistics from the regional analysis of Tidal Shrub Swamp (Wax Myrtle Type) (CEGL004656).

| | |
|---|---|
| Mean Species Richness | 27 |
| Homoteneity | 0.518 |
| Number of Plots | 49 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Rosa palustris* | 183 | 3 | 6 | +++ | 86 | 23 | 20 | 13 | 157 |
| *Morella cerifera* | 158 | 4 | 6 | ++ | 86 | 27 | 23 | 15 | 91 |
| *Acer rubrum* | 206 | 4 | 5 | + | 86 | 20 | 17 | 10 | 35 |
| *Osmunda regalis* var. *spectabilis* | 172 | 4 | 6 | ++ | 82 | 23 | 19 | 13 | 76 |
| *Toxicodendron radicans* | 253 | 3 | 5 | ++ | 82 | 16 | 13 | 7 | 52 |
| *Hibiscus moscheutos* ssp. *moscheutos* | 298 | 3 | 4 | + | 76 | 12 | 9 | 4 | 19 |
| *Thelypteris palustris* var. *pubescens* | 160 | 2 | 3 | + | 76 | 23 | 17 | 6 | 35 |
| *Polygonum arifolium* | 329 | 4 | 4 | 0 | 63 | 9 | 6 | 3 | 6 |
| *Mikania scandens* | 215 | 2 | 3 | + | 63 | 14 | 9 | 3 | 18 |
| *Leersia oryzoides* | 287 | 4 | 4 | 0 | 59 | 10 | 6 | 3 | 6 |
| *Polygonum punctatum* | 401 | 4 | 4 | 0 | 57 | 7 | 4 | 2 | 4 |
| *Peltandra virginica* | 444 | 5 | 4 | - | 57 | 6 | 4 | 2 | 2 |
| *Smilax rotundifolia* | 143 | 2 | 4 | ++ | 53 | 18 | 10 | 4 | 39 |
| *Apios americana* | 163 | 2 | 2 | 0 | 43 | 13 | 6 | 1 | 6 |
| *Boehmeria cylindrica* | 172 | 2 | 2 | 0 | 43 | 12 | 5 | 1 | 5 |
| *Galium obtusum* | 137 | 2 | 2 | 0 | 39 | 14 | 5 | 1 | 5 |
| *Cuscuta gronovii* var. *gronovii* | 132 | 2 | 2 | 0 | 37 | 14 | 5 | 1 | 5 |
| *Baccharis halimifolia* | 71 | 3 | 5 | ++ | 35 | 24 | 8 | 5 | 33 |
| *Carex stricta* | 105 | 2 | 4 | ++ | 33 | 15 | 5 | 2 | 20 |
| *Typha angustifolia* | 181 | 4 | 4 | 0 | 33 | 9 | 3 | 1 | 3 |
| *Decodon verticillatus* | 99 | 2 | 3 | + | 33 | 16 | 5 | 2 | 11 |
| *Symphyotrichum novi-belgii* | 80 | 1 | 2 | + | 33 | 20 | 7 | 1 | 13 |
| *Thalictrum pubescens* | 99 | 1 | 2 | + | 31 | 15 | 5 | 1 | 9 |
| *Cinna arundinacea* | 149 | 2 | 2 | 0 | 31 | 10 | 3 | 1 | 3 |
| *Viburnum recognitum* | 106 | 3 | 3 | 0 | 29 | 13 | 4 | 1 | 4 |
| *Ptilimnium capillaceum* | 71 | 1 | 2 | + | 29 | 20 | 6 | 1 | 11 |
| *Sium suave* | 103 | 1 | 2 | + | 29 | 14 | 4 | 1 | 8 |

Table H24. Compositional summary statistics from the regional analysis of Tidal Bald Cypress Forest / Woodland (CEGL004654).

| | |
|---|---|
| Mean Species Richness | 33 |
| Homoteneity | 0.570 |
| Number of Plots | 5 |

| SPECIES | TOTAL FREQ | TOTAL MEAN COVER | Mean Cover | Relative Cover | Constancy | Fidelity | Diagnostic Value | Adj DV (scaled) | Adj DV (unscaled) |
|---|---|---|---|---|---|---|---|---|---|
| *Carex hyalinolepis* | 36 | 3 | 7 | ++++ | 100 | 14 | 14 | 11 | 222 |
| *Taxodium distichum* | 52 | 3 | 7 | ++++ | 100 | 10 | 10 | 7 | 154 |
| *Toxicodendron radicans* | 253 | 3 | 2 | - | 100 | 2 | 2 | 0 | 1 |
| *Peltandra virginica* | 444 | 5 | 2 | - - - | 100 | 1 | 1 | 0 | 0 |
| *Myrica cerifera* var. *cerifera* | 158 | 4 | 5 | + | 80 | 3 | 2 | 1 | 4 |
| *Acer rubrum* | 206 | 4 | 3 | - | 80 | 2 | 2 | 1 | 1 |
| *Polygonum punctatum* | 401 | 4 | 2 | - - | 80 | 1 | 1 | 0 | 0 |
| *Nyssa biflora* | 106 | 3 | 4 | + | 60 | 3 | 2 | 1 | 3 |
| *Liquidambar styraciflua* | 47 | 2 | 3 | + | 60 | 6 | 4 | 1 | 8 |
| *Fraxinus pennsylvanica* | 64 | 2 | 3 | + | 60 | 5 | 3 | 1 | 6 |
| *Thelypteris palustris* var. *pubescens* | 160 | 2 | 3 | + | 60 | 2 | 1 | 0 | 2 |
| *Leersia oryzoides* | 287 | 4 | 3 | - | 60 | 1 | 1 | 0 | 0 |
| *Elymus virginicus* | 24 | 1 | 2 | + | 60 | 13 | 8 | 2 | 15 |
| *Saururus cernuus* | 79 | 2 | 2 | 0 | 60 | 4 | 2 | 1 | 2 |
| *Smilax rotundifolia* | 143 | 2 | 2 | 0 | 60 | 2 | 1 | 0 | 1 |
| *Cinna arundinacea* | 149 | 2 | 2 | 0 | 60 | 2 | 1 | 0 | 1 |
| *Polygonum arifolium* | 329 | 4 | 2 | - - | 60 | 1 | 1 | 0 | 0 |
| *Fraxinus profunda* | 77 | 4 | 4 | 0 | 40 | 3 | 1 | 0 | 1 |
| *Boehmeria cylindrica* | 172 | 2 | 3 | + | 40 | 1 | 0 | 0 | 1 |
| *Teucrium canadense* | 17 | 1 | 2 | + | 40 | 12 | 5 | 1 | 9 |
| *Campsis radicans* | 21 | 1 | 2 | + | 40 | 10 | 4 | 1 | 8 |
| *Vernonia noveboracensis* | 24 | 1 | 2 | + | 40 | 8 | 3 | 1 | 7 |
| *Pilea pumila* | 28 | 1 | 2 | + | 40 | 7 | 3 | 1 | 6 |
| *Osmunda cinnamomea* var. *cinnamomea* | 31 | 1 | 2 | + | 40 | 6 | 3 | 1 | 5 |
| *Triadenum walteri* | 42 | 1 | 2 | + | 40 | 5 | 2 | 0 | 4 |
| *Carex bromoides* ssp. *bromoides* | 24 | 2 | 2 | 0 | 40 | 8 | 3 | 1 | 3 |
| *Hydrocotyle verticillata* | 44 | 2 | 2 | 0 | 40 | 5 | 2 | 0 | 2 |
| *Thalictrum pubescens* | 99 | 1 | 2 | + | 40 | 2 | 1 | 0 | 2 |
| *Viburnum nudum* | 52 | 2 | 2 | 0 | 40 | 4 | 2 | 0 | 2 |
| *Clethra alnifolia* | 62 | 2 | 2 | 0 | 40 | 3 | 1 | 0 | 1 |
| *Rumex verticillatus* | 71 | 2 | 2 | 0 | 40 | 3 | 1 | 0 | 1 |
| *Panicum virgatum* var. *virgatum* | 78 | 2 | 2 | 0 | 40 | 3 | 1 | 0 | 1 |
| *Lonicera japonica* | 98 | 2 | 2 | 0 | 40 | 2 | 1 | 0 | 1 |
| *Parthenocissus quinquefolia* | 111 | 2 | 2 | 0 | 40 | 2 | 1 | 0 | 1 |

Appendix I. Local and global descriptions of vegetation associations and other vegetation-map classes for Colonial National Historical Park.

This appendix contains detailed local descriptions for vegetation associations and other vegetation-map classes present at Colonial National Historical Park based on information collected within the park boundary. Of the 40 map classes used to map Colonial National Historical Park, twenty-six were crosswalked to the finest level of the USNVC (association), seven were described as nonstandard, park-specific classes, and seven were crosswalked to Anderson (Anderson et al. 1976) level II classification. Two map classes are crosswalked to more than one association and all associations are described in this appendix.

All map classes crosswalked to the association level of the USNVC also include range-wide descriptions (i.e. global descriptions). Information in the global descriptions of the associations was extracted from the September 27, 2007 version of the NatureServe central databases (NatureServe 2007). A copywrite notice precedes the report.

Fields used in the local and global descriptions are defined in Appendix J. 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. 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. 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. Sources cited in the local and global vegetation descriptions are included in the literature section at the end of this appendix. Representative photographs of the vegetation types are provided after the descriptions. Photographs were taken by VADNH staff unless otherwise indicated.

Each association is crosswalked to the Ecological Group level of the state classification for Virginia (Fleming et. al 2006), which is the level that is currently tracked in the NatureServe databases from which this appendix was created. Ecological Groups contain multiple associations, some rare and some common, so a state rank is not appropriate for this level of classification. The state name (Sname) field within "Subnational Distribution with Crosswalk Data" crosswalks the USNVC association to the Ecological Group level of the Virginia Classification of Ecological Communities and the subnational ranking information is qualified with a * , indicating that the ranking information is not at the association level. State ranks for USNVC associations are managed within the Virginia Division of Natural Heritage and the state/subnational conservation rank (SRank) and global conservation rank (GRank) for all associations are provided in Appendix D. Definitions of the conservation ranks are in Appendix E. Values for the relationship (Rel) and crosswalk confidence (Conf) are defined in Appendix J.

The dichotomous key to the Colonial National Historical Park vegetation classes is presented in Appendix K. The key should be used in conjunction with the detailed descriptions.

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**Citations:**

*The following citation should be used in any published materials which reference ecological system and/or International Vegetation Classification (IVC hierarchy) and association data:*

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## COMMON NAME (PARK-SPECIFIC): LOBLOLLY PINE PLANTATION

**SYNONYMS**
**USNVC English Name:** **Loblolly Pine Planted Forest**
**USNVC Scientific Name:** ***Pinus taeda* Planted Forest**
**USNVC Identifier:** **CEGL007179**

### LOCAL INFORMATION

**Environmental Description:** Loblolly Pine Plantation occurs on areas where *Pinus taeda* (loblolly pine) has been planted or areas that have been cleared and naturally regenerated as dense, scrubby *Pinus taeda* (loblolly pine). In Colonial National Historical Park, these forests occur on upland flats over various soil types.
**Vegetation Description:** Loblolly Pine Plantations are evergreen forests that result from planting *Pinus taeda* (loblolly pine). They can occur as perfect rows of planted *Pinus taeda* (loblolly pine) or as dense, young stands. These stands support almost no other tree species in the overstory and typically very little understory and no herbaceous species. Typical associates include *Liquidambar styraciflua* (sweetgum), *Lonicera japonica* (Japanese honeysuckle), *Microstegium vimineum* (Nepalese browntop), and *Toxicodendron radicans* (eastern poison ivy). The ground usually has a dense cover of pine needles.
**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Needle-leaved tree | *Pinus taeda* (loblolly pine) |

**Characteristic Species:** *Lonicera japonica* (Japanese honeysuckle), *Microstegium vimineum* (Nepalese browntop), *Pinus taeda* (loblolly pine).
**Other Noteworthy Species:** Information not available.
**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNA | . | . | [not crosswalked] | . |

**Local Range:** Loblolly Pine Plantation is mapped as small areas throughout Colonial National Historical Park. It is mapped as 13 polygons, covering 51.4 hectares (127.1 acres).
**Classification Comments:** Loblolly Pine Plantations are distinguished from other vegetation in Colonial National Historical Park by being dominated by *Pinus taeda* (loblolly pine) with little or no other tree or shrub species.
**Other Comments:** Information not available.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Colonial National Historical Park Inventory Notes:** Information not available.

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

| | |
|---|---|
| Alliance | *Pinus taeda* Planted Forest Alliance (A.99) |
| Alliance (English name) | Loblolly Pine Planted Forest Alliance |
| Association | *Pinus taeda* Planted Forest |
| Association (English name) | Loblolly Pine Planted Forest |
| **Ecological System(s):** | Information not available. |

**GLOBAL DESCRIPTION**

**Concept Summary:** This association represents young, monospecific planted stands of *Pinus taeda* (loblolly pine). Due to the commercial value of this species, this type is widely distributed across much of the southeastern United States from the Interior Highlands to the Coastal Plain, including areas outside the natural range of the species. The core concept of stands attributable to this type are those which support dense, often perfect rows of planted *Pinus taeda* (loblolly pine) or otherwise dense, young stands which are established, managed, and/or maintained for the extraction of forest products (usually pulpwood). In most cases these stands support almost no other tree species in the overstory. Understory composition and density can vary widely depending upon location, management history, and stand age. Stands are typically established with mechanical planting, but may also be established through other means. This association rarely exceeds 20-40 years of age on most timberlands. Excluded from this association are plantation stands which have "broken up" with age or thinning to approximate a more natural structure. Dense planting in rows, if successful, tends to result in nearly complete canopy closure which persists until the stand has either been regenerated or transitions into a different association. Herbaceous ground cover of any kind tends to be sparse due to reduction during site preparation, the typically dense canopy cover, and to the fact that many young plantations are infrequently burned at best.

**Environmental Description:** Environmental setting varies widely by site. Stands often occur on level to gently sloping areas, on soils that range from dry to poorly drained.

**Vegetation Description:** There is considerable local variation among stands of this planted vegetation type across its broad range (from the Interior Highlands to the Coastal Plain, including areas outside the natural range of the species). In the Ouachita Mountains planted loblolly is found with a variable amount of *Quercus alba* (white oak), *Quercus falcata* (southern red oak), *Quercus marilandica* (blackjack oak), *Quercus stellata* (post oak), and *Quercus velutina* (black oak); on drier sites *Pinus echinata* (shortleaf pine), *Carya alba* (mockernut hickory), and *Carya texana* (black hickory); and *Acer rubrum* (red maple), *Liquidambar styraciflua* (sweetgum), and *Quercus nigra* (water oak) on wetter sites. The understory can be thick especially after thinning and/or burning. Common understory species are *Vaccinium pallidum* (Blue Ridge blueberry), *Vaccinium arboreum* (farkleberry), *Vaccinium stamineum* (deerberry), *Cornus florida* (flowering dogwood), *Ulmus alata* (winged elm), and others. Vines are an important component, including *Berchemia scandens* (Alabama supplejack), *Lonicera japonica* (Japanese honeysuckle), *Parthenocissus quinquefolia* (Virginia creeper), *Vitis* spp. (grapes), *Smilax* spp. (greenbriers), and *Toxicodendron radicans* (eastern poison ivy). In dense stands the herbaceous layer is suppressed by dense needle litter. In thinned and burned stands the plantations are often grazed. Herbaceous species can include *Solidago ulmifolia* (elmleaf goldenrod), *Chasmanthium sessiliflorum* (longleaf woodoats), *Schizachyrium scoparium* (little bluestem), *Danthonia spicata* (poverty oatgrass), *Tephrosia virginiana* (Virginia tephrosia), *Lespedeza* spp. (lespedezas), *Symphyotrichum patens* (late purple aster), *Eupatorium* spp. (thoroughworts), and others. In Oklahoma, associates include *Rhus copallinum* (flameleaf sumac), *Hypericum densiflorum* (bushy St. Johnswort), *Liquidambar styraciflua* (sweetgum) and

*Toxicodendron radicans* (eastern poison ivy) (Hoagland 2000). Additional data on several stands on the Croatan National Forest can be found in Doyle and Allard (1990).
**Most Abundant Species:** Information not available.
**Characteristic Species:** Information not available.
**Other Noteworthy Species:** Information not available.
**USFWS Wetland System:** Not applicable.

**DISTRIBUTION**
**Range:** This association is found throughout the southeastern United States.
**States/Provinces:** AL, AR, DE, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA
**Federal Lands:** DOD (Arnold, Fort Benning, Fort Bragg, Fort Gordon, Fort Stewart); DOE (Savannah River Site); NPS (Appomattox Court House, Chickamauga-Chattanooga?, Colonial, Fredericksburg-Spotsylvania, George Washington Birthplace, Natchez Trace, Obed, Petersburg, Richmond, Vicksburg); USFS (Angelina, Bankhead?, Bienville, Cherokee, Conecuh, Croatan, Davy Crockett, De Soto, Delta, Francis Marion, Holly Springs, Kisatchie, Land Between the Lakes, Oconee, Ouachita, Ouachita (Coastal Plain), Ouachita (Mountains), Ozark, Sabine, Sam Houston, St. Francis?, Sumter, Sumter (Mountains), Sumter (Piedmont), Talladega, Talladega (Oakmulgee), Talladega (Talladega), Tombigbee, Tuskegee); USFWS (Blackwater, Chesapeake Marshlands, Eufaula, Prime Hook).

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

**CLASSIFICATION INFORMATION**
**Status:** Standard.
**Confidence:** 2 - Moderate.
**Comments:** At Arnold Air Force Base, Coffee and Franklin counties, Tennessee, *Pinus taeda* (loblolly pine) is near the edge of its putative natural range and was apparently absent prior to being planted there between 1945 and 1950 on abandoned agricultural land and along roadsides. Older plantings have not been intensively managed, and many have become "modified" vegetation (e.g., CEGL007109) and are no longer regarded as plantations. More recently (1998-2001) some of these older pine stands have been harvested and replaced with true *Pinus taeda* (loblolly pine) plantations. *Pinus taeda* (loblolly pine) also invades seasonally wet hardwood depressions, but these stands remain recognizable as to their natural identity (e.g., CEGL007364). Associations occur as plantations and on old fields on Kisatchie and Sumter national forests and after blowdowns on the Kisatchie. South Carolina information after Jones et al. (1981). In the Coastal Plain of South Carolina, there are mature loblolly plantations, often with *Prunus serotina* var. *serotina* (black cherry) in the understory, that have been prescribed burned (based on seven plots at Savannah River Site) - such stands are presumably better covered under *Pinus taeda* (loblolly pine) Forest Alliance (A.130). Plantations occur in obvious rows in the aerial photos of the Delmarva Peninsula in Maryland.

**Similar Associations:**

- *Pinus taeda - Liriodendron tulipifera / Acer saccharum* Successional Forest (CEGL007105).
- *Pinus taeda - Quercus (falcata, hemisphaerica, nigra) - Liquidambar styraciflua / Rhus copallinum - Vaccinium stamineum* Forest (CEGL008450).
- *Pinus taeda / Liquidambar styraciflua - Acer rubrum* var. *rubrum / Vaccinium stamineum* Forest (CEGL006011)--develops when stands develop typical two-layered structure with well-developed subcanopy.
- *Pinus taeda / Rhus copallinum* Managed Forest (CEGL007108)--may replace this association as stands mature.
- *Pinus taeda / Saccharum alopecuroidum - (Andropogon* spp.) Forest (CEGL007109).

**Related Concepts:**

- Loblolly Pine: 81 (Eyre 1980) B

**SOURCES**

**Description Authors:** A. S. Weakley, mod. L. A. Sneddon.

**References:** ALNHP 2002, Doyle and Allard 1990, Eyre 1980, Hoagland 1998, Hoagland 2000, Jones et al. 1981, Schotz pers. comm., Southeastern Ecology Working Group n.d., TDNH unpubl. data, TNC 1998.



Figure I1. Loblolly Pine Plantation at Colonial National Historical Park. August 2003. NAD 1983 / UTM easting 343329, northing 4120950. Photo by NCSU-CEO.

## COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL TREE-OF-HEAVEN FOREST

**SYNONYMS**
**USNVC English Name:** **Tree-of-Heaven Forest**
**USNVC Scientific Name:** ***Ailanthus altissima* Forest**
**USNVC Identifier:** **CEGL007191**

### LOCAL INFORMATION

**Environmental Description:** These forests occur on rich substrates, in disturbed situations, on gently sloping uplands.
**Vegetation Description:** Successional Tree-of-Heaven Forest includes stands dominated by the alien tree *Ailanthus altissima* (tree of heaven). These forests occur on rich substrates, highly disturbed situations on slopes and in urban or developed areas. In Colonial National Historical Park, these stands may have a mix of *Pinus taeda* (loblolly pine) with an herb layer dominated by *Microstegium vimineum* (Nepalese browntop).
**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Ailanthus altissima* (tree of heaven) |

**Characteristic Species:** *Ailanthus altissima* (tree of heaven).
**Other Noteworthy Species:** Information not available.
**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNA | . | . | [not crosswalked] | . |

**Local Range:** Successional Tree-of-Heaven Forest is mapped as a single polygon in Yorktown Battlefield, just north of Wormley Pond. It covers 4.0 hectares (10.0 acres).
**Classification Comments:** This mapping unit is distinguished by the dominance of *Ailanthus altissima* (tree of heaven).
**Other Comments:** Information not available.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Colonial National Historical Park Inventory Notes:** Information 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 | *Ailanthus altissima* Forest Alliance (A.221) |
| Alliance (English name) | Tree-of-Heaven Forest Alliance |
| Association | *Ailanthus altissima* Forest |
| Association (English name) | Tree-of-Heaven Forest |
| **Ecological System(s):** | Central Appalachian Alkaline Glade and Woodland (CES202.602). |

**GLOBAL DESCRIPTION**

**Concept Summary:** This southeastern forest association, strongly dominated by the alien *Ailanthus altissima* (tree of heaven), occurs generally on nutrient-rich substrates, in disturbed situations on slopes, urban abandoned lands, and on rocky limestone slopes.

**Environmental Description:** Information not available.

**Vegetation Description:** Information not available.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Ailanthus altissima* (tree of heaven) |

**Characteristic Species:** *Ailanthus altissima* (tree of heaven).

**Other Noteworthy Species:** Information not available.

**USFWS Wetland System:** Not applicable.

**DISTRIBUTION**

**Range:** *Ailanthus altissima* (tree of heaven) Forest occurs throughout the Appalachians, the Piedmont, the Interior Low Plateau, eastern Kentucky, and in the Ozarks and Ouachita Mountains, and probably other areas in the northeastern United States.

**States/Provinces:** AR, KY, NC, PA, TN, VA, WV.

**Federal Lands:** NPS (Appomattox Court House, Colonial, Great Smoky Mountains, Natchez Trace); USFS (Ouachita (Mountains)?, Ouachita?, Ozark?).

**CONSERVATION STATUS**

**Rank:** GNA (invasive) (4-Jan-2000).

**Reasons:** This vegetation is dominated by an invasive, alien species and is thus not a conservation priority.

**CLASSIFICATION INFORMATION**

**Status:** Standard.

**Confidence:** 1 - Strong.

**Comments:** Information not available.

**Similar Associations:** Information not available.

**Related Concepts:** Information not available.

**SOURCES**

**Description Authors:** A. S. Weakley.

**References:** Patterson 1976, Southeastern Ecology Working Group n.d., TDNH unpubl. data.

## COMMON NAME (PARK-SPECIFIC): COASTAL PLAIN MESIC CALCAREOUS RAVINE FOREST

**SYNONYMS**

**USNVC English Name:** **American Beech - Southern Sugar Maple - Chinquapin Oak / Bloodroot Forest**

**USNVC Scientific Name:** ***Fagus grandifolia - Acer barbatum - Quercus muehlenbergii / Sanguinaria canadensis* Forest**

**USNVC Identifier:** **CEGL007181**

### LOCAL INFORMATION

**Environmental Description:** Coastal Plain Mesic Calcareous Ravine Forest occurs on ravine slopes and on fertile uplands with soils high in base cations. This association is found on north- to northwest-facing slopes and adjacent low interfluves downcut into Tertiary shell deposits or lime sands, including the Pliocene marine shell deposits of the calcium-rich Yorktown Formation.

**Vegetation Description:** Coastal Plain Mesic Calcareous Ravine Forest is a mesic, closed-canopy, deciduous forest of mixed canopy composition. The canopy can be variously dominated by *Quercus muehlenbergii* (chinkapin oak), *Liriodendron tulipifera* (tuliptree), *Carya cordiformis* (bitternut hickory), *Quercus alba* (white oak), and/or *Liquidambar styraciflua* (sweetgum). Other trees that are commonly present include *Acer rubrum* (red maple), *Fagus grandifolia* (American beech), *Fraxinus americana* (white ash), *Juglans nigra* (black walnut), *Quercus rubra* (northern red oak), and *Ulmus rubra* (slippery elm). The majority of stands on the Peninsula of Virginia have *Acer barbatum* (southern sugar maple) as an important canopy or subcanopy component. Stands typically have dense shrub strata dominated by *Asimina triloba* (pawpaw) and *Lindera benzoin* (northern spicebush). Lush herb layers tend to be characterized by patch-dominance of clonal forbs and ferns. *Arisaema triphyllum* (Jack in the pulpit), *Carex blanda* (eastern woodland sedge), *Circaea lutetiana* ssp. *canadensis* (broadleaf enchanter's nightshade), *Cynoglossum virginianum* (wild comfrey), *Podophyllum peltatum* (mayapple), and *Polystichum acrostichoides* (Christmas fern) are widespread and abundant herbs. More locally abundant herbs include *Adiantum pedatum* (northern maidenhair), *Actaea racemosa* (=*Cimicifuga racemosa*, black bugbane), *Phegopteris hexagonoptera* (broad beechfern), and *Verbesina virginica* var. *virginica* (white crownbeard). These forests tend to be species-rich with many additional low-cover herbaceous species present such as *Sanguinaria canadensis* (bloodroot) and *Hepatica nobilis* var. *obtusa* (roundlobe hepatica).

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Carya cordiformis* (bitternut hickory), *Quercus muehlenbergii* (chinkapin oak) |
| Tall shrub/sapling | Broad-leaved deciduous shrub | *Asimina triloba* (pawpaw) |

**Characteristic Species:** *Acer barbatum* (southern sugar maple), *Carya cordiformis* (bitternut hickory), *Cercis canadensis* var. *canadensis* (eastern redbud), *Quercus muehlenbergii* (chinkapin oak), *Sanguinaria canadensis* (bloodroot).

**Other Noteworthy Species:**

| Species | GRank | Type | Note |
|---|---|---|---|
| *Verbesina virginica* var. *virginica* (white crownbeard) | - | plant | VA State watchlist (S3) |

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | 1 | Basic Mesic Forest | Fleming et al. 2001 |

**Local Range:** In Colonial National Historical Park, Coastal Plain Mesic Calcareous Ravine Forest is mapped at College Creek / Kingsmill and as small patches on the ravine slopes of Yorktown Creek and its tributary, as well as on the slopes over Wormley Pond.

**Classification Comments:** Coastal Plain Mesic Calcareous Ravine Forest occurring on shell substrates may be confused with Coastal Plain Dry Calcareous Forest, and the two forests types may intergrade on the landscape. Coastal Plain Mesic Calcareous Ravine Forest is distinguished by the closed forest canopy and the lush forb-dominated herb layer and by the presence of mesic species *Liriodendron tulipifera* (tuliptree), *Asimina triloba* (pawpaw), *Lindera benzoin* (northern spicebush), *Sanguinaria canadensis* (bloodroot), *Adiantum pedatum* (northern maidenhair), and *Actaea racemosa* (= *Cimicifuga racemosa*, black bugbane). Late in the season, when some herb species are not evident, Coastal Plain Mesic Calcareous Ravine Forest may be confused with Mesic Mixed Hardwood Forest. Disturbed stands of this type may be confused with Successional Tuliptree - Loblolly Pine Forest. Quantitative analysis placed plot COLO.29 in the Coastal Plain Dry Calcareous Forest association, though the sample plot is compositionally intermediate between the two associations. Based on stand observations and photo interpretation, the sample was reclassified as Coastal Plain Mesic Calcareous Ravine Forest and the area including that plot was mapped as Coastal Plain Mesic Calcareous Ravine Forest.

**Other Comments:** Late in the growing season, herb density and diversity may not be evident as many species are spring ephemerals or die back before the end of summer. Exotic plant species may quickly colonize these fertile areas, making disturbed examples of the association difficult to identify.

This association has a very restricted range, being endemic to the southeastern Virginia Coastal Plain. High-quality examples are uncommon throughout the range of the association. Three examples of this association in Colonial National Historical Park meet the criteria to be considered Natural Heritage exemplary natural community occurrences, but all examples of this native plant association should be targets for conservation and management. Timber harvest degrades this community by allowing additional light and aggressive growth of invasive alien plants, which thrive in well-lit, calcareous situations and compete with the native flora. The examples in Colonial National Historical Park represent some of the few protected examples in the world.

**Local Description Authors:** K. D. Patterson.

**Plots:** COLO.6, COLO.29.

**Colonial National Historical Park Inventory Notes:** Information 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 | *Fagus grandifolia - Quercus alba* Forest Alliance (A.228) |
| Alliance (English name) | American Beech - White Oak Forest Alliance |

| | |
|---|---|
| Association | *Fagus grandifolia - Acer barbatum - Quercus muehlenbergii / Sanguinaria canadensis* Forest |
| Association (English name) | American Beech - Southern Sugar Maple - Chinquapin Oak / Bloodroot Forest |
| **Ecological System(s):** | Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242).<br>Northern Atlantic Coastal Plain Calcareous Ravine (CES203.069). |

**GLOBAL DESCRIPTION**

**Concept Summary:** These rich mesophytic to submesophytic forests of calcareous ravines are found in the southeastern Virginia Coastal Plain and possibly the adjacent Piedmont. Habitats are north- to east-facing slopes and adjacent low interfluves downcut into Tertiary shell deposits or lime sands, including the Pliocene marine shell deposits of the calcium-rich Yorktown Formation. The canopies of stands of this association are typically dominated by variable combinations of *Fagus grandifolia* (American beech), *Acer barbatum* (southern sugar maple), *Quercus rubra* (northern red oak), *Quercus muehlenbergii* (chinkapin oak), *Tilia americana* var. *americana* (American basswood), *Liriodendron tulipifera* (tuliptree), and *Quercus alba* (white oak). Although generally not as constant or abundant as *Fagus grandifolia* (American beech), *Acer barbatum* (southern sugar maple), and *Quercus muehlenbergii* (chinkapin oak) occur in over two-thirds of the plot samples and are good diagnostic species. Characteristic or locally important understory species include *Asimina triloba* (pawpaw), *Magnolia tripetala* (umbrella-tree), *Ulmus rubra* (slippery elm), *Ilex opaca* var. *opaca* (American holly), *Cornus alternifolia* (alternateleaf dogwood), *Cercis canadensis* var. *canadensis* (eastern redbud), and *Carpinus caroliniana* (American hornbeam). Common herbs are *Polystichum acrostichoides* (Christmas fern), *Asarum canadense* (Canadian wildginger), *Hepatica nobilis* var. *obtusa* (roundlobe hepatica), *Arisaema triphyllum* (Jack in the pulpit), *Actaea racemosa* (=*Cimicifuga racemosa*, black bugbane), *Cardamine concatenata* (cutleaf toothwort), *Sanguinaria canadensis* (bloodroot), *Adiantum pedatum* (northern maidenhair), *Packera aurea* (golden ragwort), and *Luzula acuminata* var. *carolinae* (Carolina woodrush). The grass *Brachyelytrum erectum* (bearded shorthusk) is abundant and characteristic of more submesic habitats (e.g., convex north slopes) occupied by the type. Related vegetation occurs in the southern Piedmont of Virginia (Charlotte County). More floristic information is available in Ware and Ware (1992).

**Environmental Description:** These rich mesophytic to submesophytic forests of calcareous ravines are found in the southeastern Virginia Coastal Plain. Habitats are north- to east-facing slopes and adjacent low interfluves downcut into Tertiary shell deposits or limesands, including the Pliocene marine shell deposits of the calcium-rich Yorktown Formation. Soils are highly calcareous, with mean calcium levels >2200 ppm in 22 analyzed samples.

**Vegetation Description:** The canopies of stands of this association are typically dominated by variable combinations of *Fagus grandifolia* (American beech), *Acer barbatum* (southern sugar maple), *Quercus rubra* (northern red oak), *Quercus muehlenbergii* (chinkapin oak), *Tilia americana* var. *americana* (American basswood), *Liriodendron tulipifera* (tuliptree), and *Quercus alba* (white oak). Although generally not as constant or abundant as *Fagus grandifolia* (American beech), *Acer barbatum* (southern sugar maple), and *Quercus muehlenbergii* (chinkapin oak) occur in more than two-thirds of the plot samples and are good diagnostic species. Characteristic or locally important understory species include *Asimina triloba* (pawpaw), *Magnolia tripetala* (umbrella-tree), *Ulmus rubra* (slippery elm), *Ilex opaca* var. *opaca* (American holly), *Cornus alternifolia* (alternateleaf dogwood), *Cercis canadensis* var. *canadensis* (eastern redbud), and *Carpinus caroliniana* (American hornbeam). Common herbs are *Polystichum acrostichoides* (Christmas fern), *Asarum canadense* (Canadian wildginger), *Hepatica nobilis* var. *obtusa* (roundlobe hepatica), *Arisaema triphyllum* (Jack in the pulpit),

*Actaea racemosa* (=*Cimicifuga racemosa*, black bugbane), *Cardamine concatenata* (cutleaf toothwort), *Sanguinaria canadensis* (bloodroot), *Adiantum pedatum* (northern maidenhair), *Packera aurea* (golden ragwort), and *Luzula acuminata* var. *carolinae* (Carolina woodrush). The grass *Brachyelytrum erectum* (bearded shorthusk) is abundant and characteristic of more submesic habitats (e.g., convex north slopes) occupied by the type. A number of herbaceous species found in this association are either at or near their northern range limit or are disjunct from a primary range farther west. Species in this group include *Chasmanthium sessiliflorum* (longleaf woodoats), *Malaxis spicata* (Florida adder's-mouth orchid), *Ponthieva racemosa* (hairy shadow witch), *Panax quinquefolius* (American ginseng), *Actaea pachypoda* (white baneberry), *Solidago flexicaulis* (zigzag goldenrod), *Desmodium glutinosum* (pointedleaf ticktrefoil), *Mitella diphylla* (twoleaf miterwort), *Thalictrum dioicum* (early meadow-rue), *Prenanthes trifoliolata* (gall of the earth), *Aralia racemosa* (American spikenard), *Scutellaria ovata* (heartleaf skullcap), *Deparia acrostichoides* (silver false spleenwort), and *Diplazium pycnocarpon* (glade fern). More floristic information is available in Ware and Ware (1992).

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Herb (field) | Forb | *Actaea racemosa* (= *Cimicifuga racemosa*, black bugbane), *Arisaema triphyllum* (Jack in the pulpit), *Asarum canadense* (Canadian wildginger), *Cardamine concatenata* (cutleaf toothwort), *Hepatica nobilis* var. *obtusa* (roundlobe hepatica), *Packera aurea* (golden ragwort), *Sanguinaria canadensis* (bloodroot) |
| Herb (field) | Graminoid | *Brachyelytrum erectum* (bearded shorthusk) |
| Herb (field) | Fern or fern ally | *Adiantum pedatum* (northern maidenhair) |

**Characteristic Species:** *Acer barbatum* (southern sugar maple), *Asimina triloba* (pawpaw), *Brachyelytrum erectum* (bearded shorthusk), *Carpinus caroliniana* (American hornbeam), *Cercis canadensis* var. *canadensis* (eastern redbud), *Cornus alternifolia* (alternateleaf dogwood), *Fagus grandifolia* (American beech), *Ilex opaca* var. *opaca* (American holly), *Magnolia tripetala* (umbrella-tree), *Quercus muehlenbergii* (chinkapin oak), *Quercus rubra* (northern red oak).
**Other Noteworthy Species:** Information not available.
**USFWS Wetland System:** Not applicable.

### DISTRIBUTION

**Range:** This community is known from Gloucester, Isle of Wight, James City, and York counties and the City of Suffolk in southeastern Virginia.
**States/Provinces:** VA.
**Federal Lands:** DOD (Yorktown); NPS (Colonial).

### CONSERVATION STATUS

**Rank:** G2? (8-Jan-2001).
**Reasons:** This association is restricted to the southeastern Virginia Coastal Plain, on north- to east-facing slopes and adjacent low interfluves downcut into Tertiary shell deposits or limesands, including the Pliocene marine shell deposits of the calcium-rich Yorktown Formation. Many herbaceous species found in this association are either at or near their northern range limit or are disjunct from a primary range farther west. Some stands have been impacted by removal of more valuable timber species (e.g., *Acer barbatum* (southern sugar maple), *Quercus alba* (white oak), *Quercus muehlenbergii* (chinkapin oak), *Quercus rubra* (northern red oak)). In addition, timber harvest degrades this community by allowing additional light and aggressive growth of invasive

alien plants which thrive in well-lit, calcareous situations, including *Lonicera japonica* (Japanese honeysuckle). A few examples are protected in Colonial National Park, Virginia, but others (including the best examples) are highly threatened by timber removal and development.

**CLASSIFICATION INFORMATION**

**Status:** Standard.

**Confidence:** 2 - Moderate.

**Comments:** Classification of this type is based on quantitative analysis of a 1250-plot regional dataset produced for the NCR and mid-Atlantic National Parks vegetation mapping project. In this analysis, this association was represented by 22 plots from the southeastern Virginia Coastal Plain and was distinct from the related *Fagus grandifolia - Liriodendron tulipifera - Carya cordiformis / Lindera benzoin / Podophyllum peltatum* Forest (CEGL006055) of the adjacent Piedmont and northern Coastal Plain from central Virginia north to New Jersey. Forests of rich ravines of the southern Virginia Piedmont have similar canopies, but their understories are dominated by *Aesculus sylvatica* (painted buckeye); based on limited data, these represent *Fagus grandifolia - Quercus rubra / Acer barbatum - Aesculus sylvatica / Actaea racemosa - Adiantum pedatum* Forest (CEGL008466). This association is mostly a small-patch vegetation type. See *Quercus muehlenbergii / Cercis canadensis / Dichanthelium boscii - Bromus pubescens - Erigeron pulchellus* var. *pulchellus - Aquilegia canadensis* Forest (CEGL007748) for related, more xerophytic forests of south-facing ravine slopes in the same region.

**Similar Associations:**

- *Fagus grandifolia - Liriodendron tulipifera - Carya cordiformis / Lindera benzoin / Podophyllum peltatum* Forest (CEGL006055)--lacks *Acer barbatum*, has a less diverse and rich herbaceous layer, and occurs more widely, north to New Jersey.
- *Fagus grandifolia - Quercus rubra / Acer barbatum - Aesculus sylvatica / Actaea racemosa - Adiantum pedatum* Forest (CEGL008466)--a similar rich mesic forest of the southern Piedmont from Virginia to Georgia.
- *Quercus muehlenbergii / Cercis canadensis / Dichanthelium boscii - Bromus pubescens - Erigeron pulchellus* var. *pulchellus - Aquilegia canadensis* Forest (CEGL007748)--is a much drier, open forest with considerably different floristic composition.

**Related Concepts:**

- *Acer barbatum - Fagus grandifolia - Quercus muehlenbergii / Hepatica nobilis* var. *obtusa* Forest (VDNH 2003) =
- *Fagus grandifolia - Acer barbatum - Quercus muhlenbergii / Sanguinaria canadensis* Forest (Patterson pers. comm.) ?
- Basic Mesic Forest, Coastal Plain Calcareous Ravine Type (Fleming pers. comm.) ?

**SOURCES**

**Description Authors:** G. P. Fleming, mod. L. A. Sneddon.

**References:** Fleming et al. 2001, Fleming pers. comm., Patterson pers. comm., Southeastern Ecology Working Group n.d., VDNH 2003, Ware and Ware 1992.



Figure I2. Coastal Plain Mesic Calcareous Ravine Forest (plot COLO.29) at Colonial National Historical Park. May 2005. NAD 1983 / UTM easting 349125, northing 4121319.

## COMMON NAME (PARK-SPECIFIC): MESIC MIXED HARDWOOD FOREST

**SYNONYMS**

| | |
|---|---|
| **USNVC English Name:** | **American Beech - (White Oak, Northern Red Oak) - Tuliptree / (American Holly) / Christmas Fern Forest** |
| **USNVC Scientific Name:** | ***Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / (Ilex opaca* var. *opaca) / Polystichum acrostichoides* Forest** |
| **USNVC Identifier:** | **CEGL006075** |

### LOCAL INFORMATION

**Environmental Description:** This deciduous forest occurs on mesic, lower slopes and ravines over well-drained, acidic soils. It is occasionally found on upland flats above ravine slopes.
**Vegetation Description:** The canopy is composed of variable combinations of *Fagus grandifolia* (American beech), *Quercus alba* (white oak), *Quercus rubra* (northern red oak), and *Liriodendron tulipifera* (tuliptree). Some stands may be strongly dominated by a single tree, typically *Fagus grandifolia* (American beech), *Quercus alba* (white oak), or *Liriodendron tulipifera* (tuliptree). Other canopy associates include *Carya alba* (mockernut hickory), *Liquidambar styraciflua* (sweetgum), *Quercus phellos* (willow oak), and *Pinus taeda* (loblolly pine). The subcanopy and shrub layers are characterized by moderately to strongly abundant *Ilex opaca* var. *opaca* (American holly); *Asimina triloba* (pawpaw) is often locally dominant. Other common trees and shrubs can include *Acer rubrum* (red maple), *Carpinus caroliniana* (American hornbeam), *Cornus florida* (flowering dogwood), *Euonymus americanus* (strawberry bush), *Kalmia latifolia* (mountain laurel), *Nyssa sylvatica* (blackgum), and *Oxydendrum arboreum* (sourwood). Common woody vines in this forest are *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), *Vitis rotundifolia* (muscadine), and the exotic vine *Lonicera japonica* (Japanese honeysuckle). The herbaceous stratum is sparse to absent, although the exotic grass *Microstegium vimineum* (Nepalese browntop) may form continuous cover in some stands. The most constant species are *Mitchella repens* (partridgeberry) and *Polystichum acrostichoides* (Christmas fern). Other characteristic herbs include *Carex albicans* (whitetinge sedge), *Carex digitalis* (slender woodland sedge), *Carex laxiculmis* var. *laxiculmis*, *Chimaphila maculata* (striped prince's pine), *Hexastylis virginica* (Virginia heartleaf), *Luzula acuminata* (hairy woodrush), *Dichanthelium boscii* (Bosc's panicgrass), *Dichanthelium dichotomum* (cypress panicgrass), *Galium circaezans* (licorice bedstraw), *Houstonia purpurea* (Venus' pride), *Maianthemum racemosum* ssp. *racemosum* (feathery false lily of the valley), *Phegopteris hexagonoptera* (broad beechfern), *Polygonatum biflorum* var. *biflorum* (smooth Solomon's-seal), and *Uvularia perfoliata* (perfoliate bellwort).

The dominant canopy species may vary from stand to stand. The shrub stratum of some stands may have scattered *Kalmia latifolia* (mountain laurel) or lack *Ilex opaca* var. *opaca* (American holly). The herbaceous stratum of some stands may be dominated by the exotic *Microstegium vimineum* (Nepalese browntop).

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Fagus grandifolia* (American beech), *Liriodendron tulipifera* (tuliptree), *Quercus alba* (white oak) |
| Tree subcanopy | Broad-leaved evergreen tree | *Ilex opaca* var. *opaca* (American holly) |
| Herb (field) | Fern or fern ally | *Polystichum acrostichoides* (Christmas fern) |

**Characteristic Species:** *Fagus grandifolia* (American beech), *Ilex opaca* var. *opaca* (American holly), *Liriodendron tulipifera* (tuliptree), *Mitchella repens* (partridgeberry), *Polystichum acrostichoides* (Christmas fern), *Quercus alba* (white oak).

**Other Noteworthy Species:** Information not available.

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | 1 | Mesic Mixed Hardwood Forest | Fleming et al. 2001 |

**Local Range:** Mesic Mixed Hardwood Forest occurs throughout Colonial National Historical Park. It is mapped as 55 polygons and covers a total of 338.2 hectares (835.8 acres).

**Classification Comments:** Some stands of Mesic Mixed Hardwood Forest may be confused with Piedmont / Coastal Plain Beech - Oak / Heath Forest, which occurs on steep slopes and has a shrub layer very strongly dominated by *Kalmia latifolia* (mountain laurel). While Mesic Mixed Hardwood Forest may share many species in common with stands of Successional Tuliptree - Loblolly Pine Forest, it is distinguished by having a more diverse canopy and a less "weedy" herbaceous stratum, often with *Fagus grandifolia* (American beech) and *Quercus* spp. (oaks) dominant in the canopy. Mesic Mixed Hardwood Forest also tends to occur on slopes where Successional Tuliptree - Loblolly Pine Forest occurs on formerly disturbed upland flats. Mesic Mixed Hardwood Forest is distinguished from Coastal Plain Mesic Calcareous Ravine Forest by lacking a lush, forb-rich herb layer with species more characteristic of high base status soils (*Sanguinaria canadensis* (bloodroot), *Adiantum pedatum* (northern maidenhair), *Actaea racemosa* (=*Cimicifuga racemosa*, black bugbane), *Hepatica nobilis* var. *obtusa* (roundlobe hepatica)). However, late in the growing season, stands of Coastal Plain Mesic Calcareous Ravine Forest can be confused with Mesic Mixed Hardwood when certain diagnostic herbs have died back.

**Other Comments:** Stands mapped as Mesic Mixed Hardwood Forest may have small disturbed areas that are better classed as Successional Tuliptree - Loblolly Pine Forest. Polygons mapped as this type may also contain small (<0.5 ha) inclusions of Coastal Plain Mesic Calcareous Ravine Forest and, where this forest crosses ravine bottoms, small seepage wetlands may occur.

**Local Description Authors:** K. D. Patterson.

**Plots:** COLO.2, COLO.19, COLO.22.

**Colonial National Historical Park Inventory Notes:** Information 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 | *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, rubra) - Liriodendron tulipifera / (Ilex opaca* var. *opaca) / Polystichum acrostichoides* Forest |
| Association (English name) | American Beech - (White Oak, Northern Red Oak) - Tuliptree / (American Holly) / Christmas Fern Forest |
| **Ecological System(s):** | Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242).<br>Northern Atlantic Coastal Plain Hardwood Forest (CES203.475). |

**GLOBAL DESCRIPTION**

**Concept Summary:** This forest of mesic to submesic, well-drained soils occurs in the Piedmont and Coastal Plain of Virginia and Maryland, extending north to southern New England on the Coastal Plain. It also occurs occasionally at low elevations of the Blue Ridge and adjacent Ridge and Valley in Virginia and Maryland. It is characteristically a mixed forest dominated by *Fagus grandifolia* (American beech), *Quercus alba* (white oak), *Quercus rubra* (northern red oak), and *Liriodendron tulipifera* (tuliptree) in various proportions. Overstory associates over the range include *Quercus velutina* (black oak), *Quercus falcata* (southern red oak), *Quercus coccinea* (scarlet oak), *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), *Carya alba* (mockernut hickory), *Carya glabra* (pignut hickory), and *Fraxinus americana* (white ash). The subcanopy is characterized by young *Fagus grandifolia* (American beech), *Acer rubrum* (red maple), *Carpinus caroliniana* (American hornbeam), *Cornus florida* (flowering dogwood), and *Sassafras albidum* (sassafras). *Ilex opaca* var. *opaca* (American holly) is particularly characteristic and abundant on the Coastal Plain. The shrub layer varies from very sparse to well-developed and can include *Asimina triloba* (pawpaw), *Viburnum acerifolium* (mapleleaf viburnum), *Viburnum dentatum* (southern arrowwood), and *Euonymus americanus* (strawberry bush). Heath shrubs, such as *Vaccinium corymbosum* (highbush blueberry) and *Vaccinium pallidum* (Blue Ridge blueberry), may be common but not abundant. Vines are common, including *Parthenocissus quinquefolia* (Virginia creeper), *Smilax glauca* (cat greenbrier), and *Toxicodendron radicans* (eastern poison ivy). In the southern part of the range, *Oxydendrum arboreum* (sourwood) and *Vitis rotundifolia* (muscadine) may be conspicuous members of the understory. The herb layer is comprised of *Polystichum acrostichoides* (Christmas fern), *Thelypteris noveboracensis* (New York fern), *Uvularia perfoliata* (perfoliate bellwort), *Cypripedium acaule* (moccasin flower), *Mitchella repens* (partridgeberry), *Tipularia discolor* (crippled cranefly), *Goodyera pubescens* (downy rattlesnake plantain), *Eurybia divaricata* (white wood aster), *Chimaphila maculata* (striped prince's pine), *Carex swanii* (Swan's sedge), *Medeola virginiana* (Indian cucumber), *Athyrium filix-femina* (common ladyfern), *Carex digitalis* (slender woodland sedge), *Carex willdenowii* (Willdenow's sedge), *Epifagus virginiana* (beechdrops), *Maianthemum canadense* (Canada mayflower), *Desmodium nudiflorum* (nakedflower ticktrefoil), *Polygonatum biflorum* (smooth Solomon's seal), *Podophyllum peltatum* (mayapple), *Arisaema triphyllum* (Jack in the pulpit), and *Maianthemum racemosum* (feathery false lily of the valley).

**Environmental Description:** This forest association occurs on mesic to submesic slopes or gentle gradients. Ravines in dissected topography are particularly typical sites in the Piedmont and parts of the Inner Coastal Plain. The type also occupies rolling uplands with deep soils. Soils are typically well-drained, acidic sandy and silt loams derived from parent material of low to moderate fertility. This association is found throughout the Piedmont from south-central Virginia to New Jersey and Pennsylvania, and on the Mid-Atlantic Coastal Plain from southeastern Virginia northward.

**Vegetation Description:** Rangewide, this vegetation type is characteristically a mixed mesophytic forest dominated by *Fagus grandifolia* (American beech), *Quercus alba* (white oak),

*Quercus rubra* (northern red oak), and *Liriodendron tulipifera* (tuliptree) in various proportions. Overstory associates over the range include *Carya alba* (mockernut hickory), *Carya glabra* (pignut hickory), *Quercus velutina* (black oak), *Quercus falcata* (southern red oak), *Quercus coccinea* (scarlet oak), *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), and *Fraxinus americana* (white ash). The subcanopy is characterized by young *Fagus grandifolia* (American beech), *Acer rubrum* (red maple), *Carpinus caroliniana* (American hornbeam), *Cornus florida* (flowering dogwood), *Ilex opaca* var. *opaca* (American holly), and *Sassafras albidum* (sassafras). The shrub layer varies from very sparse to well-developed and can include *Asimina triloba* (pawpaw), *Viburnum acerifolium* (mapleleaf viburnum), *Viburnum dentatum* (southern arrowwood), and *Euonymus americanus* (strawberry bush). Heath shrubs, such as *Vaccinium corymbosum* (highbush blueberry) and *Vaccinium pallidum* (Blue Ridge blueberry), may be common but not abundant. Vines are common, including *Parthenocissus quinquefolia* (Virginia creeper), *Smilax glauca* (cat greenbrier), and *Toxicodendron radicans* (eastern poison ivy). The herb layer is comprised of *Polystichum acrostichoides* (Christmas fern), *Uvularia perfoliata* (perfoliate bellwort), *Cypripedium acaule* (moccasin flower), *Mitchella repens* (partridgeberry), *Tipularia discolor* (crippled cranefly), *Goodyera pubescens* (downy rattlesnake plantain), *Eurybia divaricata* (white wood aster), *Chimaphila maculata* (striped prince's pine), *Carex swanii* (Swan's sedge), *Medeola virginiana* (Indian cucumber), *Athyrium filix-femina* (common ladyfern), *Carex digitalis* (slender woodland sedge), *Carex willdenowii* (Willdenow's sedge), *Epifagus virginiana* (beechdrops), *Maianthemum canadense* (Canada mayflower), *Desmodium nudiflorum* (nakedflower ticktrefoil), *Polygonatum biflorum* (smooth Solomon's seal). *Podophyllum peltatum* (mayapple), *Arisaema triphyllum* (Jack in the pulpit), and *Maianthemum racemosum* (feathery false lily of the valley).

Several intergrading compositional variants have been noted in regional and local landscape analyses. On more submesic, convex slopes, *Fagus grandifolia* (American beech), *Quercus alba* (white oak), *Cornus florida* (flowering dogwood), and *Vaccinium pallidum* (Blue Ridge blueberry) tend to be prominent, while pronounced mesophytes such as *Carpinus caroliniana* (American hornbeam) and herbaceous species in general are usually sparse. Coastal Plain stands tend to have understories heavily dominated by *Ilex opaca* var. *opaca* (American holly), while Piedmont stands generally have only scattered *Ilex opaca* var. *opaca* (American holly) as well as slightly higher herbaceous richness.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Fagus grandifolia* (American beech), *Liriodendron tulipifera* (tuliptree), *Quercus alba* (white oak) |
| Tree subcanopy | Broad-leaved deciduous tree | *Cornus florida* (flowering dogwood) |
| Tree subcanopy | Broad-leaved evergreen tree | *Ilex opaca* var. *opaca* (American holly) |
| Shrub/sapling (tall & short) | Broad-leaved deciduous shrub | *Viburnum acerifolium* (mapleleaf viburnum) |
| Shrub/sapling (tall & short) | Vine/Liana | *Parthenocissus quinquefolia* (Virginia creeper) |
| Herb (field) | Forb | *Podophyllum peltatum* (mayapple), *Polygonatum biflorum* (smooth Solomon's seal) |
| Herb (field) | Fern or fern ally | *Polystichum acrostichoides* (Christmas fern) |

**Characteristic Species:** *Carex laxiculmis* var. *laxiculmis*, *Fagus grandifolia* (American beech), *Ilex opaca* var. *opaca* (American holly), *Quercus alba* (white oak), *Viburnum acerifolium* (mapleleaf viburnum).

**Other Noteworthy Species:** Information not available.
**USFWS Wetland System:** Not applicable.

**DISTRIBUTION**
**Range:** This association is currently described from Virginia northward to Long Island, New York. The type is characteristic of the Coastal Plain throughout its range and of the Piedmont from south-central Virginia through much of Maryland. Small outliers of this vegetation occur at low elevations on both flanks of the Blue Ridge in Virginia and Maryland.
**States/Provinces:** DC, DE:S5, MD, NJ:S3, NY, PA:S1, VA:S5.
**Federal Lands:** DOD (Fort A.P. Hill, Fort Belvoir, Kerr Reservoir, Yorktown); NPS (Appomattox Court House, C&O Canal, Colonial, Fredericksburg-Spotsylvania, George Washington Parkway, National Capital-East, Petersburg, Prince William, Richmond, Rock Creek, Sagamore Hill, Shenandoah, Thomas Stone); USFWS (James River, Prime Hook).

**CONSERVATION STATUS**
**Rank:** G5 (31-Jan-2007).
**Reasons:** This association is common and widespread on the northeastern Coastal Plain and the Piedmont in Virginia and Maryland.

**CLASSIFICATION INFORMATION**
**Status:** Standard.
**Confidence:** 2 - Moderate.
**Comments:** The regional circumscription of this type is very robust and supported by 170 plots from Virginia, Maryland, and the District of Columbia. These were analyzed by VDNH with a 1300-plot regional dataset compiled for the NCR and mid-Atlantic national parks vegetation mapping projects.
**Similar Associations:**
- *Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest (CEGL006921).
- *Fagus grandifolia - Quercus alba - (Acer barbatum)* / Mixed Herbs Forest (CEGL007206).
- *Fagus grandifolia - Quercus alba - Quercus rubra* Forest (CEGL006377).
- *Fagus grandifolia - Quercus rubra / Cornus florida / Polystichum acrostichoides - Hexastylis virginica* Forest (CEGL008465).
- *Quercus alba - Carya glabra* / Mixed Herbs Coastal Plain Forest (CEGL007226).

**Related Concepts:**
- *Fagus grandifolia - Liriodendron tulipifera - Quercus (alba, rubra) / Polystichum acrostichoides - Aster divaricatus* Forest (Fleming 2001) ?
- *Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / Ilex opaca* var. *opaca - (Asimina triloba)* Forest (Patterson pers. comm.) ?
- *Fagus grandifolia - Quercus alba - Liriodendron tulipifera - Liquidambar styraciflua* Forest (Bartgis 1986) ?
- *Quercus* spp. - *Carya* spp. / *Cornus florida - Ilex opaca* Mesic Forest (Clancy 1993) ?
- CNE Mesic hardwood Forest on acidic bedrock / till (Rawinski 1984) ?
- Coastal Plain Forest (Smith 1983) B
- Maritime forest (Rawinski 1984) ?
- Mesic Coastal Plain mixed oak forest, mixed oak - beech forest subtype (Breden 1989) ?
- Mixed oak forest of the south Jersey mesic uplands (Robichaud and Buell 1973) ?
- Southern New England oak / pine forest on sandy / gravelly soils (Rawinski 1984) ?

**SOURCES**
**Description Authors:** S. L. Neid, mod. G. Fleming and L. A. Sneddon.

**References:** Bartgis 1986, Berdine 1998, Bernard and Bernard 1971, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1993, Clancy 1996, Davis et al. 1992, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fleming 2001, Fleming et al. 2001, Fleming pers. comm., Harrison 2004, Lea 2003, McCoy and Fleming 2000, Metzler and Barrett 2001, Patterson pers. comm., Rawinski 1984, Robichaud and Buell 1973, Smith 1983, Soil Conservation Service 1987.



Figure I3. Mesic Mixed Hardwood Forest (plot COLO.19) at Colonial National Historical Park. August 2004. NAD 1983 / UTM easting 367621, northing 4120331.



Figure I4. Mesic Mixed Hardwood Forest (plot COLO.22) at Colonial National Historical Park. August 2004. NAD 1983 / UTM easting 348884, northing 4124256.

## COMMON NAME (PARK-SPECIFIC): PIEDMONT / COASTAL PLAIN OAK - BEECH / HEATH FOREST

**SYNONYMS**
**USNVC English Name:** **American Beech - (White Oak, Black Oak, Chestnut Oak) / Mountain Laurel Forest**
**USNVC Scientific Name:** ***Fagus grandifolia - Quercus (alba, velutina, prinus) / Kalmia latifolia* Forest**
**USNVC Identifier:** **CEGL006919**

### LOCAL INFORMATION

**Environmental Description:** This deciduous forest occurs in submesic habitats on west- to north-facing, steep ravine slopes and bluffs with acidic, nutrient-poor soils.
**Vegetation Description:** Piedmont / Coastal Plain Oak - Beech / Heath Forest is characterized by very low species richness and evergreen shrub layers. The canopy is closed to very open. *Fagus grandifolia* (American beech) is usually the dominant overstory tree, with *Quercus alba* (white oak), *Quercus prinus* (chestnut oak), and other *Quercus* spp. (oaks) as associates. *Fagus grandifolia* (American beech) and *Acer rubrum* (red maple) usually dominate the small-tree layers. *Ilex opaca* var. *opaca* (American holly) is a common small tree/large shrub, along with *Nyssa sylvatica* (blackgum), *Sassafras albidum* (sassafras), and *Oxydendrum arboreum* (sourwood). *Kalmia latifolia* (mountain laurel) forms a dense to nearly continuous (usually >50% cover) tall-shrub layer. True herbs are very sparse and litter dominates the ground layer.

Some stands lack *Fagus grandifolia* (American beech) and are dominated by *Quercus alba* (white oak) or *Quercus prinus* (chestnut oak) and may have *Pinus taeda* (loblolly pine) in the canopy as a minor (<10% cover) component.
**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Fagus grandifolia* (American beech) |
| Tall shrub/sapling | Broad-leaved evergreen shrub | *Kalmia latifolia* (mountain laurel) |

**Characteristic Species:** *Fagus grandifolia* (American beech), *Ilex opaca* var. *opaca* (American holly), *Kalmia latifolia* (mountain laurel), *Quercus alba* (white oak), *Quercus prinus* (chestnut oak).
**Other Noteworthy Species:** Information not available.
**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | Sname | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | 1 | Piedmont / Coastal Plain Oak - Beech / Heath Forest | Fleming et al. 2006 |

**Local Range:** This association is mapped at College Creek / Kingsmill, Papermill Creek, and on the ravine slopes of Ballard Creek and Yorktown Creek in the vicinity of Yorktown Battlefield. This association is mapped as 10 polygons in the Colonial National Historical Park, covering a total of 7.6 hectares (18.7 acres).
**Classification Comments:** This community is distinguished from other forests by it occurrence on steep slopes and the dense shrub layer of *Kalmia latifolia* (mountain laurel). Some polygons mapped as this type may be similar to Mesic Mixed Hardwood Forest, but usually occupy drier, steeper sites that support fewer mesophytic plants and a greater abundance of heath shrubs.
**Other Comments:** Information not available.

**Local Description Authors:** K. D. Patterson.
**Plots:** COLO.20, COLO.21.
**Colonial National Historical Park Inventory Notes:** Information 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 | *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, velutina, prinus) / Kalmia latifolia* Forest |
| Association (English name) | American Beech - (White Oak, Black Oak, Chestnut Oak) / Mountain Laurel Forest |
| **Ecological System(s):** | Northern Atlantic Coastal Plain Hardwood Forest (CES203.475). |

### GLOBAL DESCRIPTION

**Concept Summary:** This mixed forest of beech and oaks occurs on the inner Coastal Plain and outer Piedmont from New Jersey to southern Virginia. It is particularly common on steep ravine slopes and bluffs of dissected terrain with highly acidic soils. It occurs occasionally on short, steep bluffs of the outer Coastal Plain, and occasionally occurs on elevated swamp islands with sandy, oligotrophic soils. The overstory is composed of *Fagus grandifolia* (American beech) with variable codominance by several oaks, particularly *Quercus prinus* (chestnut oak), *Quercus alba* (white oak), and *Quercus velutina* (black oak). Minor associates include *Quercus coccinea* (scarlet oak), *Acer rubrum* (red maple), *Carya* spp. (hickories), and *Liriodendron tulipifera* (tuliptree). Typical subcanopy trees include *Sassafras albidum* (sassafras), *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), *Cornus florida* (flowering dogwood), *Amelanchier arborea* (common serviceberry), and *Ilex opaca* var. *opaca* (American holly), the latter frequently dominating in Coastal Plain stands. An evergreen shrub layer with strong dominance by *Kalmia latifolia* (mountain laurel) is characteristic, with low-cover associates of *Rhododendron periclymenoides* (pink azalea), *Vaccinium* spp. (blueberries), and *Gaylussacia baccata* (black huckleberry). Deciduous ericads alone are dominant in rare patches that lack *Kalmia latifolia* (mountain laurel). On northern exposures, *Fagus grandifolia* (American beech) tends to strongly dominate, and *Kalmia latifolia* (mountain laurel) may achieve >75% cover.
**Environmental Description:** This association is characteristic of steep ravine slopes and bluffs in dissected terrain of the inner Coastal Plain and outer Piedmont. It also occurs occasionally on short, steep bluffs of the outer Coastal Plain, as well as on elevated swamp islands with sandy, oligotrophic soils. Sites are mesic to submesic, with extremely acidic, infertile soils. The type occurs on slopes of various aspects but tends to favor northerly ones. Soil samples collected from 24 Virginia and Maryland sites had a mean pH of 4.2 and very low cation and base saturation levels. In the southern part of the range, this association is fairly common in dissected landscapes of the inner Coastal Plain and fall-line zone of the Piedmont, but occurs in progressively smaller and more isolated patches westward in the Piedmont, typically on steep cut-slopes on the outside of meander bends in large creeks and small rivers.
**Vegetation Description:** The overstory is composed of *Fagus grandifolia* (American beech) with variable codominance by several oaks, particularly *Quercus prinus* (chestnut oak), *Quercus*

*alba* (white oak), and *Quercus velutina* (black oak). Minor associates include *Quercus coccinea* (scarlet oak), *Acer rubrum* (red maple), *Carya* spp. (hickories), and *Liriodendron tulipifera* (tuliptree). Typical subcanopy trees include *Sassafras albidum* (sassafras), *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), *Cornus florida* (flowering dogwood), *Amelanchier arborea* (common serviceberry), and *Ilex opaca* var. *opaca* (American holly), the latter frequently dominating in Coastal Plain stands. An evergreen shrub layer with strong dominance by *Kalmia latifolia* (mountain laurel) is characteristic, with low-cover associates of *Rhododendron periclymenoides* (pink azalea), *Vaccinium* spp. (blueberries), and *Gaylussacia baccata* (black huckleberry). Deciduous ericads alone are dominant in rare patches that lack *Kalmia latifolia* (mountain laurel). On northern exposures, *Fagus grandifolia* (American beech) tends to strongly dominate, and *Kalmia latifolia* (mountain laurel) may achieve >75% cover.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Quercus velutina* (black oak) |
| Tree subcanopy | Broad-leaved deciduous tree | *Cornus florida* (flowering dogwood) |
| Tall shrub/sapling | Broad-leaved evergreen shrub | *Kalmia latifolia* (mountain laurel) |

**Characteristic Species:** *Kalmia latifolia* (mountain laurel), *Quercus alba* (white oak), *Quercus prinus* (chestnut oak).

**Other Noteworthy Species:** Information not available.

**USFWS Wetland System:** Not applicable.

### DISTRIBUTION

**Range:** This mixed forest of beech and oaks occurs on the inner Coastal Plain and outer Piedmont from New Jersey to southern Virginia.

**States/Provinces:** DE, MD, NJ, VA.

**Federal Lands:** DOD (Fort Belvoir, Fort Dix, Kerr Reservoir); NPS (Colonial, Prince William, Rock Creek); USFWS (Great Swamp).

### CONSERVATION STATUS

**Rank:** GNR (7-Nov-2000).

**Reasons:** Information not available.

### CLASSIFICATION INFORMATION

**Status:** Standard.

**Confidence:** 2 - Moderate.

**Comments:** A variant of this type was described by A. Windisch (OH1 or DOf1) at Fort Dix. This association is similar to *Quercus velutina - Quercus coccinea - Quercus prinus / Kalmia latifolia* Forest (CEGL006374), however, it lacks *Fagus grandifolia* (American beech), *Liriodendron tulipifera* (tuliptree), or *Carya* spp. (hickories).

**Similar Associations:**

- *Fagus grandifolia - Quercus alba / Kalmia latifolia - (Symplocos tinctoria, Rhododendron catawbiense) / Galax urceolata* Forest (CEGL004539).
- *Quercus velutina - Quercus coccinea - Quercus prinus / Kalmia latifolia* Forest (CEGL006374).

**Related Concepts:**

- Beech - mixed oak forest (Windisch 1995) =

### SOURCES

**Description Authors:** L. A. Sneddon, mod. G. P. Fleming.

**References:** Eastern Ecology Working Group n.d., Windisch 1995.



Figure I5. Piedmont / Coastal Plain Oak - Beech / Heath Forest (plot COLO.21) at Colonial National Historical Park. August 2004. NAD 1983 / UTM easting 348732, northing 4124305.

## COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL BLACK WALNUT FOREST

**SYNONYMS**
**USNVC English Name:** **Black Walnut / Wingstem Forest**
**USNVC Scientific Name:** ***Juglans nigra / Verbesina alternifolia* Forest**
**USNVC Identifier:** **CEGL007879**

### LOCAL INFORMATION

**Environmental Description:** Successional Black Walnut Forest is an open forest that often occurs around former homesites or on otherwise disturbed flats over calcareous or high base status soils.

**Vegetation Description:** In Colonial National Historical Park, these forests have canopies with *Juglans nigra* (black walnut) sometimes mixed with *Robinia pseudoacacia* (black locust), *Celtis laevigata* (sugarberry), or *Liriodendron tulipifera* (tuliptree). Other trees and shrubs with minor cover can include *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Platanus occidentalis* (American sycamore), or *Quercus muehlenbergii* (chinkapin oak). There is little to no shrub cover, but a continuous, lawn-like herbaceous stratum composed mainly of grasses. Both exotic and native grasses are characteristic, with *Microstegium vimineum* (Nepalese browntop) and *Lolium pratense* (meadow ryegrass) typically dominant, and *Danthonia spicata* (poverty oatgrass) or *Elymus villosus* (hairy wildrye) forming more local patches.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Juglans nigra* (black walnut) |
| Herb (field) | Graminoid | *Lolium pratense* (meadow ryegrass), *Microstegium vimineum* (Nepalese browntop) |

**Characteristic Species:** *Juglans nigra* (black walnut)
**Other Noteworthy Species:** Information not available.
**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNA | . | . | [not crosswalked] | . |

**Local Range:** Successional Black Walnut Forest is mapped as five small polygons in the Ringfield / King Creek and Yorktown Battlefield areas of Colonial National Historical Park.
**Classification Comments:** This type is distinguished by its dominance by *Juglans nigra* (black walnut) and its occurrence on disturbed sites, often former homesites or recreation areas.
**Other Comments:** Information not available.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Colonial National Historical Park Inventory Notes:** Information 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 | *Juglans nigra* Forest Alliance (A.1932) |
| Alliance (English name) | Black Walnut Forest Alliance |

| | |
|---|---|
| Association | *Juglans nigra / Verbesina alternifolia* Forest |
| Association (English name) | Black Walnut / Wingstem Forest |
| **Ecological System(s):** | South-Central Interior Large Floodplain (CES202.705).<br>Southern Interior Low Plateau Dry-Mesic Oak Forest (CES202.898). |

**GLOBAL DESCRIPTION**

**Concept Summary:** This successional black walnut forest of the Southeast, ranging from Virginia to Georgia, occurs largely on former homesites, usually on disturbed soils having a neutral to basic pH. The community was originally defined from former homesites in Great Smoky Mountains National Park, where this association is an open, successional forest. It has since been found on some old pasture sites, associated with former settlement, and is potentially a wide-ranging type. The canopy can be closed to somewhat open. *Juglans nigra* (black walnut) is often the sole canopy tree, though *Liriodendron tulipifera* (tuliptree), *Juglans cinerea* (butternut), *Robinia pseudoacacia* (black locust), *Morus rubra* (red mulberry), and *Aesculus flava* (yellow buckeye) are codominants in some examples. Associates can also include *Platanus occidentalis* (American sycamore), *Fraxinus americana* (white ash), and *Ulmus rubra* (slippery elm); *Sassafras albidum* (sassafras) may be present as a small tree. The herb stratum is dominated by *Verbesina alternifolia* (wingstem) and/or *Ageratina altissima* (white snakeroot). Other herbs include *Amphicarpaea bracteata* (American hogpeanut), *Agrimonia pubescens* (soft agrimony), *Galium triflorum* (fragrant bedstraw), *Osmorhiza longistylis* (longstyle sweetroot), *Viola striata* (striped cream violet), and *Ambrosia trifida* (great ragweed). The exotics *Rosa multiflora* (multiflora rose) and *Microstegium vimineum* (Nepalese browntop) can be common in this community.

**Environmental Description:** This community often occurs on former homesites along streams or on slopes, possibly in association with circumneutral soils. It was originally defined from former homesites in Great Smoky Mountains National Park, where this association is an open, successional forest. This community was sampled on former homesites along streams, possibly in association with circumneutral soils, at 460-610 m (1500-2000 feet) elevation in the Smokies, as well as on ridgetops, slopes, and stream areas in the Cumberlands and Alleghenies at 460-1070 m (1500-3500 feet). In addition, the association was sampled from the Piedmont of South Carolina in low-lying, poor-drainage areas from approximately 170-200 m (550-650 feet) in elevation.

**Vegetation Description:** *Juglans nigra* (black walnut) is often the sole canopy tree, though *Liriodendron tulipifera* (tuliptree), *Juglans cinerea* (butternut), *Celtis laevigata* (sugarberry), and *Aesculus flava* (yellow buckeye) are dominant or codominant in some examples. Associates can also include *Platanus occidentalis* (American sycamore), *Fraxinus americana* (white ash), and *Ulmus rubra* (slippery elm); *Sassafras albidum* (sassafras) or *Cercis canadensis* (eastern redbud) may be present as small trees. The herb stratum is highly variable, often dominated by *Verbesina alternifolia* (wingstem) and/or *Verbesina alternifolia* (wingstem). Other herbs include *Amphicarpaea bracteata* (American hogpeanut), *Agrimonia pubescens* (soft agrimony), *Galium triflorum* (fragrant bedstraw), *Osmorhiza longistylis* (longstyle sweetroot), *Viola striata* (striped cream violet), and *Ambrosia trifida* (great ragweed). The exotic *Rosa multiflora* (multiflora rose) can be common in this community.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Juglans nigra* (black walnut) |
| Herb (field) | Forb | *Verbesina alternifolia* (wingstem) |

**Characteristic Species:** *Cercis canadensis* (eastern redbud), *Juglans nigra* (black walnut), *Rosa multiflora* (multiflora rose), *Verbesina alternifolia* (wingstem).
**Other Noteworthy Species:** Information not available.
**USFWS Wetland System:** Not applicable.

**DISTRIBUTION**

**Range:** This potentially widespread association is currently known from Tennessee and Kentucky east to the Carolinas and north to Virginia and West Virginia. It may range into adjacent states.
**States/Provinces:** GA, KY, NC, SC, TN, VA, WV.
**Federal Lands:** DOD (Camp Dawson); NPS (Appomattox Court House, Big South Fork, Blue Ridge Parkway, Chickamauga-Chattanooga, Colonial, Cumberland Gap, Great Smoky Mountains, Kings Mountain, Mammoth Cave, Ninety Six, Richmond).

**CONSERVATION STATUS**

**Rank:** GNA (ruderal) (2-Apr-2001).
**Reasons:** This vegetation represents vegetation created by anthropogenic disturbance and is thus not a conservation priority. Grank changed from GW to GD 2001-04-02 MP.

**CLASSIFICATION INFORMATION**

**Status:** Standard.
**Confidence:** 3 - Weak.
**Comments:** This association was originally described from Great Smoky Mountains National Park where this association can be distinguished with aerial photography.
**Similar Associations:**

- *Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana* Forest (CEGL006599)--is a modified successional forest that may also have a large component of *Juglans nigra* and occurs on disturbed sites, but it is largely dominated by early-successional trees in the canopy.

**Related Concepts:**

- Successional black walnut forest (Vanderhorst 2001) =

**SOURCES**

**Description Authors:** K. D. Patterson, mod. R. White and S. C. Gawler.
**References:** NatureServe Ecology - Southeastern U.S. unpubl. data, Peet et al. unpubl. data 2002, Southeastern Ecology Working Group n.d., TDNH unpubl. data, Vanderhorst 2001.



Figure I6. Successional Black Walnut Forest at Colonial National Historical Park. June 2004. NAD 1983 / UTM easting 359310, northing 4126731.

## COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL SWEETGUM FOREST

**SYNONYMS**
**USNVC English Name:** **Sweetgum Forest**
**USNVC Scientific Name:** ***Liquidambar styraciflua* Forest**
**USNVC Identifier:** **CEGL007216**

### LOCAL INFORMATION

**Environmental Description:** Successional Sweetgum Forest is an upland forest resulting from succession following human activities such as logging and clearing.
**Vegetation Description:** Stands are dominated by young, often shrubby *Liquidambar styraciflua* (sweetgum) often to the exclusion of other species. *Pinus taeda* (loblolly pine) may be a minor associate. Weedy or successional species make up the herb layer, *Lespedeza* sp. (a lespedeza).

Successional Sweetgum Forest may range in physiognomy from short and shrubby to open, short-statured woodland.
**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Liquidambar styraciflua* (sweetgum) |

**Characteristic Species:** *Liquidambar styraciflua* (sweetgum).
**Other Noteworthy Species:** Information not available.
**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNA | . | . | [not crosswalked] | . |

**Local Range:** This association is mapped at Green Spring, where is occurs as three polygons covering 2.9 hectares (7.1 acres).
**Classification Comments:** This forest is distinguished by being dominated by young, dense, shrubby *Liquidambar styraciflua* (sweetgum) occurring in association with Cultural Meadow.
**Other Comments:** Information not available.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Colonial National Historical Park Inventory Notes:** Information 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 | *Liquidambar styraciflua* Forest Alliance (A.234) |
| Alliance (English name) | Sweetgum Forest Alliance |
| Association | *Liquidambar styraciflua* Forest |
| Association (English name) | Sweetgum Forest |
| **Ecological System(s):** | Information not available. |

## GLOBAL DESCRIPTION

**Concept Summary:** This early-successional upland forest of the southeastern U.S. occurs on a variety of environmental settings, resulting from succession following human activities such as logging and clearing or agriculture. Stands are dominated by *Liquidambar styraciflua* (sweetgum), sometimes to the exclusion of other species. *Pinus taeda* (loblolly pine) is a common associate. Other associated species are highly variable and depend on location and stand history.

**Environmental Description:** This association is found in uplands that have been heavily impacted by agriculture or other severe disturbances and are recovering.

**Vegetation Description:** Stands are dominated by *Liquidambar styraciflua* (sweetgum), sometimes to the exclusion of other species.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Liquidambar styraciflua* (sweetgum) |
| Shrub/sapling (tall & short) | Broad-leaved deciduous tree | *Liquidambar styraciflua* (sweetgum) |

**Characteristic Species:** Information not available.

**Other Noteworthy Species:** Information not available.

**USFWS Wetland System:** Not applicable.

## DISTRIBUTION

**Range:** This association may be found throughout the southeastern United States, in the coastal plains and interior ecoregions. It is also attributed to New Jersey with the merger of CEGL006927. The status in intervening states (e.g., Delaware, Maryland) needs to be assessed.

**States/Provinces:** AL, AR?, DE, GA, KY, LA, MD, MS, NC, NJ, OK, SC, TN, VA.

**Federal Lands:** NPS (Big South Fork, Chickamauga-Chattanooga?, Colonial, Cowpens, George Washington Birthplace, Guilford Courthouse, Kings Mountain, Mammoth Cave, Natchez Trace, Ninety Six, Petersburg, Shiloh, Thomas Stone, Vicksburg); USFS (Cherokee?, Oconee?, St. Francis?); USFWS (Prime Hook).

## CONSERVATION STATUS

**Rank:** GNA (modified/managed) (19-Aug-2002).

**Reasons:** This is an upland successional vegetation type composed of native species. Its conservation value is limited, but it may provide buffer for communities of greater conservation value.

## CLASSIFICATION INFORMATION

**Status:** Standard.

**Confidence:** 3 - Weak.

**Comments:** Information not available.

**Similar Associations:**

- *Liquidambar styraciflua - Liriodendron tulipifera / Lindera benzoin / Arisaema triphyllum* Forest (CEGL004418)--a later-successional bottomland association.
- *Liquidambar styraciflua - Quercus (alba, falcata)* Forest (CEGL007217)--of interior provinces.
- *Liquidambar styraciflua - Quercus (nigra, phellos) - Pinus taeda / Vaccinium elliottii - Morella cerifera* Forest (CEGL007726)--a more diverse successional forest of the Coastal Plain.

**Related Concepts:**

- sweet gum successional forest (Collins and Anderson 1994) =

**SOURCES**

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

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

## COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL TULIPTREE - LOBLOLLY PINE FOREST

**SYNONYMS**
**USNVC English Name:** **Tuliptree - Loblolly Pine Forest**
**USNVC Scientific Name:** ***Liriodendron tulipifera* - *Pinus taeda* Forest**
**USNVC Identifier:** **CEGL007521**

### LOCAL INFORMATION

**Environmental Description:** These second- or third-growth forests develop after agricultural abandonment or other anthropogenic disturbances on upland flat areas that formerly supported Mesic Mixed Hardwood Forest or Coastal Plain Mesic Calcareous Ravine Forest.
**Vegetation Description:** The canopy can be dominated by *Liriodendron tulipifera* (tuliptree) or *Pinus taeda* (loblolly pine), either singly or in combination. *Liquidambar styraciflua* (sweetgum) and *Acer rubrum* (red maple) are also often in the canopy and commonly dominate the subcanopy. Other species that are less frequent but may be found in the canopy are *Platanus occidentalis* (American sycamore) and *Quercus falcata* (southern red oak). Other subcanopy and shrub species vary but often include *Cornus florida* (flowering dogwood), *Lindera benzoin* (northern spicebush), *Asimina triloba* (pawpaw), and *Ilex opaca* var. *opaca* (American holly). The vines *Lonicera japonica* (Japanese honeysuckle), *Toxicodendron radicans* (eastern poison ivy), and *Vitis* spp. (grapes) can cover large areas in these forests. The ground layer is usually covered by pine litter with few herbs or covered by the exotic grass *Microstegium vimineum* (Nepalese browntop). Other common herbs include *Erechtites hieraciifolia var. hieraciifolia* (American burnweed), *Cynoglossum virginianum var. virginianum* (wild comfrey), and *Polystichum acrostichoides* (Christmas fern). This is an early-successional type that persists for many decades because of the longevity of the nominal trees.

Tree species dominance can vary within and among stands of this association, and the phenology can vary from a predominantly deciduous to a predominantly evergreen forest. The structure can vary from a closed forest to an open woodland with a heavy shrub / vine layer, particularly in areas that have sustained wind damage. In Colonial National Historical Park, this forest has developed on disturbed areas that once supported Mesic Mixed Hardwood Forest or Coastal Plain Mesic Calcareous Ravine Forest. The associated species of shrubs, herbs and occasional trees vary greatly with the type of forest that once occurred on the site.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Needle-leaved tree | *Pinus taeda* (loblolly pine) |
| Tree canopy | Broad-leaved deciduous tree | *Liriodendron tulipifera* (tuliptree) |
| Herb (field) | Vine/Liana | *Lonicera japonica* (Japanese honeysuckle) |
| Herb (field) | Graminoid | *Microstegium vimineum* (Nepalese browntop) |

**Characteristic Species:** *Liriodendron tulipifera* (tuliptree), *Lonicera japonica* (Japanese honeysuckle), *Microstegium vimineum* (Nepalese browntop), *Pinus taeda* (loblolly pine).
**Other Noteworthy Species:** Information not available.
**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNA | . | . | [not crosswalked] | . |

**Local Range:** Successional Tuliptree - Loblolly Pine Forest covers the greatest area of any map class in Colonial National Historical Park. It is found in all areas of the park, covering a total of 1250 hectares (3090 acres).
**Classification Comments:** Some stands of Successional Tuliptree - Loblolly Pine Forest may be similar to Mesic Mixed Hardwood Forest, but can be distinguished by the lack of dominant canopy oaks or *Fagus grandifolia* (American beech) and the overall more "weedy" successional structure and composition. Stands of Successional Tuliptree - Loblolly Pine Forest tend to be even-aged, whereas Mesic Mixed Hardwood Forest has mixed age class stands. Additionally, Successional Tuliptree - Loblolly Pine Forest tends to occur on disturbed flats and gentle slopes. In general, Coastal Plain Loblolly Pine - Oak Forest has greater coverage of oak species and coastal shrubs such as *Morella cerifera* (wax myrtle) and *Persea palustris* (swamp bay), and lacks *Liriodendron tulipifera* (tuliptree). It is also found in a different landscape context than Successional Tuliptree - Loblolly Pine Forest, on low lying areas or sandy interfluves, surrounded by tidal wetlands.
**Other Comments:** Information not available.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Colonial National Historical Park Inventory Notes:** Information 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 | *Liriodendron tulipifera* Forest Alliance (A.236) |
| Alliance (English name) | Tuliptree Forest Alliance |
| Association | *Liriodendron tulipifera* - *Pinus taeda* Forest |
| Association (English name) | Tuliptree - Loblolly Pine Forest |
| **Ecological System(s):** | Information not available. |

### GLOBAL DESCRIPTION

**Concept Summary:** The initial USNVC description of this semi-natural tuliptree - loblolly pine forest was based on sites in the Piedmont of South Carolina, but it has since been documented in Virginia and Alabama, and is almost certainly present in other parts of the Piedmont. The vegetation develops on slopes following cropping. This forest is strongly dominated by *Liriodendron tulipifera* (tuliptree) and *Pinus taeda* (loblolly pine) which together contribute more than 75% canopy cover. Other canopy species include *Liquidambar styraciflua* (sweetgum) and *Acer rubrum* (red maple). *Cornus florida* (flowering dogwood) sometimes occurs in the subcanopy, and vines such as *Lonicera japonica* (Japanese honeysuckle), *Smilax rotundifolia* (roundleaf greenbrier) and *Toxicodendron radicans* (eastern poison ivy) may be abundant. The understory and ground layers are very sparse with much open ground present. *Microstegium vimineum* (Nepalese browntop) may dominated in the herbaceous layer.
**Environmental Description:** This successional forest community develops on slopes following cropping. The specific documented occurrences on the Sumter National Forest, South Carolina, have developed on former cotton fields of lower to midslopes, where soils usually have 60-70% sand.

**Vegetation Description:** Stands of this forest community are strongly dominated by *Liriodendron tulipifera* (tuliptree) and *Pinus taeda* (loblolly pine) which together contribute more than 75% canopy cover. Other canopy species include *Liquidambar styraciflua* (sweetgum) and *Acer rubrum* (red maple). The understory and ground layers are very sparse with much open ground present.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Needle-leaved tree | *Pinus taeda* (loblolly pine) |
| Tree canopy | Broad-leaved deciduous tree | *Acer rubrum* (red maple), *Liquidambar styraciflua* (sweetgum), *Liriodendron tulipifera* (tuliptree) |
| Tree subcanopy | Broad-leaved deciduous tree | *Cornus florida* (flowering dogwood) |
| Shrub/sapling (tall & short) | Vine/Liana | *Smilax rotundifolia* (roundleaf greenbrier) |
| Herb (field) | Fern or fern ally | *Polystichum acrostichoides* (Christmas fern) |

**Characteristic Species:** *Carya alba* (mockernut hickory), *Cercis canadensis* (eastern redbud), *Quercus falcata* (southern red oak).

**Other Noteworthy Species:** Information not available.

**USFWS Wetland System:** Not applicable.

**DISTRIBUTION**

**Range:** This association is known from the Piedmont of South Carolina, but is likely to be found in the North Carolina and Georgia Piedmont, as well the coastal plains. It also occurs in Virginia and Alabama and is likely in Tennessee.

**States/Provinces:** AL, FL?, GA?, MS?, NC?, SC, TN?, VA.

**Federal Lands:** NPS (Colonial); USFS (Apalachicola?, Bankhead, Bienville?, Conecuh?, De Soto?, Oconee?, Sumter, Sumter (Piedmont), Tombigbee?, Tuskegee?).

**CONSERVATION STATUS**

**Rank:** GNA (ruderal) (11-May-2001).

**Reasons:** A successional type, not of conservation value, but dominated by species native to North America (Grank changed from GW).

**CLASSIFICATION INFORMATION**

**Status:** Standard.

**Confidence:** 3 - Weak.

**Comments:** Information not available.

**Similar Associations:**

- *Liriodendron tulipifera - Acer negundo* Forest (CEGL007184)--has a shrub stratum of *Robinia pseudoacacia*.
- *Liriodendron tulipifera / (Cercis canadensis) / (Lindera benzoin)* Forest (CEGL007220).
- *Pinus taeda - Liquidambar styraciflua* Semi-natural Forest (CEGL008462).

**Related Concepts:**

- IF3a. Recently Harvested Timber Land (Allard 1990) B
- Loblolly Pine - Hardwood: 82 (Eyre 1980) B
- Yellow poplar (50) (USFS 1988) ?
- Yellow-Poplar: 57 (Eyre 1980) B

**SOURCES**

**Description Authors:** S. Landaal, mod. M. Pyne and L. A. Sneddon.

**References:** Allard 1990, Eyre 1980, Schotz pers. comm., Southeastern Ecology Working Group n.d., TDNH unpubl. data, USFS 1988.



Figure I7. Successional Tuliptree – Loblolly Pine Forest at Colonial National Historical Park. September 2004. NAD 1983 / UTM easting 361593, northing 4125905. Note: *Microstegium vimineum* (Nepalese browntop) dominates the herbaceous stratum.



Figure I8. Successional Tuliptree – Loblolly Pine Forest at Colonial National Historical Park. June 2004. NAD 1983 / UTM easting 359222, northing 4126654. Wind damage from Hurricane Isabel.

## COMMON NAME (PARK-SPECIFIC): ACIDIC OAK - HICKORY FOREST

**SYNONYMS**

**USNVC English Name:** **White Oak - Northern Red Oak - Mockernut Hickory / Flowering Dogwood / Deerberry / Naked-stem Tick-trefoil Piedmont Forest**

**USNVC Scientific Name:** ***Quercus alba - Quercus rubra - Carya alba / Cornus florida / Vaccinium stamineum / Desmodium nudiflorum* Piedmont Forest**

**USNVC Identifier:** **CEGL008475**

### LOCAL INFORMATION

**Environmental Description:** Acidic Oak - Hickory Forest occurs on submesic to subxeric uplands on short, steep slopes and associated flat areas above tidal marshes. Slope aspects are northwest to south. Soils are strongly acidic and nutrient-poor, being weathered primarily from Pleistocene-aged fluvial deposits.

**Vegetation Description:** The canopy is dominated by *Quercus prinus* (chestnut oak) and / or *Quercus alba* (white oak) in combination with other, less abundant, dry-site oaks and hickories like *Quercus marilandica* (blackjack oak), *Quercus stellata* (post oak), *Quercus falcata* (southern red oak), (*Carya pallida* (sand hickory), *Carya glabra* (pignut hickory), and *Carya alba* (mockernut hickory). Small trees and saplings of the canopy species, as well as of *Pinus virginiana* (Virginia pine) and *Ilex opaca var. opaca* (American holly), are common in the subcanopy and tall shrub layer. The short-shrub layer is sparse to absent. The ground is covered with litter and mosses with sparse herbaceous cover composed primarily of graminoids with scattered forbs. The most abundant herbs are *Danthonia spicata* (poverty oatgrass) and *Dichanthelium dichotomum* (cypress panicgrass). Other typical herbaceous species include *Antennaria plantaginifolia* (woman's tobacco), *Carex albicans* (whitetinge sedge), *Chimaphila maculata* (striped prince's pine), *Erechtites hieraciifolia var. hieraciifolia* (American burnweed), *Galium circaezans* (licorice bedstraw), *Hieracium venosum* (rattlesnakeweed), and *Schizachyrium scoparium* (little bluestem).

Some stands may lack *Quercus prinus* (chestnut oak) entirely and have *Quercus alba* (white oak) dominating the canopy. *Carya pallida* (sand hickory) may be dominant in some stands. Hickories may not be present in every stand. While most stands lack a short-shrub layer, *Gaylussacia frondosa* (blue huckleberry) can occur locally in small patches, but does not dominate the shrub layer.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Quercus alba* (white oak), *Quercus prinus* (chestnut oak) |

**Characteristic Species:** *Dichanthelium dichotomum* (cypress panicgrass), *Ilex opaca* var. *opaca* (American holly), *Pinus virginiana* (Virginia pine), *Quercus alba* (white oak), *Quercus prinus* (chestnut oak), *Quercus stellata* (post oak).

**Other Noteworthy Species:** Information not available.

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | 1 | Acidic Oak - Hickory Forest | Fleming et al. 2006 |

**Local Range:** In Colonial National Historical Park, Acidic Oak - Hickory Forest is mapped at Ringfield / King Creek and at College Creek / Kingsmill. It is mapped as 12 polygons, ranging in size from 0.3 to 3.3 hectares (0.8 to 8.1 acres) and covering a total land area of 18.9 hectares (46.8 acres).
**Classification Comments:** This forest is distinguished from Piedmont / Low Elevation Mixed Oak / Heath Forest by lacking a more-or-less continuous, dense ericaceous shrub layer. Acidic Oak - Hickory Forest is distinguished from Mesic Mixed Hardwood by occurring on xeric to submesic sites and having less species diversity in all strata. Mesic Mixed Hardwood Forest often has high cover of *Liriodendron tulipifera* (tuliptree) or *Fagus grandifolia* (American beech), two species absent to rare in Acidic Oak - Hickory Forest.
**Other Comments:** Information not available.
**Local Description Authors:** K. D. Patterson.
**Plots:** COLO.24.
**Colonial National Historical Park Inventory Notes:** Information 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 - Quercus rubra - Carya alba / Cornus florida / Vaccinium stamineum / Desmodium nudiflorum* Piedmont Forest |
| Association (English name) | White Oak - Northern Red Oak - Mockernut Hickory / Flowering Dogwood / Deerberry / Naked-stem Tick-trefoil Piedmont Forest |
| **Ecological System(s):** | Northern Atlantic Coastal Plain Hardwood Forest (CES203.475).<br>Northeastern Interior Dry-Mesic Oak Forest (CES202.592).<br>Southern Piedmont Dry Oak-(Pine) Forest (CES202.339).<br>Piedmont Hardpan Woodland and Forest (CES202.268). |

### GLOBAL DESCRIPTION

**Concept Summary:** This forest is found on submesic to subxeric upland sites throughout the Piedmont of the Carolinas, Virginia, south-central Maryland, and possibly Georgia. It favors mid- to upper-slope positions with northerly or easterly aspects, or mid- to lower slopes with more southerly aspects. In drier landscapes, this type occupies habitats considered relatively mesic (e.g., concave slopes, lower slopes, shallow ravines). These sites are described as dry to intermediate in soil moisture. The soils are moderately to strongly acidic and nutrient-poor, being weathered primarily from felsic metamorphic, metasedimentary, and sedimentary rocks, or composed of unconsolidated sediments. At some sites, soils are weathered from interbedded metasedimentary and mafic rocks, resulting in soil chemistry that is intermediate or slightly basic. Stands of this forest are closed to somewhat open and are dominated by mixtures of oaks and hickories, with *Quercus alba* (white oak) being most prevalent, along with *Quercus rubra* (northern red oak), *Quercus coccinea* (scarlet oak), *Quercus velutina* (black oak), *Quercus falcata* (southern red oak), *Carya alba* (mockernut hickory), *Carya ovalis* (red hickory), and *Carya glabra* (pignut hickory). *Carya* spp. (hickories) are common in this type but often most abundant in the understory. In forests with a history of disturbance, such as selective logging or

windstorms, early-successional species such as *Liriodendron tulipifera* (tuliptree) or *Pinus* sp. (a pine) may codominate. In Virginia examples, *Quercus prinus* (chestnut oak) is inconstant but sometimes important. In addition, *Pinus* spp. (pines), *Liriodendron tulipifera* (tuliptree), *Liquidambar styraciflua* (sweetgum), and *Acer rubrum* (red maple) may be common. Understory species include *Acer rubrum* (red maple), *Cornus florida* (flowering dogwood), *Oxydendrum arboreum* (sourwood), *Ilex opaca* var. *opaca* (American holly), and *Nyssa sylvatica* (blackgum). Shrubs include *Vaccinium stamineum* (deerberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Viburnum acerifolium* (mapleleaf viburnum), *Viburnum rafinesquianum* (downy arrowwood), and *Euonymus americanus* (strawberry bush). The woody vines *Vitis rotundifolia* (muscadine) and *Toxicodendron radicans* (eastern poison ivy) often are present. Herbs vary from sparse to moderately dense, with dry-mesophytic, acid-tolerant species such as *Hexastylis* spp. (heartleafs), *Goodyera pubescens* (downy rattlesnake plantain), *Chimaphila maculata* (striped prince's pine), *Desmodium nudiflorum* (nakedflower ticktrefoil), *Maianthemum racemosum* (feathery false lily of the valley), *Polygonatum biflorum* (smooth Solomon's seal), *Viola hastata* (halberdleaf yellow violet), *Tipularia discolor* (crippled cranefly), and *Hieracium venosum* (rattlesnakeweed) prevalent. This association occupies less nutrient-rich habitats than *Quercus rubra - Quercus alba - Carya glabra / Geranium maculatum* Forest (CEGL007237).

**Environmental Description:** The sites on which this vegetation is found are described as "intermediate" in soil moisture (Jones 1988a, 1988b). Soils are less nutrient-rich than *Quercus alba - Quercus rubra - Carya (ovata*, *carolinae-septentrionalis) / Cercis canadensis* Forest (CEGL007232). Virginia stands occur on submesic to subxeric uplands with acidic, moderately nutrient-poor soils weathered from felsic metamorphic, metasedimentary, and sedimentary rocks (especially Triassic siltstones), and unconsolidated sediments. However, Virginia soils supporting this type are demonstrably more fertile than those supporting very species-poor mixed oak forests with dense ericaceous shrub layers. At some sites, soils are weathered from interbedded metasedimentary and mafic rocks, resulting in soil chemistry that is intermediate or slightly basic. This type frequently occupies somewhat mesic habitats (e.g., concave slopes, lower slopes, shallow ravines) in dry landscapes where mixed oak/heath types are prevalent. It is a large-patch or matrix type in some parts of Virginia but is not as abundant in the Piedmont as mixed oak/heath forests (G. Fleming pers. comm. 2001). In North Carolina, this is a matrix type, probably the most common forest type remaining in the Piedmont.

**Vegetation Description:** Stands of this forest are closed to somewhat open, and are dominated by mixtures of oaks and hickories, with *Quercus alba* (white oak) being most prevalent, along with *Quercus rubra* (northern red oak), *Quercus coccinea* (scarlet oak), *Quercus velutina* (black oak), *Carya alba* (mockernut hickory), *Carya ovalis* (red hickory), and *Carya glabra* (pignut hickory). *Carya* spp. (hickories) are common in this type but often most abundant in the understory. In Virginia examples, *Quercus prinus* (chestnut oak) and *Quercus falcata* (southern red oak) are inconstant but sometimes important. In addition, *Pinus* spp. (pines), *Liriodendron tulipifera* (tuliptree), *Liquidambar styraciflua* (sweetgum), and *Acer rubrum* (red maple) may be common, especially in disturbed stands. Understory species include *Acer rubrum* (red maple), *Cornus florida* (flowering dogwood), *Oxydendrum arboreum* (sourwood), *Ilex opaca* var. *opaca* (American holly), and *Nyssa sylvatica* (blackgum). Shrubs include *Vaccinium stamineum* (deerberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Viburnum acerifolium* (mapleleaf viburnum), *Viburnum rafinesquianum* (downy arrowwood), and *Euonymus americanus* (strawberry bush). In Virginia, *Vaccinium pallidum* (Blue Ridge blueberry) and *Vaccinium stamineum* (deerberry) are the principal ericads of patchy low-shrub layers (G. Fleming pers.

comm. 2004). The woody vines *Vitis rotundifolia* (muscadine) and *Toxicodendron radicans* (eastern poison ivy) often are present. Herbs vary from sparse to moderately dense, with dry-mesophytic species such as *Hexastylis* spp. (heartleafs), *Goodyera pubescens* (downy rattlesnake plantain), *Chimaphila maculata* (striped prince's pine), *Desmodium nudiflorum* (nakedflower ticktrefoil), *Maianthemum racemosum* (feathery false lily of the valley), *Polygonatum biflorum* (smooth Solomon's seal), *Viola hastata* (halberdleaf yellow violet), *Tipularia discolor* (crippled cranefly), *Carex albicans* (whitetinge sedge), and *Hieracium venosum* (rattlesnakeweed) prevalent (Schafale and Weakley 1990). Although not lush, these forests can be impressively species-rich, with high woody diversity and many low-cover herbaceous species occurring. Species richness of 116 Virginia plots averages 53 taxa per 400 square meters, varying from a low of 17 to a high of 114. Low species richness in this type is most often the result of long-term overgrazing by large deer populations. At least some of the stands with high species richness are located on sites where deer populations are effectively controlled.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Carya alba* (mockernut hickory), *Carya glabra* (pignut hickory), *Carya ovalis* (red hickory), *Quercus alba* (white oak), *Quercus coccinea* (scarlet oak), *Quercus rubra* (northern red oak), *Quercus velutina* (black oak) |
| Tree subcanopy | Broad-leaved deciduous tree | *Cornus florida* (flowering dogwood), *Nyssa sylvatica* (blackgum), *Oxydendrum arboreum* (sourwood) |
| Tree subcanopy | Broad-leaved evergreen tree | *Ilex opaca* var. *opaca* (American holly) |

**Characteristic Species:** *Acer rubrum* (red maple), *Carya alba* (mockernut hickory), *Carya glabra* (pignut hickory), *Carya ovalis* (red hickory), *Chimaphila maculata* (striped prince's pine), *Cornus florida* (flowering dogwood), *Desmodium nudiflorum* (nakedflower ticktrefoil), *Euonymus americanus* (strawberry bush), *Goodyera pubescens* (downy rattlesnake plantain), *Hieracium venosum* (rattlesnakeweed), *Ilex opaca* var. *opaca* (American holly), *Liquidambar styraciflua* (sweetgum), *Liriodendron tulipifera* (tuliptree), *Maianthemum racemosum* (feathery false lily of the valley), *Nyssa sylvatica* (blackgum), *Oxydendrum arboreum* (sourwood), *Polygonatum biflorum* (smooth Solomon's seal), *Quercus alba* (white oak), *Quercus coccinea* (scarlet oak), *Quercus rubra* (northern red oak), *Quercus velutina* (black oak), *Tipularia discolor* (crippled cranefly), *Toxicodendron radicans* (eastern poison ivy), *Vaccinium pallidum* (Blue Ridge blueberry), *Vaccinium stamineum* (deerberry), *Viburnum acerifolium* (mapleleaf viburnum), *Viburnum rafinesquianum* (downy arrowwood), *Viola hastata* (halberdleaf yellow violet), *Vitis rotundifolia* (muscadine).

**Other Noteworthy Species:** Information not available.

**USFWS Wetland System:** Not applicable.

**DISTRIBUTION**

**Range:** This association occurs throughout the Piedmont of the Carolinas, Virginia, south-central Maryland, and possibly Georgia. In northern Virginia and Maryland, it also occurs occasionally in the Coastal Plain.

**States/Provinces:** GA?, MD, NC, SC, VA.

**Federal Lands:** DOD (Fort Pickett, Kerr Reservoir); NPS (Appomattox Court House, Booker T. Washington, C&O Canal, Colonial, Fredericksburg-Spotsylvania, George Washington

Parkway, Guilford Courthouse, Kings Mountain, Manassas, Ninety Six, Petersburg, Prince William, Richmond, Rock Creek); USFS (Oconee?, Uwharrie).

**CONSERVATION STATUS**

**Rank:** G4G5 (15-Feb-2007).

**Reasons:** This is not a rare community type, although stands older than about 80 years old are probably rare. Most of the rolling upland landscape of the Piedmont and other regions where this occurs have been logged more than once since European settlement. This is a large-patch or matrix type in some regions of Virginia (G. Fleming pers. comm. 2001). In North Carolina, this is a matrix type, probably the most common forest type remaining in the Piedmont.

**CLASSIFICATION INFORMATION**

**Status:** Standard.

**Confidence:** 1 - Strong.

**Comments:** At the northern end of the range, the classification is supported by analysis of a 1250-plot regional dataset assembled for the NCR and mid-Atlantic national parks vegetation mapping project. In that analysis, this association was represented by 116 Virginia plots and several from Montgomery County, Maryland.

**Similar Associations:**

- *Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest (CEGL006336)--northern analogue from Maryland to New England.
- *Quercus alba - Carya alba / Euonymus americanus / Hexastylis arifolia* Forest (CEGL006227)--similar with a more southerly range.
- *Quercus alba - Carya alba / Vaccinium elliottii* Forest [Provisional] (CEGL007224)--of the Coastal Plain.
- *Quercus alba - Carya glabra* / Mixed Herbs Coastal Plain Forest (CEGL007226)--of the Coastal Plain.
- *Quercus alba - Quercus nigra - Quercus falcata / Ilex opaca / Clethra alnifolia - Arundinaria gigantea* ssp. *tecta* Forest (CEGL007862)--of the Coastal Plain.
- *Quercus alba - Quercus rubra - Carya (ovata, carolinae-septentrionalis) / Cercis canadensis* Forest (CEGL007232)--occurs in the same region but on basic soils weathered from mafic rocks.
- *Quercus falcata - Quercus alba - Carya alba / Oxydendrum arboreum / Vaccinium stamineum* Forest (CEGL007244)--is a drier community of similar substrates, with more *Quercus falcata* or *Quercus stellata* than *Quercus rubra* codominating with *Quercus alba*.
- *Quercus rubra - Quercus alba - Carya glabra / Geranium maculatum* Forest (CEGL007237).
- *Quercus rubra / Magnolia tripetala - Cercis canadensis / Actaea racemosa - Tiarella cordifolia* Forest (CEGL003949).

**Related Concepts:**

- *Quercus alba - Quercus rubra - Carya (alba, glabra) / Cornus florida / Vaccinium stamineum* Forest (VDNH 2003) =
- *Quercus alba - Quercus rubra - Carya (alba, glabra) / Cornus florida / Vaccinium stamineum* Forest (Fleming pers. comm.) ?
- IA6i. Interior Upland Dry-Mesic Oak - Hickory Forest (Allard 1990) B
- Oak - Chestnut - Hickory Forest (Ambrose 1990) B
- Piedmont Acidic Oak-Hickory Forest (Fleming et al. 2004) ?
- White oak - northern red oak - false Solomon's seal (*Quercus alba - Quercus rubra - Smilacina racemosa*) community type (Jones 1988a) ?
- White oak - northern red oak - false Solomon's seal (*Quercus alba - Quercus rubra - Smilacina racemosa*) community type (Jones 1988b) ?

**SOURCES**

**Description Authors:** M. P. Schafale and G. P. Fleming.

**References:** Allard 1990, Ambrose 1990, Fleming et al. 2001, Fleming et al. 2004, Fleming pers. comm., Harrison 2004, Jones 1988a, Jones 1988b, NRCS 2006, Nelson 1986, Patterson pers. comm., Schafale and Weakley 1990, Skeen et al. 1980, Southeastern Ecology Working Group n.d., VDNH 2003.



Figure I9. Acidic Oak - Hickory Forest (plot COLO.24) at Colonial National Historical Park. September 2004. NAD 1983 / UTM easting 349821, northing 4121229.

## COMMON NAME (PARK-SPECIFIC): COASTAL PLAIN DRY CALCAREOUS FOREST

**SYNONYMS**

| | |
|---|---|
| **USNVC English Name:** | **Chinquapin Oak / Eastern Redbud / Bosc's Witchgrass - Common Eastern Brome - Robin's-plantain - Eastern Columbine Forest** |
| **USNVC Scientific Name:** | ***Quercus muehlenbergii / Cercis canadensis / Dichanthelium boscii - Bromus pubescens - Erigeron pulchellus* var. *pulchellus* - *Aquilegia canadensis* Forest** |
| **USNVC Identifier:** | **CEGL007748** |

### LOCAL INFORMATION

**Environmental Description:** Coastal Plain Dry Calcareous Forest is found on xeric to subxeric, fertile habitats on southeast- to southwest-facing, usually convex slopes of deep ravines or stream-fronting bluffs that have downcut into Tertiary shell deposits. Shell fragments are often abundantly exposed by sheet erosion.

**Vegetation Description:** Coastal Plain Dry Calcareous Forest is an open, deciduous forest or woodland. Some stands of this association tend toward a woodland physiognomy, with low-statured, gnarled trees. *Quercus muehlenbergii* (chinkapin oak) is a constant codominant or dominant overstory tree, occurring with a variety of associates, including *Acer barbatum* (southern sugar maple), *Carya cordiformis* (bitternut hickory), *Fagus grandifolia* (American beech), *Juglans nigra* (black walnut), *Quercus alba* (white oak), and *Quercus falcata* (southern red oak). Small tree and shrub associates include *Cercis canadensis* var. *canadensis* (eastern redbud), *Celtis occidentalis* (common hackberry), *Cornus florida* (flowering dogwood), *Diospyros virginiana* (common persimmon), *Ilex opaca* var. *opaca* (American holly), *Ostrya virginiana* (hophornbeam), and *Juniperus virginiana* var. *virginiana* (eastern redcedar). The herb layer is usually patchy but relatively species-rich with a mixture of mesophytic and xerophytic species. Graminoids species such as *Dichanthelium commutatum* (variable panicgrass), *Sorghastrum elliottii* (slender Indiangrass), *Chasmanthium sessiliflorum* (longleaf woodoats), *Danthonia spicata* (poverty oatgrass), *Dichanthelium boscii* (Bosc's panicgrass), *Elymus villosus* (hairy wildrye), and *Schizachyrium scoparium* (little bluestem) can occur as patch dominants with scattered, numerous forbs species. Other species typically found in the herb layer include *Aquilegia canadensis* (red columbine), *Arabis laevigata* var. *laevigata* (smooth rockcress), *Arnoglossum atriplicifolium* (pale Indian plaintain), *Carex albicans* var. *australis* (stellate sedge), *Carex laxiflora* var. *laxiflora* (broad looseflower sedge), *Chasmanthium sessiliflorum* (longleaf woodoats), *Erigeron pulchellus* var. *pulchellus* (robin's plantain), *Galium circaezans* (licorice bedstraw), *Geum virginianum* (cream avens), *Polygonatum biflorum* var. *biflorum* (smooth Solomon's-seal), *Packera aurea* (golden ragwort), *Smallanthus uvedalius* (hairy leafcup), *Verbesina virginica* (white crownbeard), and *Verbesina occidentalis* (yellow crownbeard).

Disturbed stands of this type may have high cover (25-50%) of *Liriodendron tulipifera* (tuliptree) in the canopy. Herb cover can range from 25-50%.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Quercus muehlenbergii* (chinkapin oak) |

**Characteristic Species:** *Cercis canadensis* var. *canadensis* (eastern redbud), *Dichanthelium boscii* (Bosc's panicgrass), *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Quercus muehlenbergii* (chinkapin oak).

**Other Noteworthy Species:**

| Species | GRank | Type | Note |
|---|---|---|---|
| *Fleischmannia incarnata* (pink thoroughwort) | - | plant | VA imperiled (S2) |
| *Ponthieva racemosa* (hairy shadow witch) | - | plant | VA watchlist (S3) |
| *Verbena scabra* (sandpaper vervain) | - | plant | VA imperiled (S2) |
| *Verbesina virginica* var. *virginica* (white crownbeard) | - | plant | VA watchlist (S3) |
| *Viburnum rufidulum* (rusty blackhaw) | - | plant | VA watchlist (S3S4) |

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | S1 | = | 1 | Coastal Plain Dry Calcareous Forest / Woodland | Fleming et al. 2006 |

**Local Range:** This association is mapped in the vicinity of Yorktown Battlefield on the ravine slopes of Ballard Creek, a tributary of Yorktown Creek, and around Wormley Pond. It is also found at King Creek / Ringfield. Coastal Plain Dry Calcareous Forest is mapped as nine polygons in Colonial National Historical Park, covering a total of 5.8 hectares (14.9 acres).

**Classification Comments:** This forest is distinguished from Coastal Plain Mesic Calcareous Ravine Forest by its more open canopy structure, more graminoid species cover, the occurrence of *Juniperus virginiana* var. *virginiana* (eastern redcedar), and general absence of the mesic species that characterize Coastal Plain Mesic Calcareous Ravine Forest like *Asimina triloba* (pawpaw), *Lindera benzoin* (northern spicebush), *Sanguinaria canadensis* (bloodroot), *Adiantum pedatum* (northern maidenhair), and *Actaea racemosa* (=*Cimicifuga racemosa*, black bugbane). Also, Coastal Plain Mesic Calcareous Ravine Forest tends to have a more lush and better developed herbaceous strata with upwards of 50-75% coverage.

**Other Comments:** This community is restricted to dry, calcium-rich, shell-containing soils of the eastern Virginia and Maryland Coastal Plain. This community is naturally rare and restricted to a specialized edaphic situation that is regionally restricted and extremely rare within this region. All examples of this native plant association in Colonial National Historical Park meet the criteria to be considered Natural Heritage exemplary natural community occurrences and should be targets for conservation and management. All examples are subject to encroachment by invasive weeds. Stands are also subject to blowdowns and downfalls caused by soil slumping, especially where trees are rooted on very steep, erosive slopes.

**Local Description Authors:** K. D. Patterson.

**Plots:** COLO.1, COLO.3, COLO.13, COLO.14, COLO.15, COLO.16.

**Colonial National Historical Park Inventory Notes:** Information 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 muehlenbergii - (Acer saccharum)* Forest Alliance (A.1912) |

| | |
|---|---|
| Alliance (English name) | Chinquapin Oak - (Sugar Maple) Forest Alliance |
| Association | *Quercus muehlenbergii / Cercis canadensis / Dichanthelium boscii - Bromus pubescens - Erigeron pulchellus* var. *pulchellus - Aquilegia canadensis* Forest |
| Association (English name) | Chinquapin Oak / Eastern Redbud / Bosc's Witchgrass - Common Eastern Brome - Robin's-plantain - Eastern Columbine Forest |
| **Ecological System(s):** | Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242).<br>Northern Atlantic Coastal Plain Calcareous Ravine (CES203.069). |

**GLOBAL DESCRIPTION**

**Concept Summary:** This dry, open, calcareous forest of the Coastal Plain of Virginia and Maryland is restricted to subxeric to xeric, fertile habitats over unconsolidated, calcareous deposits. These localized habitats are found on southeast- to southwest-facing, usually convex slopes of deep ravines or stream-fronting bluffs that have downcut into Tertiary shell deposits or limesands. Occurrences are small (typically <1 acre) and highly localized in dissected portions of the Virginia inner Coastal Plain and Maryland outer Coastal Plain. *Quercus muehlenbergii* (chinkapin oak) is a constant, codominant or dominant canopy tree and is the most characteristic tree of this type. Some stands tend toward a woodland physiognomy, with low-statured, gnarled trees and a very open canopy. The understory includes *Juniperus virginiana* var. *virginiana* (eastern redcedar) and *Cercis canadensis* var. *canadensis* (eastern redbud). The herb layer is usually patchy but contains a diversity of species, including several long-range mountain disjuncts. Particularly abundant or noteworthy herbaceous species include *Erigeron pulchellus* var. *pulchellus* (robin's plantain), *Dichanthelium boscii* (Bosc's panicgrass), *Bromus pubescens* (hairy woodland brome), and *Aquilegia canadensis* (red columbine). Other locally important species are *Carex albicans* (whitetinge sedge), *Matelea carolinensis* (maroon Carolina milkvine), *Elymus hystrix* var. *hystrix* (eastern bottlebrush grass), *Elymus villosus* (hairy wildrye), *Solidago ulmifolia* var. *ulmifolia* (elmleaf goldenrod), *Symphyotrichum patens* (late purple aster), *Arabis laevigata* (smooth rockcress), *Verbesina virginica* var. *virginica* (white crownbeard), *Campanulastrum americanum* (American bellflower), *Smallanthus uvedalius* (hairy leafcup), *Silphium trifoliatum* var. *trifoliatum* (whorled rosinweed), *Desmodium pauciflorum* (fewflower ticktrefoil), *Hexalectris spicata* (spiked crested coralroot), and *Piptochaetium avenaceum* (blackseed speargrass).

**Environmental Description:** This forest occurs on subxeric to xeric, fertile habitats over unconsolidated, calcareous deposits in dissected portions of the inner Coastal Plain from southeastern Virginia north to Kent County, Maryland. The majority of documented stands are in the central Virginia Coastal Plain near Williamsburg (James City, Surry, and York counties). Habitats are developed on the steep, convex, south-facing slopes of deep ravines and stream-fronting bluffs that have downcut into Tertiary shell deposits or limesands. Soils are slightly acidic to circumneutral, with high calcium levels. Mean soil chemistry values from plots of this type are comparable to those from limestone soils in the mountains (G. Fleming unpubl. data): pH = 6.5, Ca = 4707 (ppm), Mg = 116, Fe = 158, Mn = 67, Al = 403, P = 40, K = 113, cation exchange capacity = 27.4, total base saturation = 86.3%.

**Vegetation Description:** *Quercus muehlenbergii* (chinkapin oak) is a constant, codominant or dominant canopy tree and is the most characteristic tree of this type, occurring with a variety of mostly inconstant associates, including *Acer barbatum* (southern sugar maple), *Carya cordiformis* (bitternut hickory), *Celtis occidentalis* (common hackberry), *Fagus grandifolia* (American beech), *Fraxinus americana* (white ash), *Quercus alba* (white oak), *Quercus rubra* (northern red oak), *Quercus prinus* (chestnut oak), *Tilia americana* (American basswood), and

*Ulmus rubra* (slippery elm). Small tree and shrub associates include *Cercis canadensis* var. *canadensis* (eastern redbud), *Cornus florida* (flowering dogwood), *Dirca palustris* (eastern leatherwood), *Ilex opaca* var. *opaca* (American holly), *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Ostrya virginiana* (hophornbeam), *Sideroxylon lycioides* (buckthorn bully), and *Viburnum rufidulum* (rusty blackhaw). The most characteristic or locally abundant herbs include *Agrimonia rostellata* (beaked agrimony), *Aquilegia canadensis* (red columbine), *Arabis laevigata* var. *laevigata* (smooth rockcress), *Aristolochia serpentaria* (Virginia snakeroot), *Bromus pubescens* (hairy woodland brome), *Carex albicans* var. *australis* (stellate sedge), *Carex laxiflora* var. *laxiflora* (broad looseflower sedge), *Dichanthelium boscii* (Bosc's panicgrass), *Elymus hystrix* var. *hystrix* (eastern bottlebrush grass), *Elymus villosus* (hairy wildrye), *Erigeron pulchellus* var. *pulchellus* (robin's plantain), *Phryma leptostachya* (American lopseed), *Solidago caesia* (wreath goldenrod), and *Solidago ulmifolia* var. *ulmifolia* (elmleaf goldenrod). Herbs that are important in specific geographic parts of the range include *Arnoglossum atriplicifolium* (pale Indian plaintain), *Asclepias verticillata* (whorled milkweed), *Chasmanthium sessiliflorum* (longleaf woodoats), *Desmodium pauciflorum* (fewflower ticktrefoil), *Fleischmannia incarnata* (pink thoroughwort), *Eupatorium sessilifolium* (upland boneset), *Heuchera americana* (American alumroot), *Matelea carolinensis* (maroon Carolina milkvine), *Piptochaetium avenaceum* (blackseed speargrass), *Scleria oligantha* (littlehead nutrush), *Silphium trifoliatum* (whorled rosinweed), *Smallanthus uvedalius* (hairy leafcup), *Sorghastrum elliottii* (slender Indiangrass), and *Symphyotrichum patens* var. *patens* (late purple aster). Stands of this community type also contain a number of species that are more-or-less strongly disjunct from primary ranges in the mountains and Piedmont, including *Hexalectris spicata* (spiked crested coralroot), *Corallorhiza wisteriana* (spring coralroot), *Campanulastrum americanum* (American bellflower), *Celastrus scandens* (American bittersweet), *Muhlenbergia sobolifera* (rock muhly), *Muhlenbergia tenuiflora* (slender muhly), *Sanicula marilandica* (Maryland sanicle), *Arabis lyrata* (lyrate rockcress), *Packera obovata* (roundleaf ragwort), *Symphyotrichum laeve* var. *laeve*, and *Thalictrum revolutum* (waxyleaf meadow-rue). Mean species richness of 24 plot samples analyzed by VDNH was 67 taxa per 400 square meters.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Quercus muehlenbergii* (chinkapin oak) |

**Characteristic Species:** *Agrimonia rostellata* (beaked agrimony), *Aquilegia canadensis* (red columbine), *Arabis laevigata* (smooth rockcress), *Aristolochia serpentaria* (Virginia snakeroot), *Bromus pubescens* (hairy woodland brome), *Carex albicans* var. *australis* (stellate sedge), *Carex laxiflora* (broad looseflower sedge), *Cercis canadensis* (eastern redbud), *Dichanthelium boscii* (Bosc's panicgrass), *Elymus hystrix* (eastern bottlebrush grass), *Elymus villosus* (hairy wildrye), *Erigeron pulchellus* (robin's plantain), *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Phryma leptostachya* (American lopseed), *Quercus muehlenbergii* (chinkapin oak), *Solidago caesia* (wreath goldenrod), *Solidago ulmifolia* (elmleaf goldenrod).

**Other Noteworthy Species:**

| Species | GRank | Type | Note |
|---|---|---|---|
| *Hedera helix* (English ivy) | - | plant | invasive nonnative |
| *Lonicera japonica* (Japanese honeysuckle) | - | plant | invasive nonnative |

**USFWS Wetland System:** Not applicable.

**DISTRIBUTION**

**Range:** This dry, open, calcareous forest is widely scattered in the Coastal Plain of Virginia and Maryland. Occurrences in Virginia are in highly dissected portions of the inner Coastal Plain in James City, Stafford, Surry, Westmoreland, and York counties. Occurrences in Maryland are in the outer Coastal Plain in Kent County.

**States/Provinces:** MD, VA.

**Federal Lands:** DOD (Yorktown); NPS (Colonial, George Washington Birthplace).

**CONSERVATION STATUS**

**Rank:** G1 (15-Feb-2007).

**Reasons:** This community is restricted to dry, calcium-rich, shell-containing soils of the eastern Virginia and Maryland Coastal Plain. This community is naturally rare and restricted to a specialized edaphic situation that is regionally restricted and extremely rare within this region. Despite relatively intensive inventory, fewer than 30 scattered occurrences totaling less than 20 hectares are known. About 25% of the known patches are located on public lands, but many of these occur in a poor landscape context and are subject to encroachment by invasive weeds.

**CLASSIFICATION INFORMATION**

**Status:** Standard.

**Confidence:** 2 - Moderate.

**Comments:** Classification of this type is supported by analysis of a 1250-plot regional dataset for the NCR and mid-Atlantic national parks vegetation mapping projects. In that analysis, this association was represented by 22 plots from James City, Stafford, Surry, Westmoreland, and York counties, Virginia, and two plots from Kent County, Maryland. According to Rod Simmons, vegetation similar to the stands of this type at Crow's Nest, Stafford County, Virginia, occurs across the Potomac River at Chapman's Landing, Maryland. It is likely that this community type is endemic to a narrow region of the Coastal Plain stretching from Charles County, Maryland, south to Surry County, Virginia. Further inventory is required to determine whether it is present in Isle of Wight County and City of Suffolk, Virginia. This is a small-patch community type, usually occurring in patches of <1 acre or 0.4 ha. The total acreage of all known occurrences is <20 hectares.

**Similar Associations:**

- *Fagus grandifolia - Acer barbatum - Quercus muehlenbergii / Sanguinaria canadensis* Forest (CEGL007181)--is a mesic forest occurring on cooler, more sheltered slopes of calcareous ravines; contains substantial *Fagus grandifolia, Acer barbatum*, and mesophytic understory species such as *Asimina triloba*.

**Related Concepts:**

- *Quercus muehlenbergii / Erigeron pulchellus* var. *pulchellus - Dichanthelium boscii - (Verbesina virginica)* Forest (VDNH 2003) =
- *Quercus muhlenbergii / Erigeron pulchellus* var. *pulchellus - Dichanthelium boscii - (Verbesina virginica)* Forest (Patterson pers. comm.) ?

**SOURCES**

**Description Authors:** G. P. Fleming.

**References:** Eastern Ecology Working Group n.d., Fleming 2001, Fleming et al. 2001, Fleming unpubl. data, Harrison 2004, Patterson pers. comm., VDNH 2003, Ware and Ware 1992.



Figure I10. Coastal Plain Dry Calcareous Forest (plot COLO.15) at Colonial National Historical Park. July 2004. NAD 1983 / UTM easting 365084, northing 4122417.



Figure I11. Coastal Plain Dry Calcareous Forest at Colonial National Historical Park. July 2004. NAD 1983 / UTM easting 358415, northing 4126410.

## COMMON NAME (PARK-SPECIFIC): PIEDMONT / LOW ELEVATION MIXED OAK / HEATH FOREST

**SYNONYMS**

**USNVC English Name:** **White Oak - (Scarlet Oak, Black Oak, Chestnut Oak) / Black Huckleberry Forest**

**USNVC Scientific Name:** ***Quercus alba* - *Quercus (coccinea, velutina, prinus)* / *Gaylussacia baccata* Forest**

**USNVC Identifier:** **CEGL008521**

### LOCAL INFORMATION

**Environmental Description:** Piedmont / Low Elevation Mixed Oak / Heath Forest is found on xeric sites over well-drained, sandy soils derived from fluvial terrace gravels.

**Vegetation Description:** This xeric deciduous oak forest has a canopy dominated by *Quercus alba* (white oak) occurring with *Quercus prinus* (chestnut oak) and *Pinus virginiana* (Virginia pine). Other canopy and subcanopy associates can include *Quercus falcata* (southern red oak), *Quercus stellata* (post oak), *Quercus coccinea* (scarlet oak), *Nyssa sylvatica* (blackgum), and *Acer rubrum* (red maple). *Oxydendrum arboreum* (sourwood) and *Ilex opaca* var. *opaca* (American holly) are common in subcanopy or tall-shrub strata. Herbs such as *Mitchella repens* (partridgeberry), *Monotropa uniflora* (Indianpipe), and *Chimaphila maculata* (striped prince's pine) are absent to very sparse. Short ericaceous shrubs dominate the ground layer, most commonly *Gaylussacia baccata* (black huckleberry), but other common shrub species include *Gaylussacia frondosa* (blue huckleberry), *Vaccinium pallidum* (Blue Ridge blueberry), and *Vaccinium stamineum* (deerberry).

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Quercus alba* (white oak), *Quercus prinus* (chestnut oak) |
| Short shrub/sapling | Broad-leaved deciduous shrub | *Gaylussacia baccata* (black huckleberry) |

**Characteristic Species:** *Gaylussacia baccata* (black huckleberry), *Quercus alba* (white oak), *Quercus prinus* (chestnut oak).

**Other Noteworthy Species:** Information not available.

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | 1 | Oak / Heath Forest | Fleming et al. 2006 |

**Local Range:** This association is mapped as a single polygon in the College Creek / Kingsmill area of Colonial National Historical Park.

**Classification Comments:** This type is distinguished from Acidic Oak - Hickory Forest by the presence of a dense, almost continuous ericaceous shrub layer, the absence or lower frequency of *Carya* (hickory) species, and the absence or very low cover of herbaceous species.

**Other Comments:** The vegetation in Colonial National Historical Park was classified as this association because of the dominance of *Gaylussacia baccata* (black huckleberry) and presence of *Quercus prinus* (chestnut oak). Despite the occurrence in the Coastal Plain, it is compositionally more similar to oak / heath forests of the Piedmont and low elevations of the Central Appalachians, than those classed as Coastal Plain Mixed Oak / Heath Forest (CEGL006269).

**Local Description Authors:** K. D. Patterson.

**Plots:** COLO.23.
**Colonial National Historical Park Inventory Notes:** Information 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 velutina - Quercus alba - (Quercus coccinea)* Forest Alliance (A.1911) |
| Alliance (English name) | Black Oak - White Oak - (Scarlet Oak) Forest Alliance |
| Association | *Quercus alba - Quercus (coccinea, velutina, prinus) / Gaylussacia baccata* Forest |
| Association (English name) | White Oak - (Scarlet Oak, Black Oak, Chestnut Oak) / Black Huckleberry Forest |
| **Ecological System(s):** | Northern Atlantic Coastal Plain Hardwood Forest (CES203.475).<br>Central Appalachian Dry Oak-Pine Forest (CES202.591).<br>Allegheny-Cumberland Dry Oak Forest and Woodland (CES202.359). |

### GLOBAL DESCRIPTION

**Concept Summary:** This community is a matrix forest of dry, nutrient-poor uplands of the Mid-Atlantic Piedmont Plateau, occurring locally in similar low-elevation landscapes of the northern Blue Ridge and Ridge and Valley, Cumberland Plateau and Mid-Atlantic Coastal Plain provinces. The type is well-documented across Virginia, and to a lesser extent in Tennessee and Maryland, but probably also occurs at similar sites in West Virginia and Pennsylvania. Stands are located between 30 and 700 m (100-2300 feet) elevation on rolling to sublevel sites of Piedmont and inner Coastal Plain uplands, mountain valleys and lower mountain slope benches. In the mountains, many documented occurrences are located on ancient alluvial fan deposits, which are especially extensive along the western foot of the Blue Ridge. The vegetation is a closed to very open oak forest with mixed and variable canopy dominance by *Quercus alba* (white oak), *Quercus velutina* (black oak), *Quercus coccinea* (scarlet oak), and *Quercus prinus* (chestnut oak). Various *Pinus* spp. (pines), including *Pinus virginiana* (Virginia pine), *Pinus echinata* (shortleaf pine), *Pinus strobus* (eastern white pine), and *Pinus rigida* (pitch pine), are frequent overstory associates, particularly following fire or logging disturbances. *Quercus falcata* (southern red oak), *Quercus stellata* (post oak), *Carya glabra* (pignut hickory), and *Carya alba* (mockernut hickory) are infrequent canopy trees. *Nyssa sylvatica* (blackgum), *Amelanchier arborea* (common serviceberry) and, in the southern part of the range, *Oxydendrum arboreum* (sourwood) attain exceptional abundance and stature in these forests, dominating the subcanopy layers and occasionally reaching the overstory. *Acer rubrum* (red maple) and *Sassafras albidum* (sassafras) are other common understory trees. In typical stands, the shrub layer is dominated by deciduous ericaceous species, herbaceous species are sparse, and species-richness is moderate to very low.
**Environmental Description:** Stands are located between 30 and 700 m (100-2300 feet) elevation on rolling to sublevel sites of Piedmont and inner Coastal Plain uplands, mountain valleys and lower mountain slope benches. The type is generally distributed in nutrient-poor soils of the Piedmont uplands. In the mountains, many documented occurrences are located on ancient alluvial fan deposits, which are especially extensive along the western foot of the Blue Ridge from Page County south to Rockbridge County, Virginia. Similar but smaller fans are common

where incising streams drain "piedmont" landforms at the foot of Ridge and Valley strike ridges (Harbor 1996). Slopes of plot-sampled stands range from 1-13 degrees (mean = 6 degrees), with aspects essentially flat to westerly. Soils of these sites are deep, very oligotrophic, gravelly loams with low pH and base status. Exposed rocks of any kind (outcrops, boulders, or stones) are usually sparse to absent. Most sites appear to have a history of fires.

**Vegetation Description:** The vegetation is a closed to very open oak forest with mixed and variable canopy dominance by *Quercus alba* (white oak), *Quercus coccinea* (scarlet oak), and *Quercus prinus* (chestnut oak). Various *Pinus* spp. (pines), including *Pinus virginiana* (Virginia pine), *Pinus echinata* (shortleaf pine), *Pinus strobus* (eastern white pine), and *Pinus rigida* (pitch pine), are frequent overstory associates, particularly following fire or logging disturbances. *Quercus falcata* (southern red oak), *Quercus stellata* (post oak), *Carya glabra* (pignut hickory), and *Carya alba* (mockernut hickory) are infrequent canopy trees. *Nyssa sylvatica* (blackgum), *Amelanchier arborea* (common serviceberry) and, in the southern part of the range, *Oxydendrum arboreum* (sourwood) attain exceptional abundance and stature in these forests, dominating the subcanopy layers and occasionally reaching the overstory. *Acer rubrum* (red maple) and *Sassafras albidum* (sassafras) are other common understory trees. The shrub layer is typically dominated by deciduous ericaceous species, with *Gaylussacia baccata* (black huckleberry), *Vaccinium pallidum* (Blue Ridge blueberry), and/or *Vaccinium stamineum* (deerberry) consistently forming dense colonies. Less abundant or constant shrubs and vines include *Castanea pumila* (chinkapin), *Quercus ilicifolia* (bear oak), *Kalmia latifolia* (mountain laurel), *Rhododendron periclymenoides* (pink azalea), *Lyonia ligustrina* (maleberry), *Vaccinium stamineum* (deerberry), *Smilax glauca* (cat greenbrier), *Smilax rotundifolia* (roundleaf greenbrier), and *Cornus florida* (flowering dogwood). Despite high shrub densities, a number of low-cover herbs and subshrubs occur in the type, including *Chimaphila maculata* (striped prince's pine), *Isotria verticillata* (purple fiveleaf orchid), *Uvularia puberula* (mountain bellwort), *Epigaea repens* (trailing arbutus), *Pteridium aquilinum* var. *latiusculum* (western brackenfern), *Cypripedium acaule* (moccasin flower), *Gentiana villosa* (striped gentian), *Comandra umbellata* (bastard toadflax), *Angelica venenosa* (hairy angelica), and *Iris verna* (dwarf violet iris). Mean species richness of 54 Virginia, Maryland, and District of Columbia plot samples is 25 taxa per 400 square meters.

**Most Abundant Species:** Information not available.

**Characteristic Species:** *Amelanchier arborea* (common serviceberry), *Castanea pumila* (chinkapin), *Gaylussacia baccata* (black huckleberry), *Isotria verticillata* (purple fiveleaf orchid), *Nyssa sylvatica* (blackgum), *Oxydendrum arboreum* (sourwood), *Quercus alba* (white oak), *Quercus coccinea* (scarlet oak), *Quercus prinus* (chestnut oak), *Quercus velutina* (black oak), *Rhododendron periclymenoides* (pink azalea).

**Other Noteworthy Species:** Information not available.

**USFWS Wetland System:** Not applicable.

### DISTRIBUTION

**Range:** This community is a matrix forest of dry, nutrient-poor uplands of the Mid-Atlantic Piedmont Plateau, occurring locally in similar low-elevation landscapes of the northern Blue Ridge and Ridge and Valley provinces of the Central Appalachians, and the Cumberland Plateau in Tennessee. In Maryland and northern Virginia, the type also occurs on uplands of the dissected Inner Coastal Plain. The type is well-documented through quantitative analysis in Virginia, and qualitatively in Maryland, but probably also occurs at similar sites in West Virginia and Pennsylvania.

**States/Provinces:** KY?, MD, PA?, TN, VA:S5, WV?
**Federal Lands:** DOD (Fort Belvoir, Kerr Reservoir); NPS (Appomattox Court House, Big South Fork, C&O Canal, Colonial, Fredericksburg-Spotsylvania, George Washington Parkway, National Capital-East, Obed, Prince William, Rock Creek, Shenandoah, Thomas Stone); USFS (Daniel Boone?, George Washington, Jefferson, Sumter (Piedmont)?, Sumter?).

**CONSERVATION STATUS**
**Rank:** G5 (24-Jan-2005).
**Reasons:** This community is a matrix-forming vegetation type in the Virginia and Maryland Piedmont and is probably more widespread at low elevations of the central Appalachian Mountains than documentation indicates.

**CLASSIFICATION INFORMATION**
**Status:** Standard.
**Confidence:** 2 - Moderate.
**Comments:** This unit is distinct among Virginia's oak/heath forests in its occurrence on low-elevation, rolling to sub-level, usually non-rocky terrain of the Piedmont and mountains. *Quercus alba* (white oak), normally a minor tree in montane oak/heath forests, is characteristic and usually codominant, while the prevalence of deciduous ericads and the presence of the low-elevation oaks *Quercus falcata* (southern red oak) and *Quercus stellata* (post oak) further distinguish the type. *Quercus prinus* (chestnut oak) and *Kalmia latifolia* (mountain laurel), although present and occasionally abundant, are not as important in this unit as in related Central Appalachian oak/heath vegetation types, particularly *Quercus prinus - (Quercus coccinea, Quercus rubra) / Kalmia latifolia / Vaccinium pallidum* Forest (CEGL006299). The latter is generally associated with relatively steep, often rocky terrain of the Central Appalachians and dissected topography in the Piedmont. Originally, the concept of this type (CEGL008521) was restricted to "Piedmont"-like landscapes in the mountains. However, additional quantitative data analysis of a statewide (Virginia) set of 180 oak/heath plots led to a broader conceptual interpretation that includes both montane and Piedmont stands. The type is represented by 54 plots from Virginia, and 20 from Maryland and the District of Columbia. Attempts to split this unit based on the presence or absence of *Quercus prinus* (chestnut oak) have proven unworkable because significant environmental or floristic differences between the putative groups are lacking.

**Similar Associations:**
- *Quercus (prinus, coccinea) / Kalmia latifolia / (Galax urceolata, Gaultheria procumbens)* Forest (CEGL006271)--of southern Appalachians.
- *Quercus alba - Quercus falcata - (Carya pallida) / Gaylussacia frondosa* Forest (CEGL006269)--of the Mid-Atlantic Coastal Plain.
- *Quercus alba - Quercus falcata / Vaccinium (arboreum, hirsutum, pallidum)* Forest (CEGL008567)--described from southeastern Tennessee, with similar understory and associated species but with prominent *Quercus falcata*.
- *Quercus prinus - (Quercus coccinea, Quercus rubra) / Kalmia latifolia / Vaccinium pallidum* Forest (CEGL006299)--of the Central Appalachians and northern Piedmont.

**Related Concepts:**
- *Quercus alba - Quercus falcata - Carya tomentosa / Cornus florida* Association (Rawinski et al. 1996) ?
- *Quercus coccinea - Quercus velutina - Quercus alba / Amelanchier arborea / Gaylussacia baccata* Forest (Fleming and Coulling 2001) F
- *Quercus coccinea - Quercus velutina - Quercus alba / Amelanchier arborea / Gaylussacia baccata* Forest (Fleming et al. 2004) =
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) B
- White Oak - Scarlet Oak - Pine Type (Schmalzer and DeSelm 1982) =

**SOURCES**

**Description Authors:** G. P. Fleming and P. Coulling, mod. L. A. Sneddon.

**References:** Eyre 1980, Fleming and Coulling 2001, Fleming et al. 2001, Fleming et al. 2004, Hall and Mathews 1974, Harbor 1996, Harrison 2004, Rawinski et al. 1996, Schmalzer and DeSelm 1982, TDNH unpubl. data.



Figure I12. Piedmont / Low Elevation Mixed Oak – Heath Forest (plot COLO.23) at Colonial National Historical Park. September 2004. NAD 1983 / UTM easting 348874, northing 4121350.

## COMMON NAME (PARK-SPECIFIC): COASTAL PLAIN / PIEDMONT SMALL-STREAM FLOODPLAIN FOREST

**SYNONYMS**

**USNVC English Name:** **Sweetgum - Tuliptree / Northern Spicebush / Jack-in-the-Pulpit Forest**

**USNVC Scientific Name:** ***Liquidambar styraciflua - Liriodendron tulipifera / Lindera benzoin / Arisaema triphyllum* Forest**

**USNVC Identifier:** **CEGL004418**

### LOCAL INFORMATION

**Environmental Description:** Coastal Plain / Piedmont Small-Stream Floodplain Forest is a deciduous forest occurring on temporarily flooded, well-drained alluvial floodplains of small streams.

**Vegetation Description:** *Liquidambar styraciflua* (sweetgum) is usually the most abundant overstory tree in mixed stands with *Liriodendron tulipifera* (tuliptree), *Acer rubrum* (red maple), *Ulmus americana* (American elm), and *Platanus occidentalis* (American sycamore). A number of other trees can occur as inconstant, low-cover associates, including *Juglans nigra* (black walnut), *Celtis occidentalis* (common hackberry), *Fraxinus pennsylvanica* (green ash), and *Carya cordiformis* (bitternut hickory). *Lindera benzoin* (northern spicebush) often dominates the shrub layer with *Ilex opaca* var. *opaca* (American holly), *Carpinus caroliniana* (American hornbeam), and *Asimina triloba* (pawpaw). The vines *Decumaria barbara* (woodvamp) and *Toxicodendron radicans* (eastern poison ivy) often climb into the canopy. In Colonial National Historical Park, the herb stratum is often a carpet formed by the exotic grass *Microstegium vimineum* (Nepalese browntop), but less degraded floodplains have a relatively diverse herb layer composed of both mesophytic and hydrophytic species. Characteristic species include *Arisaema triphyllum* (Jack in the pulpit), *Amphicarpaea bracteata* (American hogpeanut), *Symphyotrichum lateriflorum* var. *lateriflorum* (calico aster), *Boehmeria cylindrica* (smallspike false nettle), *Carex intumescens* (greater bladder sedge), *Carex radiata* (eastern star sedge), *Cinna arundinacea* (sweet woodreed), *Festuca subverticillata* (nodding fescue), *Galium triflorum* (fragrant bedstraw), *Geum canadense* (white avens), and *Impatiens capensis* (jewelweed). Ferns, especially *Thelypteris noveboracensis* (New York fern), may also form large dominance patches.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Liquidambar styraciflua* (sweetgum) |
| Shrub/sapling (tall & short) | Broad-leaved deciduous shrub | *Lindera benzoin* (northern spicebush) |

**Characteristic Species:** *Cinna arundinacea* (sweet woodreed), *Geum canadense* (white avens), *Lindera benzoin* (northern spicebush), *Liquidambar styraciflua* (sweetgum), *Platanus occidentalis* (American sycamore), *Ulmus americana* (American elm).

**Other Noteworthy Species:** Information not available.

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | 1 | Coastal Plain / Piedmont Floodplain Forest | Fleming et al. 2006 |

**Local Range:** Coastal Plain / Piedmont Small-Stream Floodplain Forest is mapped mostly in Yorktown Battlefield where it is found along Baptist Run and Great Run. Along Beaverdam

Creek, this forest is transitional to Coastal Plain / Piedmont Floodplain Swamp (Green Ash – Red Maple Type). There is a small area classed as Coastal Plain / Piedmont Small-Stream Floodplain Forest along Colonial Parkway, just north of Jones Millpond.

**Classification Comments:** Coastal Plain / Piedmont Small-Stream Floodplain Forest often occurs adjacent to and grades into Coastal Plain / Piedmont Floodplain Swamp (Green Ash – Red Maple Type), which occupies poorly drained floodplain backswamps and has a seasonally flooded hydrology. In ecotonal areas these forests may be difficult to distinguish; however, Coastal Plain / Piedmont Floodplain Swamp (Green Ash – Red Maple Type) typically has high cover of *Fraxinus pennsylvanica* (green ash) and/or *Acer rubrum* (red maple) and more cover by species favoring longer hydroperiods and poorly drained, mucky soils, e.g., *Saururus cernuus* (lizard's tail), *Leersia oryzoides* (rice cutgrass), *Carex tribuloides* (blunt broom sedge), *Triadenum walteri* (greater marsh St. Johnswort), *Dulichium arundinaceum* (threeway sedge). Species that are found in Coastal Plain / Piedmont Small-Stream Floodplain Forest that are uncommon in Coastal Plain / Piedmont Floodplain Swamp (Green Ash – Red Maple Type) include *Liriodendron tulipifera* (tuliptree), *Platanus occidentalis* (American sycamore), *Thelypteris noveboracensis* (New York fern), *Polystichum acrostichoides* (Christmas fern), and *Festuca subverticillata* (nodding fescue).

**Other Comments:** Information not available.

**Local Description Authors:** K. D. Patterson.

**Plots:** COLO.11.

**Colonial National Historical Park Inventory Notes:** Information 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 | Temporarily flooded cold-deciduous forest (I.B.2.N.d.) |
| Alliance | *Liquidambar styraciflua - (Liriodendron tulipifera, Acer rubrum)* Temporarily Flooded Forest Alliance (A.287) |
| Alliance (English name) | Sweetgum - (Tuliptree, Red Maple) Temporarily Flooded Forest Alliance |
| Association | *Liquidambar styraciflua - Liriodendron tulipifera / Lindera benzoin / Arisaema triphyllum* Forest |
| Association (English name) | Sweetgum - Tuliptree / Northern Spicebush / Jack-in-the-Pulpit Forest |
| **Ecological System(s):** | Northern Atlantic Coastal Plain Stream and River (CES203.070).<br>Southern Piedmont Small Floodplain and Riparian Forest (CES202.323). |

### GLOBAL DESCRIPTION

**Concept Summary:** These low-elevation forests develop along relatively acidic soils on small streams in the Coastal Plain of Maryland and Virginia, extending west across the Virginia and North Carolina Piedmont to the Cumberland Plateau and Ridge and Valley. The topographic features of floodplains can heavily influence the individual makeup of examples of this association. The canopy, subcanopy, shrub, and herbaceous layers often are well-developed. Dominant canopy species always include *Liquidambar styraciflua* (sweetgum) and *Liriodendron tulipifera* (tuliptree), while *Acer barbatum* (southern sugar maple) and *Acer rubrum* var. *rubrum* (red maple) may also make up significant amounts of the canopy. This community type exists as a continuum between two subtypes, i.e., the tuliptree subtype and the sweetgum subtype. In some

examples, only one or the other dominates the canopy. However, in many examples, both are equally dominant. Common species in the canopy and understory include *Ilex opaca* var. *opaca* (American holly), *Aesculus sylvatica* (painted buckeye), *Carpinus caroliniana* ssp. *caroliniana* (American hornbeam), *Cornus florida* (flowering dogwood), *Fagus grandifolia* (American beech), *Juglans nigra* (black walnut), *Morus rubra* var. *rubra* (red mulberry), *Ostrya virginiana* var. *virginiana* (hophornbeam), *Oxydendrum arboreum* (sourwood), *Pinus echinata* (shortleaf pine), *Prunus serotina* var. *serotina* (black cherry), *Quercus alba* (white oak), *Quercus rubra* var. *rubra* (northern red oak), *Ulmus rubra* (slippery elm), *Ulmus americana* (American elm), *Ulmus alata* (winged elm), *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Nyssa sylvatica* (blackgum), *Fraxinus americana* (white ash), *Halesia tetraptera* var. *tetraptera* (mountain silverbell), *Arundinaria gigantea* ssp. *gigantea* (giant cane), *Cornus florida* (flowering dogwood), *Platanus occidentalis* (American sycamore), *Betula nigra* (river birch), and *Fraxinus pennsylvanica* (green ash). *Euonymus americanus* (strawberry bush), *Lindera benzoin* var. *benzoin* (northern spicebush), and *Corylus americana* (American hazelnut) are common and dominant in the shrub layer. The herbaceous layer is species-rich and often has good sedge development. The exotics *Microstegium vimineum* (Nepalese browntop), *Ligustrum sinense* (Chinese privet), and *Lonicera japonica* (Japanese honeysuckle) are common in this community.

**Environmental Description:** These forests develop along small streams. Soils are relatively acidic and relatively well-drained. Topographic differences from one floodplain to another, such as gradient and height above the creek, as well as floodplain microtopography (i.e., depositional landforms such as natural levees and sloughs) may influence the variation of vegetation within this association. However, in most floodplains supporting this type, the distinct alluvial landforms are poorly developed or occur at very small scales.

**Vegetation Description:** The canopy, subcanopy, shrub, and herbaceous layers of stands of this association are often well-developed. Dominant canopy species always include *Liquidambar styraciflua* (sweetgum) and *Liriodendron tulipifera* (tuliptree), while *Acer barbatum* (southern sugar maple) (in the southern part of the range) and *Acer rubrum* var. *rubrum* (red maple) may also make up significant amounts of the canopy. This community type exists as a continuum between two subtypes, i.e., the tuliptree subtype and the sweetgum subtype. In some examples, only one or the other dominates the canopy. However, in many examples, both are equally dominant. Other common species in the canopy and understory include *Ilex opaca* var. *opaca* (American holly), *Aesculus sylvatica* (painted buckeye), *Carpinus caroliniana* ssp. *caroliniana* (American hornbeam), *Cornus florida* (flowering dogwood), *Fagus grandifolia* (American beech), *Juglans nigra* (black walnut), *Morus rubra* var. *rubra* (red mulberry), *Ostrya virginiana* var. *virginiana* (hophornbeam), *Oxydendrum arboreum* (sourwood), *Pinus echinata* (shortleaf pine), *Prunus serotina* var. *serotina* (black cherry), *Quercus alba* (white oak), *Quercus rubra* var. *rubra* (northern red oak), *Ulmus rubra* (slippery elm), *Ulmus americana* (American elm), *Ulmus alata* (winged elm), *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Nyssa sylvatica* (blackgum), *Fraxinus americana* (white ash), *Halesia tetraptera* var. *tetraptera* (mountain silverbell), *Arundinaria gigantea* ssp. *gigantea* (giant cane), and *Fraxinus pennsylvanica* (green ash). Scattered individuals of *Platanus occidentalis* (American sycamore) and *Betula nigra* (river birch) may also occur in some stands. *Euonymus americanus* (strawberry bush), *Lindera benzoin* var. *benzoin* (northern spicebush), and *Corylus americana* (American hazelnut) are common and dominant in the shrub layer. Other shrub species that may be present include *Viburnum acerifolium* (mapleleaf viburnum), *Viburnum nudum* var. *nudum*

(possumhaw), *Viburnum prunifolium* (blackhaw), *Viburnum rufidulum* (rusty blackhaw), *Hamamelis virginiana* (American witchhazel), *Asimina triloba* (pawpaw), and *Ilex decidua* (possumhaw), among others. On the most acidic sites of the Maryland Coastal Plain, *Clethra alnifolia* (coastal sweetpepperbush), *Vaccinium corymbosum* (highbush blueberry), and *Magnolia virginiana* (sweetbay) may be present. Vines are prominent and include *Vitis rotundifolia* (muscadine), *Apios americana* (groundnut), *Campsis radicans* (trumpet creeper), *Aristolochia macrophylla* (pipevine), *Bignonia capreolata* (crossvine), *Dioscorea quaternata* (fourleaf yam), *Gelsemium sempervirens* (evening trumpetflower), *Parthenocissus quinquefolia* (Virginia creeper), *Campsis radicans* (trumpet creeper), *Passiflora lutea* (yellow passionflower), *Smilax bona-nox* (saw greenbrier), *Smilax glauca* (cat greenbrier), *Smilax hugeri* (Huger's carrionflower), *Smilax rotundifolia* (roundleaf greenbrier), and *Toxicodendron radicans* ssp. *radicans* (eastern poison ivy). The herbaceous layer is species-rich and often has good sedge development. Common species in this layer include *Thalictrum thalictroides* (rue anemone), *Trillium cuneatum* (little sweet Betsy), *Arisaema triphyllum* (Jack in the pulpit), *Asplenium platyneuron* var. *platyneuron* (ebony spleenwort), *Botrychium virginianum* (rattlesnake fern), *Carex* spp. (sedges), *Carex impressinervia* (ravine sedge), *Carex striatula* (lined sedge), *Cinna arundinacea* (sweet woodreed), *Elymus virginicus* (Virginia wildrye), *Galium circaezans* (licorice bedstraw), *Geum canadense* (white avens), *Medeola virginiana* (Indian cucumber), *Polystichum acrostichoides* (Christmas fern), and *Scutellaria integrifolia* (helmet flower), among many others. *Thelypteris noveboracensis* (New York fern) is a common patch-dominant in the northern part of the range and the Uwharrie Mountains of North Carolina. The exotics *Microstegium vimineum* (Nepalese browntop), *Ligustrum sinense* (Chinese privet), and *Lonicera japonica* (Japanese honeysuckle) are common in this community. Other exotics that colonize quickly in disturbed and fragmented versions of this association include *Wisteria sinensis* (Chinese wisteria), *Rosa multiflora* (multiflora rose), *Clematis terniflora* (sweet autumn virginsbower), *Hedera helix* (English ivy), and *Elaeagnus* sp. (an elaeagnus).

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Liquidambar styraciflua* (sweetgum), *Liriodendron tulipifera* (tuliptree) |

**Characteristic Species:** *Arisaema triphyllum* (Jack in the pulpit), *Asplenium platyneuron* (ebony spleenwort), *Botrychium virginianum* (rattlesnake fern), *Campsis radicans* (trumpet creeper), *Carex striatula* (lined sedge), *Cinna arundinacea* (sweet woodreed), *Corylus americana* (American hazelnut), *Elymus virginicus* (Virginia wildrye), *Euonymus americanus* (strawberry bush), *Galium circaezans* (licorice bedstraw), *Geum canadense* (white avens), *Lindera benzoin* (northern spicebush), *Liquidambar styraciflua* (sweetgum), *Liriodendron tulipifera* (tuliptree), *Medeola virginiana* (Indian cucumber), *Polystichum acrostichoides* (Christmas fern), *Scutellaria integrifolia* (helmet flower), *Smilax rotundifolia* (roundleaf greenbrier), *Thalictrum thalictroides* (rue anemone), *Toxicodendron radicans* (eastern poison ivy), *Trillium cuneatum* (little sweet Betsy).

**Other Noteworthy Species:**

| Species | GRank | Type | Note |
|---|---|---|---|
| *Carex impressinervia* (ravine sedge) | G1G2 | plant | |

**USFWS Wetland System:** Palustrine.

**DISTRIBUTION**

**Range:** This association is found in the Chesapeake Bay Lowlands, the Piedmont, and other low-elevation interior ecoregions (e.g., parts of the Cumberland Plateau and Ridge and Valley). It is defined as being absent from the Mid-Atlantic Coastal Plain of southeastern Virginia, the Carolinas, and Georgia. Its status in the Upper East Gulf Coastal Plain is unknown.
**States/Provinces:** GA, MD, NC, SC?, TN, VA.
**Federal Lands:** DOD (Fort Belvoir); NPS (Chickamauga-Chattanooga, Colonial, Cowpens, Fredericksburg-Spotsylvania, Guilford Courthouse, Kings Mountain, National Capital-East, Petersburg, Prince William, Richmond, Thomas Stone); USFS (Uwharrie).

**CONSERVATION STATUS**

**Rank:** G4 (15-Feb-2007).
**Reasons:** This community is widespread from the Coastal Plain of Maryland and Virginia through the Piedmont of Virginia and North Carolina to the Cumberland Plateau. Very few streams supporting this type have impoundments or diversions, and most are protected by wetland regulations. However, few, if any, pristine examples remain, and all are highly threatened by invasive exotic species that have colonized most of the remaining examples of this association.

**CLASSIFICATION INFORMATION**

**Status:** Standard.
**Confidence:** 3 - Weak.
**Comments:** At Chickamauga-Chattanooga National Military Park, this association was observed on Lookout Creek, but no plot data were taken. Low-quality occurrences of this type may look very similar to some occurrences of *Liquidambar styraciflua - (Liriodendron tulipifera)* Temporarily Flooded Forest (CEGL007330). The presence of higher quality patches of native herbs and stands of native shrubs such as *Lindera benzoin* (northern spicebush) is the best way to distinguish these two types. In addition, stands of CEGL007330 will generally be more even-aged and single species-dominated than this association (CEGL004418).

**Similar Associations:**

- *Liquidambar styraciflua - (Liriodendron tulipifera)* Temporarily Flooded Forest (CEGL007330)--occurs in the same habitat but is a highly impacted version of this forest that occurs on old farm fields and other second-growth areas.
- *Liquidambar styraciflua* Forest (CEGL007216).
- *Liriodendron tulipifera - Acer (rubrum, negundo) - (Platanus occidentalis) / Carpinus caroliniana / Polygonum virginianum* Forest (CEGL006492).

**Related Concepts:**

- *Liquidambar styraciflua - Quercus palustris / Carpinus caroliniana / Carex intumescens* Forest (Meininger and McCarthy 1998) ?
- Maple-Gum Association of the Western Shore District (Shreve et al. 1910) B

**SOURCES**

**Description Authors:** R. K. Peet, mod. R. White, M. Pyne, G. P. Fleming.
**References:** Fleming et al. 2001, Meininger and McCarthy 1998, Naczi et al. 2002, Peet et al. unpubl. data 2002, Schafale and Weakley 1990, Shreve et al. 1910, Southeastern Ecology Working Group n.d.



Figure I13. Coastal Plain / Piedmont Small-Stream Floodplain Forest at Colonial National Historical Park. September 2004. NAD 1983 / UTM easting 365243, northing 4119396.

## COMMON NAME (PARK-SPECIFIC): COASTAL PLAIN / PIEDMONT FLOODPLAIN SWAMP FOREST (GREEN ASH - RED MAPLE TYPE)

**SYNONYMS**
**USNVC English Name:** **Red Maple - Green Ash / Lizard's-tail Forest**
**USNVC Scientific Name:** ***Acer rubrum - Fraxinus pennsylvanica / Saururus cernuus* Forest**
**USNVC Identifier:** **CEGL006606**

### LOCAL INFORMATION

**Environmental Description:** Coastal Plain / Piedmont Floodplain Swamp (Green Ash – Red Maple Type) occurs on poorly drained areas along small streams and in backswamps along the outer edges of large floodplains.. These bottomlands have pronounced seasonal flooding and hummock-and-hollow microtopography.
**Vegetation Description:** These broad-leaved deciduous forests are dominated by various combinations or pure stands of *Fraxinus pennsylvanica* (green ash) and/or *Acer rubrum* (red maple). Other inconstant, low-frequency canopy trees may include *Liquidambar styraciflua* (sweetgum), *Quercus michauxii* (swamp chestnut oak), *Pinus taeda* (loblolly pine), and *Platanus occidentalis* (American sycamore). Shrub and understory strata can be sparse or moderately dense with species varying from site to site. Typical shrub layer species may include *Fraxinus pennsylvanica* (green ash) and *Cornus foemina* (stiff dogwood). Herbaceous composition varies with microhabitats. Hummocks usually support *Boehmeria cylindrica* (smallspike false nettle), *Chasmanthium laxum* (slender woodoats), *Cinna arundinacea* (sweet woodreed), *Pilea pumila* (Canadian clearweed), *Glyceria striata* (fowl mannagrass), *Impatiens capensis* (jewelweed), and many *Carex* spp. (sedges) like *Carex crinita* (fringed sedge), *Carex gracillima* (graceful sedge), *Carex granularis* (limestone meadow sedge), *Carex intumescens* (greater bladder sedge), *Carex laevivaginata* (smoothsheath sedge), *Carex lupulina* (hop sedge), *Carex lurida* (shallow sedge), *Carex oxylepis* (sharpscale sedge), *Carex stipata* (owlfruit sedge), *Carex styloflexa* (bent sedge), and *Carex tribuloides* (blunt broom sedge). Hollows are usually dominated by *Saururus cernuus* (lizard's tail), with associates such as *Peltandra virginica* (green arrow arum), *Rumex verticillatus* (swamp dock), *Triadenum walteri* (greater marsh St. Johnswort), and in more disturbed areas, *Juncus effusus* (common rush) and *Mikania scandens* (climbing hempvine).

Coastal Plain / Piedmont Floodplain Swamp (Green Ash – Red Maple Type) occurs on poorly drained areas along small streams, but some areas mapped may be cut off from former natural flooding regimes due to the presence of roads, ditching, or beaver activities. Disturbed stands of Coastal Plain / Piedmont Floodplain Swamp (Green Ash – Red Maple Type) may have mostly coppice regeneration and little herb cover other than *Lonicera japonica* (Japanese honeysuckle) and *Microstegium vimineum* (Nepalese browntop), which occur on hummocks.
**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Acer rubrum* (red maple), *Fraxinus pennsylvanica* (green ash) |
| Herb (field) | Forb | *Saururus cernuus* (lizard's tail) |

**Characteristic Species:** *Acer rubrum* (red maple), *Carex tribuloides* (blunt broom sedge), *Fraxinus pennsylvanica* (green ash), *Leersia oryzoides* (rice cutgrass), *Saururus cernuus* (lizard's tail).
**Other Noteworthy Species:** Information not available.
**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | 1 | Coastal Plain / Piedmont Swamp Forest | Fleming et al. 2006 |

**Local Range:** Coastal Plain / Piedmont Floodplain Swamp (Green Ash – Red Maple Type) is mapped as one polygon in Yorktown Battlefield where it occurs along Beaverdam Creek and covers 30.9 hectares (76.4 acres).
**Classification Comments:** Coastal Plain / Piedmont Floodplain Swamp (Green Ash – Red Maple Type) is distinguished from other wetland forests by being seasonally flooded with deep muck and standing water prevalent and with canopies dominated by *Fraxinus pennsylvanica* (green ash) and/or *Acer rubrum* (red maple), and by occurring on the outer edges of large floodplains rather than in narrow ravine bottoms or as isolated wetlands. Some disturbed stands of Non-Riverine Saturated Forest may be similar to this mapping unit but are distinguished by the non-riverine landscape position (on terraces well away from current or historic river channels) and by the greater frequency of *Liquidambar styraciflua* (sweetgum).
**Other Comments:** The delineation of the boundary between this association and Coastal Plain / Piedmont Small-Stream Floodplain Forest is somewhat arbitrary. On the ground the transitions (ecotones) between the two associations may be quite broad, with hydrology and species composition changing gradually over a distance. These ecotonal areas may be transitional in species composition and concept.

Areas heavily impacted by beavers may be transitional in concept to Semipermanent Impoundment
**Local Description Authors:** K. D. Patterson.
**Plots:** COLO.12, COLO.17.
**Colonial National Historical Park Inventory Notes:** Information 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 | Seasonally flooded cold-deciduous forest (I.B.2.N.e.) |
| Alliance | *Acer rubrum - Fraxinus pennsylvanica* Seasonally Flooded Forest Alliance (A.316) |
| Alliance (English name) | Red Maple - Green Ash Seasonally Flooded Forest Alliance |
| Association | *Acer rubrum - Fraxinus pennsylvanica / Saururus cernuus* Forest |
| Association (English name) | Red Maple - Green Ash / Lizard's-tail Forest |
| **Ecological System(s):** | Northern Atlantic Coastal Plain Basin Swamp and Wet Hardwood Forest (CES203.520).<br>Northern Atlantic Coastal Plain Stream and River (CES203.070). |

### GLOBAL DESCRIPTION

**Concept Summary:** This red maple swamp community of the Mid-Atlantic Coastal Plain of the Chesapeake Bay and Piedmont regions occurs on poorly drained to very poorly drained soils on

flats and along watercourses that are seasonally to semipermanently flooded. The organic horizon is of variable depth and overlies sandy or silt clay loam soils. This swamp has pronounced hummock-and-hollow microtopography. The tree canopy is closed to partially open and dominated by *Acer rubrum* (red maple) and *Fraxinus pennsylvanica* (green ash). Other canopy associates may include *Nyssa sylvatica* (blackgum), *Liquidambar styraciflua* (sweetgum), *Ulmus americana* (American elm), *Quercus lyrata* (overcup oak), *Quercus phellos* (willow oak), *Quercus lyrata* (overcup oak), and *Populus heterophylla* (swamp cottonwood). The shrub layer includes *Lindera benzoin* (northern spicebush), *Leucothoe racemosa* (swamp doghobble), *Ilex verticillata* (common winterberry), *Viburnum* spp. (viburnums), and *Fraxinus pennsylvanica* (green ash) saplings. The herb layer is characterized by *Saururus cernuus* (lizard's tail), *Peltandra virginica* (green arrow arum), *Boehmeria cylindrica* (smallspike false nettle), *Triadenum walteri* (greater marsh St. Johnswort), *Cinna arundinacea* (sweet woodreed), *Pilea pumila* (Canadian clearweed), *Impatiens capensis* (jewelweed), *Osmunda regalis* (royal fern), *Leersia oryzoides* (rice cutgrass), *Leersia virginica* (whitegrass), *Glyceria striata* (fowl mannagrass), *Rumex verticillatus* (swamp dock), *Carex* spp. (sedges), and *Polygonum arifolium* (halberdleaf tearthumb).

**Environmental Description:** This swamp forest occurs in backswamps, watercourses, flats and depressions that are flooded for significant portions of the growing season. These areas receive some nutrient inputs from adjacent uplands or overland flooding and have soils that are moderately calcareous. The substrate is deep muck with a pronounced hummock-and-hollow microtopography.

**Vegetation Description:** This forest type is characterized by a well-developed tree canopy codominated by *Acer rubrum* (red maple) and *Fraxinus pennsylvanica* (green ash) in variable proportions. Other canopy associates may include *Nyssa sylvatica* (blackgum), *Quercus phellos* (willow oak), *Quercus lyrata* (overcup oak), *Ulmus americana* (American elm), and *Populus heterophylla* (swamp cottonwood). At the southern end of the range, *Nyssa biflora* (swamp tupelo) and *Taxodium distichum* (bald cypress) may be minor associates. The shrub layer is of variable cover but usually not dense. The most common species are *Lindera benzoin* (northern spicebush), *Leucothoe racemosa* (swamp doghobble), *Vaccinium corymbosum* (highbush blueberry), *Ilex verticillata* (common winterberry), *Carpinus caroliniana* (American hornbeam), *Rosa palustris* (swamp rose), and *Viburnum dentatum* (southern arrowwood). Other shrub associates may include *Rhododendron viscosum* (swamp azalea), *Cephalanthus occidentalis* (common buttonbush), *Alnus serrulata* (hazel alder), and *Cornus amomum* (silky dogwood). The herb layer is diverse and generally characterized by abundant *Saururus cernuus* (lizard's tail), typically in hollows. Other associates are many and varied but generally include *Peltandra virginica* (green arrow arum), *Impatiens capensis* (jewelweed), *Pontederia cordata* (pickerelweed), *Boehmeria cylindrica* (smallspike false nettle), *Glyceria* spp. (mannagrasses), *Cinna arundinacea* (sweet woodreed), *Bidens connata* (purplestem beggarticks), *Thelypteris palustris* (eastern marsh fern), *Onoclea sensibilis* (sensitive fern), *Osmunda regalis* (royal fern), *Carex stricta* (upright sedge), *Carex lurida* (shallow sedge), *Carex crinita* (fringed sedge), *Triadenum walteri* (greater marsh St. Johnswort), *Lobelia cardinalis* (cardinalflower), *Lycopus virginicus* (Virginia water horehound), *Pilea pumila* (Canadian clearweed), *Carex tribuloides* (blunt broom sedge), *Polygonum punctatum* (dotted smartweed), *Polygonum arifolium* (halberdleaf tearthumb), *Cicuta maculata* (spotted water hemlock), *Leersia oryzoides* (rice cutgrass), *Galium obtusum* (bluntleaf bedstraw), and others. Vines may include *Toxicodendron radicans* (eastern poison ivy), *Smilax rotundifolia* (roundleaf greenbrier), *Campsis radicans*

(trumpet creeper), and *Parthenocissus quinquefolia* (Virginia creeper). Mosses are generally sparse to absent, except on logs and tree bases above the high-water line.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Acer rubrum* (red maple), *Fraxinus pennsylvanica* (green ash) |
| Herb (field) | Forb | *Saururus cernuus* (lizard's tail) |

**Characteristic Species:** *Acer rubrum* (red maple), *Bidens connata* (purplestem beggarticks), *Boehmeria cylindrica* (smallspike false nettle), *Carex crinita* (fringed sedge), *Carex lurida* (shallow sedge), *Carex stricta* (upright sedge), *Carex tribuloides* (blunt broom sedge), *Carpinus caroliniana* (American hornbeam), *Cicuta maculata* (spotted water hemlock), *Cinna arundinacea* (sweet woodreed), *Fraxinus pennsylvanica* (green ash), *Galium obtusum* (bluntleaf bedstraw), *Ilex verticillata* (common winterberry), *Impatiens capensis* (jewelweed), *Leersia oryzoides* (rice cutgrass), *Leucothoe racemosa* (swamp doghobble), *Lindera benzoin* (northern spicebush), *Lobelia cardinalis* (cardinalflower), *Lycopus virginicus* (Virginia water horehound), *Onoclea sensibilis* (sensitive fern), *Osmunda regalis* (royal fern), *Peltandra virginica* (green arrow arum), *Pilea pumila* (Canadian clearweed), *Polygonum arifolium* (halberdleaf tearthumb), *Polygonum punctatum* (dotted smartweed), *Pontederia cordata* (pickerelweed), *Rosa palustris* (swamp rose), *Saururus cernuus* (lizard's tail), *Thelypteris palustris* (eastern marsh fern), *Triadenum walteri* (greater marsh St. Johnswort), *Vaccinium corymbosum* (highbush blueberry), *Viburnum dentatum* (southern arrowwood).

**Other Noteworthy Species:** Information not available.

**USFWS Wetland System:** Palustrine.

### DISTRIBUTION

**Range:** This red maple - green ash swamp community occurs in the Coastal Plain of the Chesapeake Bay region and rarely in the adjacent Piedmont from New Jersey to central Virginia.

**States/Provinces:** DE, MD, NJ, VA.

**Federal Lands:** DOD (Fort Belvoir); NPS (Colonial, National Capital-East); USFWS (Chesapeake Marshlands, Great Swamp).

### CONSERVATION STATUS

**Rank:** GNR (21-Mar-2000).

**Reasons:** This association requires global ranking.

### CLASSIFICATION INFORMATION

**Status:** Standard.

**Confidence:** 1 - Strong.

**Comments:** Classification is supported by analysis of a 1250-plot regional dataset compiled for the NCR and MAR national parks vegetation mapping projects. In that analysis, this association was represented by 23 Maryland and Virginia plots.

**Similar Associations:**

- *Acer (rubrum, saccharinum) - Fraxinus pennsylvanica - Ulmus americana / Boehmeria cylindrica* Forest (CEGL006548).

**Related Concepts:**

- *Fraxinus pennsylvanica - Acer rubrum / Cinna arundinacea - Saururus cernuus - Boehmeria cylindrica* Forest (VDNH 2003) =

**SOURCES**

**Description Authors:** D. Thompson, J. Meininger, L. A. Sneddon, mod. L. A. Sneddon and G. P. Fleming.

**References:** Bowman 2000, Breden et al. 2001, Eastern Ecology Working Group n.d., Fleming 2001, Harrison 2004, Harrison and Stango 2003, Meininger 1998, Thomson et al. 1999, VDNH 2003.



Figure I14. Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash – Red Maple Type) (plot COLO.17) at Colonial National Historical Park. July 2004. NAD 1983 / UTM easting 365101, northing 4118166.

## COMMON NAME (PARK-SPECIFIC): COASTAL PLAIN DEPRESSION WETLAND (SWAMP TUPELO TYPE)

**SYNONYMS**

**USNVC English Name:** **Sweetgum - Red Maple - Swamp Blackgum / Cypress Swamp Sedge Forest**

**USNVC Scientific Name:** ***Liquidambar styraciflua - Acer rubrum - Nyssa biflora / Carex joorii* Forest**

**USNVC Identifier:** **CEGL006223**

### LOCAL INFORMATION

**Environmental Description:** Coastal Plain Depression Wetland (Swamp Tupelo Type) occurs as a seasonally flooded deciduous forest in an otherwise upland landscape. It includes poorly drained basin wetlands occurring on nearly flat Coastal Plain terraces with fluctuating, seasonally perched water tables. Most of these wetlands are seasonally flooded and are believed to be sinkhole features that formed through dissolution of underlying carbonate-rich, shell marl deposits. The marl deposits are too deep to influence soil or water chemistry of the depressions, which are strongly acidic in most examples. This association typically occupies the more deeply flooded ponds or pond centers that are flooded to depths > 50 cm (2 ft).

**Vegetation Description:** In Colonial National Historical Park, Coastal Plain Depression Wetland (Swamp Tupelo Type) includes forested ponds with *Acer rubrum* (red maple), *Liquidambar styraciflua* (sweetgum), and *Nyssa biflora* (swamp tupelo). Shrubs include *Leucothoe racemosa* (swamp doghobble) and *Cephalanthus occidentalis* (common buttonbush). During the winter and spring these ponds are often filled with water. When drawn down, these communities have very sparse herb strata with the ground covered in litter and bare soil. Herb species vary from site to site, but in general, herbs characteristic of these communities are well-adapted to long periods of submersion. Some typical herbaceous species in park examples include *Carex joorii* (cypress swamp sedge) and *Carex striata* var. *brevis* (Walter's sedge).

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Acer rubrum* (red maple), *Liquidambar styraciflua* (sweetgum) |

**Characteristic Species:** *Acer rubrum* (red maple), *Carex joorii* (cypress swamp sedge), *Liquidambar styraciflua* (sweetgum), *Nyssa biflora* (swamp tupelo).

**Other Noteworthy Species:** Information not available.

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | . | Coastal Plain Depression Pond | Fleming et al. 2001 |

**Local Range:** This association is mapped as a single polygon in the vicinity of Yorktown Battlefield.

**Classification Comments:** This community is distinguished by occurring as small, isolated wetlands in an otherwise upland landscape and by the presence of *Nyssa biflora* (swamp tupelo). It has a longer hydroperiod than Coastal Plain Depression Wetland (Red Maple - Sweetgum - WIllow Oak Type).

**Other Comments:** No information.

**Local Description Authors:** K. D. Patterson.

**Plots:** None.
**Colonial National Historical Park Inventory Notes:** Information 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 | Seasonally flooded cold-deciduous forest (I.B.2.N.e.) |
| Alliance | *Liquidambar styraciflua - (Acer rubrum)* Seasonally Flooded Forest Alliance (A.321) |
| Alliance (English name) | Sweetgum - (Red Maple) Seasonally Flooded Forest Alliance |
| Association | *Liquidambar styraciflua - Acer rubrum - Nyssa biflora / Carex joorii* Forest |
| Association (English name) | Sweetgum - Red Maple - Swamp Blackgum / Cypress Swamp Sedge Forest |
| **Ecological System(s):** | Northern Atlantic Coastal Plain Basin Swamp and Wet Hardwood Forest (CES203.520).<br>Northern Atlantic Coastal Plain Pondshore (CES203.518). |

### GLOBAL DESCRIPTION

**Concept Summary:** This seasonally flooded hardwood forest community occurs in groundwater basins on the Coastal Plain of Maryland and Virginia. The canopy is of variable closure and is dominated by *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), and *Nyssa biflora* (swamp tupelo). Associated canopy species include *Quercus lyrata* (overcup oak), *Quercus laurifolia* (laurel oak) and *Diospyros virginiana* (common persimmon). The shrub layer is comprised of *Leucothoe racemosa* (swamp doghobble) and scattered *Cephalanthus occidentalis* (common buttonbush). The herbaceous layer is characterized by *Carex joorii* (cypress swamp sedge), *Carex striata* var. *brevis* (Walter's sedge), *Panicum verrucosum* (warty panicgrass), *Fimbristylis autumnalis* (slender fimbry), and others.
**Environmental Description:** This seasonally flooded hardwood forest community occurs in seasonally flooded groundwater basins on the Coastal Plain of Maryland and Virginia.
**Vegetation Description:** The canopy of stands of this type is of variable closure and is dominated by *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), and *Nyssa biflora* (swamp tupelo). Associated canopy species include *Quercus lyrata* (overcup oak), *Quercus laurifolia* (laurel oak) and *Diospyros virginiana* (common persimmon). The shrub layer is comprised of *Leucothoe racemosa* (swamp doghobble) and scattered *Cephalanthus occidentalis* (common buttonbush). The herbaceous layer is characterized by *Carex joorii* (cypress swamp sedge), *Carex striata* (Walter's sedge), *Panicum verrucosum* (warty panicgrass), *Fimbristylis autumnalis* (slender fimbry), and others.
**Most Abundant Species:** Information not available.
**Characteristic Species:** Information not available.
**Other Noteworthy Species:** Information not available.
**USFWS Wetland System:** Palustrine.

### DISTRIBUTION

**Range:** This community is limited to small seasonally flooded depressions of the Coastal Plain of Maryland and Virginia.
**States/Provinces:** MD, VA.
**Federal Lands:** NPS (Colonial); USFWS (Chesapeake Marshlands).

**CONSERVATION STATUS**

**Rank:** G1G2 (20-Nov-1997).

**Reasons:** This community is limited to small seasonally flooded depressions of the coastal plain of Maryland and Virginia. The community is naturally small in size, reaching no more than 25 acres and on average is less than this size. The greatest threat to this community is incompatible human use of surrounding lands, generally agriculture with insufficient buffers to protect from pesticide and fertilizer use. Since this community depends on intact hydrology, another major threat is altered hydrology from ditching or over-pumping of groundwater.

**CLASSIFICATION INFORMATION**

**Status:** Standard.

**Confidence:** 2 - Moderate.

**Comments:** Information not available.

**Similar Associations:**

- *Acer rubrum - Nyssa biflora - (Liquidambar styraciflua, Fraxinus* sp.) Maritime Swamp Forest (CEGL004082).

**Related Concepts:** Information not available.

**SOURCES**

**Description Authors:** L. A. Sneddon.

**References:** Eastern Ecology Working Group n.d., Fleming et al. 2001, Harrison 2004, J. Harrison pers. comm., Rawinski 1997, Sneddon et al. 1996.

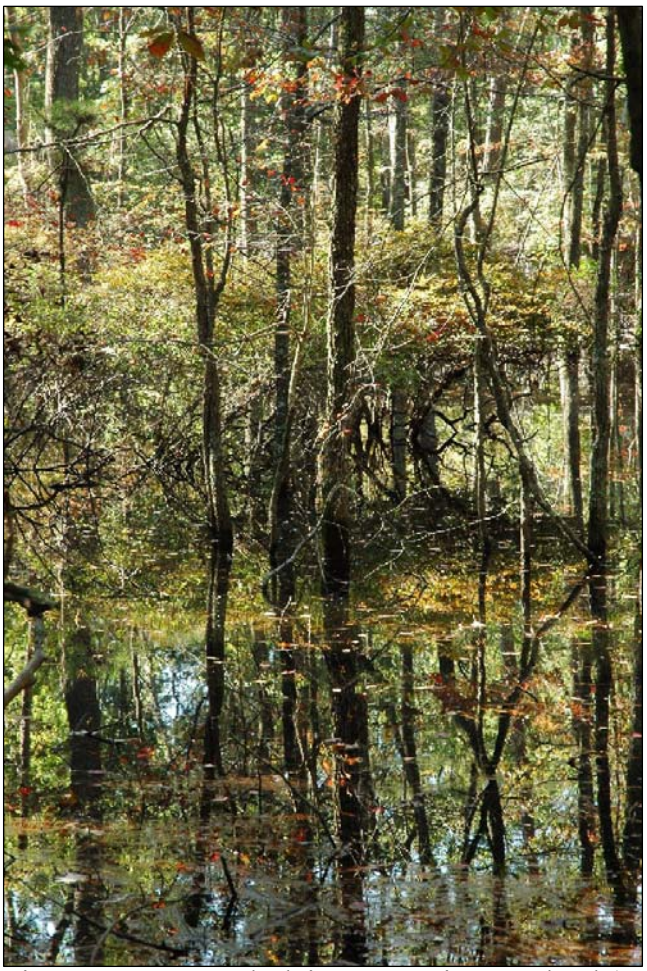


Figure I15. Coastal Plain Depression Wetland (Swamp Tupelo Type) at Colonial National Historical Park. September 2004. NAD 1983 / UTM easting 366051, northing 4117556.

## COMMON NAME (PARK-SPECIFIC): COASTAL PLAIN DEPRESSION WETLAND (RED MAPLE - SWEETGUM - WILLOW OAK TYPE)

**SYNONYMS**

**USNVC English Name:** **Sweetgum - Red Maple - Willow Oak / Swamp Doghobble Forest**

**USNVC Scientific Name:** ***Liquidambar styraciflua - Acer rubrum - Quercus phellos / Leucothoe racemosa* Forest**

**USNVC Identifier:** **CEGL006110**

### LOCAL INFORMATION

**Environmental Description:** Coastal Plain Depression Wetland occurs as a seasonally flooded deciduous forest in an otherwise upland landscape. It includes poorly drained basin wetlands occurring on nearly flat Coastal Plain terraces with fluctuating, seasonally perched water tables. Most of these wetlands are seasonally flooded and are believed to be sinkhole features that formed through dissolution of underlying carbonate-rich, shell marl deposits. The marl deposits are too deep to influence soil or water chemistry of the depressions, which are strongly acidic in most examples. This community type typically occupies ponds that are flooded to depths < 50 cm (2 ft).

**Vegetation Description:** In Colonial National Historical Park, Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type) includes forested ponds with *Acer rubrum* (red maple), *Liquidambar styraciflua* (sweetgum), *Nyssa sylvatica* (blackgum), and *Quercus phellos* (willow oak) as typical canopy components. Shrubs that dominate some ponds include *Ilex opaca* var. *opaca* (American holly), *Vaccinium corymbosum* (highbush blueberry), and *Leucothoe racemosa* (swamp doghobble). During the winter and spring these ponds are often filled with water. When drawn down, these communities have very sparse herb strata with the ground covered in litter and bare soil. Herb species vary from site to site, but in general, herbs characteristic of these communities are well-adapted to long periods of submersion. Some typical herbaceous species in Colonial National Historical Park examples include *Carex joorii* (cypress swamp sedge), *Juncus effusus* (common rush), *Osmunda regalis* var. *spectabilis* (royal fern), *Thelypteris palustris* var. *pubescens* (eastern marsh fern), and *Woodwardia areolata* (netted chainfern). Some examples may have cover by *Sphagnum* spp. (sphagnum mosses).

Coastal Plain Depression Wetland occurs in patches of 0.5 ha or less than. Disturbed ponds may have *Pinus taeda* (loblolly pine) as a component and less diverse vegetation strata. Many examples in the park have canopy wind damage from past hurricanes.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Acer rubrum* (red maple), *Liquidambar styraciflua* (sweetgum) |

**Characteristic Species:** *Acer rubrum* (red maple), *Carex joorii* (cypress swamp sedge), *Liquidambar styraciflua* (sweetgum), *Quercus phellos* (willow oak).

**Other Noteworthy Species:** Information not available.

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | . | Coastal Plain Depression Wetland | . |

**Local Range:** This association is mapped as five polygons in Yorktown Battlefield.
**Classification Comments:** This community is distinguished by occurring as small, isolated wetlands in an otherwise upland landscape. Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type) has a shorter hydroperiod (less deeply flooded) than the other association in the map class Coastal Plain Depression Wetland (Swamp Tupelo Type).
**Other Comments:** Information not available.
**Local Description Authors:** K. D. Patterson.
**Plots:** COLO.7.
**Colonial National Historical Park Inventory Notes:** Information 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 | Seasonally flooded cold-deciduous forest (I.B.2.N.e.) |
| Alliance | *Liquidambar styraciflua - (Acer rubrum)* Seasonally Flooded Forest Alliance (A.321) |
| Alliance (English name) | Sweetgum - (Red Maple) Seasonally Flooded Forest Alliance |
| Association | *Liquidambar styraciflua - Acer rubrum - Quercus phellos / Leucothoe racemosa* Forest |
| Association (English name) | Sweetgum - Red Maple - Willow Oak / Swamp Doghobble Forest |
| **Ecological System(s):** | Northern Atlantic Coastal Plain Basin Swamp and Wet Hardwood Forest (CES203.520). |
| | Northern Atlantic Coastal Plain Pondshore (CES203.518). |

### GLOBAL DESCRIPTION

**Concept Summary:** This association is a seasonally flooded forest of shallow basins and other depressions of the Coastal Plain of the Chesapeake Bay region. The substrate is characterized by mineral soils, generally acidic, gleyed to mottled, sandy or clay loams. Characteristic tree species include *Acer rubrum* (red maple), *Liquidambar styraciflua* (sweetgum), and *Nyssa sylvatica* (blackgum), which are nearly constant in the canopy. Associates include *Ilex opaca* var. *opaca* (American holly), *Magnolia virginiana* (sweetbay), *Nyssa biflora* (swamp tupelo), *Sassafras albidum* (sassafras), *Quercus palustris* (pin oak), *Pinus taeda* (loblolly pine), and *Quercus phellos* (willow oak), and occasionally *Quercus falcata* (southern red oak), *Quercus lyrata* (overcup oak), or *Betula nigra* (river birch). The shrub layer is characterized by *Leucothoe racemosa* (swamp doghobble), *Vaccinium corymbosum* (highbush blueberry), *Clethra alnifolia* (coastal sweetpepperbush), *Lindera benzoin* (northern spicebush), *Ilex verticillata* (common winterberry), and *Rhododendron viscosum* (swamp azalea). *Smilax rotundifolia* (roundleaf greenbrier) is a particularly characteristic vine. The herbaceous layer is generally sparse but may include *Mitchella repens* (partridgeberry), *Osmunda cinnamomea* (cinnamon fern), *Chasmanthium laxum* (slender woodoats), *Woodwardia areolata* (netted chainfern), *Onoclea sensibilis* (sensitive fern), *Osmunda regalis* (royal fern), *Carex albolutescens* (greenwhite sedge), *Carex debilis* var. *debilis* (white edge sedge), *Scirpus cyperinus* (woolgrass), *Juncus effusus* (common rush), and *Polygonum* spp. (knotweeds). *Carex joorii* (cypress swamp sedge) is inconstant but locally abundant in some stands in the southern part of the range.
**Environmental Description:** This type occurs in seasonally flooded shallow basins or depressions. Substrates are acidic, gleyed to mottled, sandy or clay loams. Sites are commonly

flooded by perched groundwater to depths up to about 50 cm during the winter and early part of the growing season, but commonly are drawn down by late summer. Soils collected from 12 Virginia plot samples were extremely acidic (mean pH = 4.1) with very low cation levels and total base saturation.

**Vegetation Description:** Characteristic tree species include *Acer rubrum* (red maple), *Liquidambar styraciflua* (sweetgum), and *Nyssa sylvatica* (blackgum), which are nearly constant in the canopy. *Quercus phellos* (willow oak) is an important associate or codominant in many stands. Other associates include *Ilex opaca* var. *opaca* (American holly), *Magnolia virginiana* (sweetbay), *Nyssa biflora* (swamp tupelo), *Sassafras albidum* (sassafras), *Quercus palustris* (pin oak), *Pinus taeda* (loblolly pine), and occasionally *Quercus falcata* (southern red oak), *Quercus lyrata* (overcup oak), or *Betula nigra* (river birch). The shrub layer is characterized by *Leucothoe racemosa* (swamp doghobble), *Vaccinium corymbosum* (highbush blueberry), *Vaccinium fuscatum* (black highbush blueberry), *Vaccinium formosum* (southern blueberry), *Clethra alnifolia* (coastal sweetpepperbush), *Lindera benzoin* (northern spicebush), *Ilex verticillata* (common winterberry), and *Rhododendron viscosum* (swamp azalea). *Smilax rotundifolia* (roundleaf greenbrier) is a particularly characteristic vine, often forming dense tangles among the shrubs. The herbaceous layer is generally sparse but may include *Mitchella repens* (partridgeberry), *Osmunda cinnamomea* (cinnamon fern), *Chasmanthium laxum* (slender woodoats), *Woodwardia areolata* (netted chainfern), *Onoclea sensibilis* (sensitive fern), *Osmunda regalis* (royal fern), *Carex albolutescens* (greenwhite sedge), *Carex debilis* var. *debilis* (white edge sedge), *Scirpus cyperinus* (woolgrass), *Juncus effusus* (common rush), and *Polygonum* spp. (knotweeds). *Carex joorii* (cypress swamp sedge) is inconstant but locally abundant in some stands in the southern part of the range.

**Most Abundant Species:** Information not available.

**Characteristic Species:** Information not available.

**Other Noteworthy Species:** Information not available.

**USFWS Wetland System:** Palustrine.

### DISTRIBUTION

**Range:** This association is a seasonally flooded forest of shallow basins and depressions in the Chesapeake Bay region. It is primarily associated with the Coastal Plain but occurs locally in gentle, highly acidic terrain of the eastern Piedmont in central and southern Virginia.

**States/Provinces:** DE, MD, NJ:S3, NY:S1S2, PA, VA.

**Federal Lands:** DOD (Fort Belvoir, Yorktown); NPS (Colonial, Fredericksburg-Spotsylvania, National Capital-East, Thomas Stone); USFWS (Chesapeake Marshlands, Prime Hook).

### CONSERVATION STATUS

**Rank:** G4G5 (31-Jan-2007).

**Reasons:** Information not available.

**CLASSIFICATION INFORMATION**

**Status:** Standard.

**Confidence:** 1 - Strong.

**Comments:** Classification of this type is supported by two regional analyses of Maryland and Virginia plot data conducted by VDNH for the NCR vegetation mapping project. It is represented by 15 plots from the greater NCR region and an additional 57 plots from The Peninsula in York County, Virginia (Grafton Ponds complex). Delaware examples contain *Quercus* spp. (oaks) and *Magnolia virginiana* (sweetbay). In Maryland, *Clethra* (sweetpepperbush) is more prominent than *Leucothoe* (doghobble), *Quercus phellos* (willow oak) less characteristic than *Nyssa sylvatica* (blackgum).

**Similar Associations:**

- *Acer rubrum / Lindera benzoin - Alnus serrulata* Forest (CEGL006953).
- *Pinus serotina / Magnolia virginiana / Vaccinium corymbosum / Carex atlantica* Woodland (CEGL006470).
- *Populus heterophylla - Acer rubrum - Quercus palustris - Liquidambar styraciflua* Forest (CEGL006469).
- *Quercus (phellos, pagoda, michauxii) / Ilex opaca* var. *opaca / Clethra alnifolia / Woodwardia areolata* Forest (CEGL004644).
- *Quercus palustris - (Quercus bicolor) - Acer rubrum / Vaccinium corymbosum / Osmunda cinnamomea* Forest (CEGL006240).
- *Quercus phellos / Carex (albolutescens, intumescens, joorii) / Climacium americanum* Forest (CEGL007403)--of the Virginia Piedmont and more southerly areas, dominated by *Quercus phellos*.

**Related Concepts:**

- *Acer rubrum - Liquidambar styraciflua - (Quercus phellos) / Vaccinium corymbosum* Forest (VDNH 2003) =
- *Leucothoe racemosa* communities (Tyndall et al. 1990) ?
- *Liquidambar-Acer* hardwood swamp (Breden 1989) ?

**SOURCES**

**Description Authors:** L. A. Sneddon, mod. E. Largay and G. P. Fleming.

**References:** Bowman 2000, Breden 1989, Breden et al. 2001, Brush et al. 1980, Clancy 1996, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fleming et al. 2001, Harrison 2004, Harrison and Stango 2003, Hunt 1998, Sneddon and Anderson 1994, Sneddon et al. 1996, Thomson et al. 1999, Tyndall et al. 1990, VDNH 2003.



Figure I16. Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type) at Colonial National Historical Park. July 2003. NAD 1983 / UTM easting 364330, northing 4120404.

## COMMON NAME (PARK-SPECIFIC): NON-RIVERINE SATURATED FOREST

**SYNONYMS**

**USNVC English Name:** **(Willow Oak, Cherrybark Oak, Swamp Chestnut Oak) / American Holly / Coastal Sweet-pepperbush / Netted Chainfern Forest**

**USNVC Scientific Name:** ***Quercus (phellos, pagoda, michauxii) / Ilex opaca* var. *opaca* / *Clethra alnifolia* / *Woodwardia areolata* Forest**

**USNVC Identifier:** **CEGL004644**

### LOCAL INFORMATION

**Environmental Description:** Non-Riverine Saturated Forest is a deciduous, seasonally saturated to shortly seasonally flooded forest occupying nearly flat, broad terraces, as well as old, very broad stream terraces that are no longer subject to overland flooding. Habitats are nearly flat, with seasonally perched water tables. Some sites experience periodic sheetflows of anastomosing seepage from adjacent slope-base springs. Shallow, braided channels and depressions which pond water intermittently are frequent habitat features. Soils are silt, sand, and clay loams, sometimes with a thin (<30 cm [12 inches]) mantle of coarse, fibric peat.

**Vegetation Description:** The canopy and subcanopy contain mixtures of *Liquidambar styraciflua* (sweetgum), *Fraxinus pennsylvanica* (green ash), and *Acer rubrum* (red maple), with scattered hydric oaks, including *Quercus laurifolia* (laurel oak), *Quercus michauxii* (swamp chestnut oak), *Quercus nigra* (water oak), *Quercus pagoda* (cherrybark oak), *Quercus palustris* (pin oak), and *Quercus phellos* (willow oak). Mature, less disturbed areas may be dominated by these oak species. Typical shrubs include species from the canopy as well as *Ilex opaca* var. *opaca* (American holly), *Ilex decidua* (possumhaw), *Carpinus caroliniana* (American hornbeam), *Magnolia virginiana* (sweetbay), *Ulmus americana* (American elm), *Smilax rotundifolia* (roundleaf greenbrier), and *Vaccinium fuscatum* (black highbush blueberry). Vines like *Bignonia capreolata* (crossvine), *Campsis radicans* (trumpet creeper), *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), and *Vitis rotundifolia* (muscadine) can be abundant, often climbing into the canopy. *Carex* spp. (sedges) can have high cover or even be locally dominant. Some characteristic and common species include *Carex debilis* (white edge sedge), *Carex glaucescens* (southern waxy sedge), *Carex gracillima* (graceful sedge), *Carex styloflexa* (bent sedge), *Carex tribuloides* (blunt broom sedge), *Chasmanthium laxum* (slender woodoats), *Cinna arundinacea* (sweet woodreed), *Dichanthelium sphaerocarpon* var. *sphaerocarpon* (roundseed panicgrass), and *Poa autumnalis* (autumn bluegrass).

Most of the area mapped as Non-Riverine Saturated Forest is regeneration of *Liquidambar styraciflua* (sweetgum) codominating with *Pinus taeda* (loblolly pine), but there are a few islands of more mature hydric oaks scattered throughout the stands, representing the historic condition of the forest.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | Liquidambar styraciflua (sweetgum), Quercus pagoda (cherrybark oak) |

**Characteristic Species:** *Carex debilis* (white edge sedge), *Ilex decidua* (possumhaw), *Liquidambar styraciflua* (sweetgum), *Quercus michauxii* (swamp chestnut oak), *Quercus pagoda* (cherrybark oak), *Quercus phellos* (willow oak).
**Other Noteworthy Species:** Information not available.
**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | 1 | Non-Riverine Saturated Forest | Fleming et al. 2006 |

**Local Range:** Non-Riverine Saturated Forest occurs on a broad terrace near Powhatan Creek and Green Spring. It is mapped as five polygons and covers a total of 53.4 hectares (132.0 acres).
**Classification Comments:** This forest is distinguished by its non-riverine landscape position and the high frequency of hydric oaks and other characteristic herbaceous species.
**Other Comments:** Small areas of higher, drier forest may occur within areas mapped as Non-Riverine Saturated Forest. Mature, undisturbed examples of this globally rare association are uncommon. Only one polygon of this association in Colonial National Historical Park meets the criteria to be considered a Natural Heritage exemplary natural community occurrence. Polygons representing particularly disturbed examples are noted in the comment field of the map attribute table.
**Local Description Authors:** K. D. Patterson.
**Plots:** COLO.18, COLO.28.
**Colonial National Historical Park Inventory Notes:** Information 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 | Seasonally flooded cold-deciduous forest (I.B.2.N.e.) |
| Alliance | *Quercus phellos* Seasonally Flooded Forest Alliance (A.330) |
| Alliance (English name) | Willow Oak Seasonally Flooded Forest Alliance |
| Association | *Quercus (phellos, pagoda, michauxii) / Ilex opaca* var. *opaca / Clethra alnifolia / Woodwardia areolata* Forest |
| Association (English name) | (Willow Oak, Cherrybark Oak, Swamp Chestnut Oak) / American Holly / Coastal Sweet-pepperbush / Netted Chainfern Forest |
| **Ecological System(s):** | Northern Atlantic Coastal Plain Basin Swamp and Wet Hardwood Forest (CES203.520). |

### GLOBAL DESCRIPTION

**Concept Summary:** This association occurs in the central and northern Virginia Coastal Plain on extensive, flat terraces and very wide, ancient floodplains that are no longer subject to alluvial processes. Its hydrology is seasonally to nearly permanently saturated, with occasional ponding or groundwater sheetflows, and is maintained by a high water table rather than riverine or estuarine flooding. The overstory of relatively undisturbed examples contain variable mixtures of hydrophytic oaks, most commonly *Quercus phellos* (willow oak), *Quercus pagoda* (cherrybark oak), and *Quercus michauxii* (swamp chestnut oak). Associated canopy species varying from site to site can include *Quercus alba* (white oak), *Quercus palustris* (pin oak), *Quercus lyrata* (overcup oak), *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), *Pinus taeda* (loblolly pine), *Nyssa sylvatica* (blackgum), and *Fraxinus pennsylvanica* (green ash). The subcanopy layers are usually dominated by *Ilex opaca* var. *opaca* (American holly) and also

contain *Magnolia virginiana* (sweetbay) and recruitment of the overstory trees. The shrub layer varies from open to dense. and most characteristically contains *Clethra alnifolia* (coastal sweetpepperbush), *Leucothoe racemosa* (swamp doghobble), *Ilex verticillata* (common winterberry), *Vaccinium corymbosum* (highbush blueberry), *Vaccinium fuscatum* (black highbush blueberry), *Vaccinium formosum* (southern blueberry), *Viburnum dentatum* (southern arrowwood), *Rhododendron viscosum* (swamp azalea), and *Viburnum nudum* var. *nudum* (possumhaw). The herb layer is also highly variable. Some stands have a rather sparse herbaceous flora, with scattered colonies and individuals of *Woodwardia areolata* (netted chainfern), *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* var. *spectabilis* (royal fern), *Woodwardia virginica* (Virginia chainfern), *Saururus cernuus* (lizard's tail), and various sedges. Others have a relatively dense graminoid-dominated herb layer with variable patch-dominance by *Chasmanthium laxum* (slender woodoats), *Carex debilis* var. *debilis* (white edge sedge), *Carex intumescens* (greater bladder sedge), *Carex seorsa* (weak stellate sedge), *Carex lonchocarpa* (southern long sedge), and more rarely, *Carex bullata* (button sedge) or *Carex striata* var. *brevis* (Walter's sedge). Many stands of this association have been degraded by cutting or ditching, and extensive areas of suitable habitat have been lost to agriculture, hydrologic alterations, and conversion of hardwood forests to silvicultural pine plantations.
**Environmental Description:** This association occurs on extensive, flat Coastal Plain terraces and very wide, ancient floodplains that are no longer subject to alluvial processes. Its hydrology is seasonally to nearly permanently saturated, with occasional ponding or groundwater sheetflows, and is maintained by a high water table rather than riverine or estuarine flooding. Shallow channels and streams are sometimes evident, and hummock and hollow microtopography may be present. On the Eastern Shore of Virginia (Accomack County), it is found in isolated and extensive but shallow upland depressions. The stands here cover many hectares and occur in slight depressions with drainage impeded by an impermeable clay layer about half a meter below the soil surface. The habitat apparently has a seasonally high water table but ponds water only intermittently or for short periods (G. Fleming pers. comm.). Surficial soils occupied by this forest are extremely acidic and infertile silt or silty-clay loams.
**Vegetation Description:** The overstory of relatively undisturbed examples contain variable mixtures of hydrophytic oaks, most commonly *Quercus phellos* (willow oak), *Quercus pagoda* (cherrybark oak), and *Quercus michauxii* (swamp chestnut oak). Associated canopy species varying from site to site can include *Quercus alba* (white oak), *Quercus palustris* (pin oak), *Quercus lyrata* (overcup oak), *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), *Pinus taeda* (loblolly pine), *Nyssa sylvatica* (blackgum), and *Fraxinus pennsylvanica* (green ash). *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), and *Pinus taeda* (loblolly pine) are often abundant in stands disturbed by cutting. The subcanopy layers are usually dominated by *Ilex opaca* var. *opaca* (American holly) and also contain *Magnolia virginiana* (sweetbay) and recruitment of the overstory trees. The shrub layer varies from open to dense, and most characteristically contains *Clethra alnifolia* (coastal sweetpepperbush), *Leucothoe racemosa* (swamp doghobble), *Ilex verticillata* (common winterberry), *Vaccinium corymbosum* (highbush blueberry), *Vaccinium fuscatum* (black highbush blueberry), *Vaccinium formosum* (southern blueberry), *Viburnum dentatum* (southern arrowwood), *Rhododendron viscosum* (swamp azalea), and *Viburnum nudum* var. *nudum* (possumhaw). The herb layer is also highly variable. Some stands have a rather sparse herbaceous flora, with scattered colonies and individuals of *Woodwardia areolata* (netted chainfern), *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* var. *spectabilis* (royal fern), *Woodwardia virginica* (Virginia chainfern),

*Saururus cernuus* (lizard's tail), and various sedges. Others have a relatively dense graminoid-dominated herb layer with variable patch-dominance by *Chasmanthium laxum* (slender woodoats), *Carex debilis* var. *debilis* (white edge sedge), *Carex intumescens* (greater bladder sedge), *Carex seorsa* (weak stellate sedge), *Carex lonchocarpa* (southern long sedge), and more rarely, *Carex bullata* (button sedge) or *Carex striata* var. *brevis* (Walter's sedge). Many other hydrophytic herbs occur at low constancy and cover. The composition of this community is something of a "hybrid," with an overstory similar to that of oak-dominated floodplain forests and lower strata resembling those of an acidic seepage swamp.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree subcanopy | Broad-leaved evergreen tree | *Ilex opaca* var. *opaca* (American holly), *Magnolia virginiana* (sweetbay) |
| Herb (field) | Graminoid | *Carex debilis* var. *debilis* (white edge sedge), *Carex intumescens* (greater bladder sedge), *Carex lonchocarpa* (southern long sedge), *Carex seorsa* (weak stellate sedge), *Chasmanthium laxum* (slender woodoats) |

**Characteristic Species:** *Clethra alnifolia* (coastal sweetpepperbush), *Ilex verticillata* (common winterberry), *Leucothoe racemosa* (swamp doghobble), *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* var. *spectabilis* (royal fern), *Quercus michauxii* (swamp chestnut oak), *Quercus pagoda* (cherrybark oak), *Quercus phellos* (willow oak), *Rhododendron viscosum* (swamp azalea), *Saururus cernuus* (lizard's tail), *Vaccinium corymbosum* (highbush blueberry), *Viburnum dentatum* (southern arrowwood), *Viburnum nudum* var. *nudum* (possumhaw), *Woodwardia areolata* (netted chainfern), *Woodwardia virginica* (Virginia chainfern).
**Other Noteworthy Species:** Information not available.
**USFWS Wetland System:** Palustrine.

### DISTRIBUTION

**Range:** This association is known from about 25 sites in 13 counties of the Virginia central and northern Coastal Plain. It is not currently documented in Maryland, but requisite habitat conditions are present (J. Harrison pers. comm.).
**States/Provinces:** VA.
**Federal Lands:** DOD (Fort Lee); NPS (Colonial, Fredericksburg-Spotsylvania, George Washington Birthplace, Richmond).

### CONSERVATION STATUS

**Rank:** G2? (15-Aug-1997).
**Reasons:** This association is restricted to special wetland habitats and was probably never common on the landscape. However, extensive areas of suitable habitat have been lost to agriculture, hydrologic alterations, and conversion of hardwood forests to silvicultural pine plantations. The largest known remaining stands are all on private lands and are not protected. Mature, undisturbed examples of this type are rare.

### CLASSIFICATION INFORMATION

**Status:** Standard.
**Confidence:** 2 - Moderate.
**Comments:** Classification of this type is based on intensive field investigation by the Virginia Natural Heritage Program (VDNH) and analysis of a 1250-plot regional dataset assembled for the NCR and mid-Atlantic national parks vegetation mapping projects. In that analysis, this

association was represented by 21 plots from the northern Coastal Plain of Virginia. The original concept of this vegetation was based on field work by Bill Moorhead (VDNH), who investigated several of the large, elliptical depressions that dot the flat landscape in Accomack County. There are three plots that document this vegetation at two sites: "Dahl Swamp" and "The Lake" (G. Fleming pers. comm.). The stands apparently cover many hectares and are associated with slight depressions with drainage impeded by an impermeable clay layer about half a meter below the soil surface. The habitat apparently has a seasonally high water table but ponds water only intermittently or for short periods. Most of the areas seen by Bill Moorhead had been logged some decades ago and had a very open (woodland-like) physiognomy due to poor restocking of canopy trees. However, he also obtained information from local people that one of the areas was known historically as "savanna land," suggesting that fire and hydrology maintained a woodland physiognomy in the depressions (G. Fleming pers. comm.).

**Similar Associations:**

- *Carex striata* var. *brevis* Herbaceous Vegetation (CEGL004120).
- *Liquidambar styraciflua - Acer rubrum - Quercus phellos / Leucothoe racemosa* Forest (CEGL006110)--is also found in Ecoregion 58.
- *Quercus michauxii - Quercus pagoda / Clethra alnifolia - Leucothoe axillaris* Forest (CEGL007449)--southern analogue found on mineral soils near the edge of extensive peat flats on the outer Coastal Plain terraces of southeastern Virginia and North Carolina; compositionally very similar to CEGL004644 but contains southern species such as *Quercus laurifolia, Leucothoe axillaris, Arundinaria gigantea* ssp. *tecta*, and *Sabal minor* that are absent from CEGL004644.

**Related Concepts:**

- *Quercus (michauxii, pagoda, phellos, alba) / Clethra alnifolia / Woodwardia virginica* Forest (VDNH 2003) =

**SOURCES**

**Description Authors:** G. P. Fleming, mod. M. Pyne and G. P. Fleming.

**References:** Fleming et al. 2001, Fleming pers. comm., J. Harrison pers. comm., Southeastern Ecology Working Group n.d., VDNH 2003.



Figure I17. Non-Riverine Saturated Forest (plot COLO.18) at Colonial National Historical Park. July 2004. NAD 1983 / UTM easting 340914, northing 4124971.



Figure I18. Non-Riverine Saturated Forest (plot COLO.28) at Colonial National Historical Park. May 2005. NAD 1983 / UTM easting 340770, northing 4124926.

## COMMON NAME (PARK-SPECIFIC): COASTAL PLAIN CALCAREOUS SEEPAGE SWAMP

**SYNONYMS**

**USNVC English Name:** **Red Maple - Green Ash / Golden Groundsel - Bromelike Sedge - Lesser Clearweed - Smooth Beggarticks Forest**

**USNVC Scientific Name:** ***Acer rubrum - Fraxinus pennsylvanica / Packera aurea - Carex bromoides - Pilea fontana - Bidens laevis* Forest**

**USNVC Identifier:** **CEGL006413**

### LOCAL INFORMATION

**Environmental Description:** Coastal Plain Calcareous Seepage Swamp includes deciduous forests occurring on moderately to highly base-rich substrates in the bottoms of ravines that have downcut into Tertiary shell deposits or limesands. Habitats consist of mucky, braided ravine bottoms saturated by constant groundwater seepage, and soils with high base status. Hummock-and-hollow microtopography is prevalent, and exposed shells are common in springs and rills.
**Vegetation Description:** *Fraxinus pennsylvanica* (green ash) and *Acer rubrum* (red maple) are common overstory trees in most stands, but a subset of ravines on the south side of the James River features the unusual codominance of *Taxodium distichum* (bald cypress). Climbing lianas and seedlings of *Decumaria barbara* (woodvamp) are abundant. Small trees and shrubs include *Fraxinus pennsylvanica* (green ash), *Ulmus americana* (American elm), *Liquidambar styraciflua* (sweetgum), and *Lindera benzoin* (northern spicebush). Common or patch-dominant herbs on the better-drained hummocks include *Packera aurea* (golden ragwort), *Scirpus lineatus* (drooping bulrush), *Carex bromoides* (bromelike sedge), *Thelypteris palustris* var. *pubescens* (eastern marsh fern), *Cicuta maculata* var. *maculata* (spotted water hemlock), and *Carex granularis* (limestone meadow sedge). Mucky hollows and seepage rills support abundant *Saururus cernuus* (lizard's tail), *Bidens laevis* (smooth beggartick), *Pilea fontana* (lesser clearweed), *Glyceria striata* (fowl mannagrass), and *Impatiens capensis* (jewelweed).

Disturbed stands of this type may have *Platanus occidentalis* (American sycamore) in the canopy. Some stands are codominated by *Taxodium distichum* (bald cypress).

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Acer rubrum* (red maple), *Fraxinus pennsylvanica* (green ash) |
| Herb (field) | Forb | *Packera aurea* (golden ragwort), *Saururus cernuus* (lizard's tail) |
| Herb (field) | Graminoid | *Scirpus lineatus* (drooping bulrush) |

**Characteristic Species:** *Acer rubrum* (red maple), *Fraxinus pennsylvanica* (green ash), *Packera aurea* (golden ragwort), *Pilea fontana* (lesser clearweed), *Saururus cernuus* (lizard's tail), *Scirpus lineatus* (drooping bulrush).

**Other Noteworthy Species:**

| Species | GRank | Type | Note |
|---|---|---|---|
| *Ponthieva racemosa* (hairy shadow witch) | - | plant | VA watchlist (S3) |
| *Scirpus lineatus* (drooping bulrush) | - | plant | VA watchlist (S3) |

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | 1 | Coastal Plain / Piedmont Basic Seepage Swamp | Fleming et al. 2006 |

**Local Range:** Coastal Plain Calcareous Seepage Swamp is mapped at Swanns Point, along Colonial Parkway near Papermill Creek, and in various ravine bottoms in the vicinity of Yorktown Battlefield.

**Classification Comments:** Coastal Plain Calcareous Seepage Swamp is easily recognized in the field by its occurrence in narrow ravine bottoms and the characteristic canopy and herbaceous flora. Some wetlands mapped as Disturbed Seepage Swamp may have once been this association, but now lack the species composition to confidently classify them as this association.

**Other Comments:** High-quality examples of Coastal Plain Calcareous Seepage Swamp are uncommon throughout the range of this globally rare association. Even though only three examples of this association in Colonial National Historical Park meet the criteria to be considered a Natural Heritage exemplary natural community occurrence, all examples of this native plant association should be targets for conservation and management. These habitats are generally wet and somewhat protected from fire. Several uncommon odonates (dragonflies and damselflies) depend on forested seeps for breeding habitat. Coastal Plain Calcareous Seepage Swamps are relatively small in size and threatened by beaver activities, agricultural pollutants, hydrologic disturbances, and logging.

**Local Description Authors:** K. D. Patterson.

**Plots:** COLO.4, COLO.5, COLO.8.

**Colonial National Historical Park Inventory Notes:** Information 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 | Saturated cold-deciduous forest (I.B.2.N.g.) |
| Alliance | *Acer rubrum - Fraxinus pennsylvanica* Saturated Forest Alliance (A.3035) |
| Alliance (English name) | Red Maple - Green Ash Saturated Forest Alliance |
| Association | *Acer rubrum - Fraxinus pennsylvanica / Packera aurea - Carex bromoides - Pilea fontana - Bidens laevis* Forest |
| Association (English name) | Red Maple - Green Ash / Golden Groundsel - Bromelike Sedge - Lesser Clearweed - Smooth Beggarticks Forest |
| **Ecological System(s):** | Northern Atlantic Coastal Plain Calcareous Ravine (CES203.069). |

### GLOBAL DESCRIPTION

**Concept Summary:** This calcareous seepage swamp occurs on the Virginia Coastal Plain on groundwater-saturated stream bottoms in ravines that have cut into Tertiary shell deposits or limesands. Braided streams and hummock-and-hollow microtopography are characteristic of the environmental setting. Soils are highly calcareous with pH values up to 7.4 and calcium levels that range up to 6000 ppm. The tree canopy is consistently codominated by *Fraxinus pennsylvanica* (green ash) and *Acer rubrum* (red maple) with a few other species locally important. The shrub layer is typically open and contains *Lindera benzoin* (northern spicebush), *Morella cerifera* (wax myrtle), *Carpinus caroliniana* (American hornbeam), and *Cornus foemina*

(stiff dogwood). Vines are often abundant, especially *Decumaria barbara* (woodvamp). The herb layer is dense, lush, and clearly divisible into two relatively discrete assemblages that occupy hummocks and mucky hollows, respectively. The most constant patch-dominants of the relatively well-drained hummocks are *Packera aurea* (golden ragwort) and *Carex bromoides* (bromelike sedge). Characteristic patch-dominants of the wet, mucky hollows are *Pilea fontana* (lesser clearweed), *Bidens laevis* (smooth beggartick), *Saururus cernuus* (lizard's tail), *Cicuta maculata* var. *maculata* (spotted water hemlock), *Impatiens capensis* (jewelweed), and *Glyceria striata* (fowl mannagrass). Other common or noteworthy herbs include *Caltha palustris* (yellow marsh marigold), *Thelypteris palustris* var. *pubescens* (eastern marsh fern), *Carex granularis* (limestone meadow sedge), *Scirpus lineatus* (drooping bulrush), *Orontium aquaticum* (goldenclub), *Pedicularis lanceolata* (swamp lousewort), *Liparis loeselii* (yellow widelip orchid), and *Carex tetanica* (rigid sedge).

**Environmental Description:** This community type is confined to the groundwater-saturated bottoms of ravines that have cut into Tertiary shell deposits or limesands. Braided streams and pronounced hummock-and-hollow microtopography are characteristic of this habitat. Soil environments are somewhat heterogeneous, with deep organic muck in hollows and firm sandy substrates on hummocks. Samples collected from 15 plots were highly calcareous with pH values up to 7.4 and calcium levels up to 6000 ppm. Most sites for this community are in ravines that drain directly into tidal creeks.

**Vegetation Description:** The overstory is consistently codominated by *Fraxinus pennsylvanica* (green ash) and *Acer rubrum* (red maple). In near-tidal situations, *Nyssa biflora* (swamp tupelo) and *Taxodium distichum* (bald cypress) are locally codominant. *Ulmus americana* (American elm), *Liquidambar styraciflua* (sweetgum), *Liriodendron tulipifera* (tuliptree), and *Pinus taeda* (loblolly pine) are minor overstory trees throughout the range. The understory and shrub layers are typically very open and contain young specimens of the overstory trees, *Carpinus caroliniana* (American hornbeam), *Lindera benzoin* (northern spicebush), *Cornus foemina* (stiff dogwood), and *Morella cerifera* (wax myrtle). *Dirca palustris* (eastern leatherwood) is a common shrub in a subset of ravines in the York River drainage. The climbing liana *Decumaria barbara* (woodvamp) is common, along with *Toxicodendron radicans* (eastern poison ivy). The herb layer is dense, lush, and clearly divisible into two relatively discrete assemblages that occupy hummocks and mucky hollows, respectively. The most constant patch-dominants of the relatively well-drained hummocks are *Packera aurea* (golden ragwort) and *Carex bromoides* (bromelike sedge), with *Caltha palustris* (yellow marsh marigold), *Cinna arundinacea* (sweet woodreed), *Galium triflorum* (fragrant bedstraw), *Geum canadense* (white avens), *Thelypteris palustris* var. *pubescens* (eastern marsh fern), *Carex granularis* (limestone meadow sedge), *Leersia virginica* (whitegrass), *Amphicarpaea bracteata* (American hogpeanut), *Arisaema triphyllum* (Jack in the pulpit), *Carex laevivaginata* (smoothsheath sedge), *Carex styloflexa* (bent sedge), *Carex gracillima* (graceful sedge), *Rudbeckia laciniata* (cutleaf coneflower), and *Polygonum setaceum* (bog smartweed) occurring at lower cover and/or constancy. Characteristic patch-dominants of the wet, mucky hollows are *Pilea fontana* (lesser clearweed), *Bidens laevis* (smooth beggartick), *Saururus cernuus* (lizard's tail), *Cicuta maculata* var. *maculata* (spotted water hemlock), *Impatiens capensis* (jewelweed), and *Glyceria striata* (fowl mannagrass). Additional herbs associated with wetter microhabitats are *Scirpus lineatus* (drooping bulrush), *Boehmeria cylindrica* (smallspike false nettle), *Orontium aquaticum* (goldenclub), *Polygonum arifolium* (halberdleaf tearthumb), *Viola cucullata* (marsh blue violet), and *Cardamine pensylvanica* (Pennsylvania bittercress). Stands of this community contain a number of species

disjunct from primary ranges inland and farther west, including *Caltha palustris* (yellow marsh marigold), *Pedicularis lanceolata* (swamp lousewort), *Liparis loeselii* (yellow widelip orchid), and *Carex tetanica* (rigid sedge).

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Acer rubrum* (red maple), *Fraxinus pennsylvanica* (green ash) |

**Characteristic Species:** *Acer rubrum* (red maple), *Bidens laevis* (smooth beggartick), *Carex bromoides* (bromelike sedge), *Carpinus caroliniana* (American hornbeam), *Cicuta maculata* var. *maculata* (spotted water hemlock), *Cornus foemina* (stiff dogwood), *Decumaria barbara* (woodvamp), *Fraxinus pennsylvanica* (green ash), *Glyceria striata* (fowl mannagrass), *Impatiens capensis* (jewelweed), *Lindera benzoin* (northern spicebush), *Morella cerifera* (wax myrtle), *Packera aurea* (golden ragwort), *Pilea fontana* (lesser clearweed), *Saururus cernuus* (lizard's tail), *Toxicodendron radicans* (eastern poison ivy).

**Other Noteworthy Species:** Information not available.

**USFWS Wetland System:** Palustrine.

### DISTRIBUTION

**Range:** This calcareous seepage swamp occurs in dissected terrain in the central Virginia Coastal Plain. It is known only from calcareous ravines in the James and York river drainages, in James City, Surry, and York counties.

**States/Provinces:** MD?, VA.

**Federal Lands:** DOD (Yorktown); NPS (Colonial); USFWS (Great Swamp).

### CONSERVATION STATUS

**Rank:** G2 (16-Feb-2007).

**Reasons:** Despite considerable efforts to inventory this community over the years, fewer than 50 patches of this vegetation are known covering an aggregate area of perhaps 300 acres. It is likely that quite a few additional patches have yet to be located, but patch-size is small (<10 acres), the habitat is rare, and the region of potential habitat is limited.

### CLASSIFICATION INFORMATION

**Status:** Standard.

**Confidence:** 2 - Moderate.

**Comments:** Classification of this type is supported by analysis of a 1250-plot regional dataset assembled for the NCR and mid-Atlantic national parks vegetation mapping projects. In that analysis, this association was represented by 15 plots.

**Similar Associations:** Information not available.

**Related Concepts:**

- *Acer rubrum - Fraxinus pennsylvanica / Bidens laevis - Pilea fontana - (Scirpus lineatus)* Saturated Forest [Provisional] (Fleming 2001) ?
- *Acer rubrum - Fraxinus pennsylvanica / Pilea fontana - Packera aurea - (Scirpus lineatus)* Forest (VDNH 2003) =

### SOURCES

**Description Authors:** Chesapeake Bay Ecology Group, mod. L. A. Sneddon and G. P. Fleming.

**References:** Eastern Ecology Working Group n.d., Fleming 2001, Fleming et al. 2001, Harrison 2004, VDNH 2003.



Figure I19. Coastal Plain Calcareous Seepage Swamp (plot COLO.8) at Colonial National Historical Park. May 2003. NAD 1983 / UTM easting 367768, northing 4118887.

## COMMON NAME (PARK-SPECIFIC): COASTAL PLAIN LOBLOLLY PINE - OAK FOREST

**SYNONYMS**

**USNVC English Name:** **Loblolly Pine - (White Oak, Southern Red Oak, Post Oak) Successional Coastal Plain Forest**

**USNVC Scientific Name:** ***Pinus taeda - Quercus (alba, falcata, stellata)*** **Successional Coastal Plain Forest**

**USNVC Identifier:** **CEGL004766**

### LOCAL INFORMATION

**Environmental Description:** This is a natural to semi-natural habitat type that has developed following anthropogenic disturbance. It is found in low-lying areas or sandy interfluves surrounded by tidal wetlands.

**Vegetation Description:** These forests are dominated by one or more species of *Quercus* (oak) occurring with varying amounts of *Pinus taeda* (loblolly pine). The most typical oaks in this habitat are *Quercus alba* (white oak), *Quercus velutina* (black oak), and *Quercus falcata* (southern red oak), but in areas with seasonally perched water tables or ephemeral seepage, *Quercus pagoda* (cherrybark oak) often dominates, and occasional individuals of *Quercus laurifolia* (laurel oak) can be found. On higher, drier sites, *Quercus stellata* (post oak) is a typical associate. *Liquidambar styraciflua* (sweetgum) can be important in some stands. The understory of these forests can be open, but can often have a well-developed shrub stratum dominated by *Ilex opaca* var. *opaca* (American holly) or *Persea palustris* (swamp bay) or, in drier, sandier sites, *Morella cerifera* (wax myrtle). Vines of *Smilax bona-nox* (saw greenbrier), *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy), and *Vitis rotundifolia* (muscadine) often climb into the shrub and tree strata. The ground layer is often covered with the exotic *Microstegium vimineum* (Nepalese browntop) or has sparse vegetation cover, dominated by pine litter with only scattered grasses and forbs.

Canopy and shrub associates vary with the moisture regime of a site. Shrub density is also variable from site to site.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Pinus taeda* (loblolly pine) |

**Characteristic Species:** *Chasmanthium laxum* (slender woodoats), *Morella cerifera* (wax myrtle), *Pinus taeda* (loblolly pine), *Quercus falcata* (southern red oak), *Quercus pagoda* (cherrybark oak), *Quercus stellata* (post oak).

**Other Noteworthy Species:** Information not available.

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR | . | . | [not crosswalked] | . |

**Local Range:** This forest type is the matrix forest of Jamestown Island and the surrounding area. It is found at Swanns Point and Jamestown Island, where it covers 311 hectares (768 acres).

**Classification Comments:** This forest is distinguished from Successional Tuliptree - Loblolly Pine Forest by having greater coverage of oak species and less abundance or lack of *Liriodendron tulipifera* (tuliptree) and by the presence of such coastal shrubs as *Morella cerifera* (wax myrtle) and *Persea palustris* (swamp bay).

**Other Comments:** Polygons mapped as this forest may contain inclusions of Disturbed Tidal Hardwood Swamp. Where there has been extensive wind damage, Successional Mixed Scrub can occur as inclusions in this forest.
**Local Description Authors:** K. D. Patterson.
**Plots:** COLO.25, COLO.101, COLO.102, COLO.104, COLO.105, COLO.106, COLO.107, COLO.109.
**Colonial National Historical Park Inventory Notes:** Information not available.

## 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 | Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a.) |
| Alliance | *Pinus taeda - Quercus (alba, falcata, stellata)* Forest Alliance (A.404) |
| Alliance (English name) | Loblolly Pine - (White Oak, Southern Red Oak, Post Oak) Forest Alliance |
| Association | *Pinus taeda - Quercus (alba, falcata, stellata)* Successional Coastal Plain Forest |
| Association (English name) | Loblolly Pine - (White Oak, Southern Red Oak, Post Oak) Successional Coastal Plain Forest |
| **Ecological System(s):** | Information not available. |

### GLOBAL DESCRIPTION

**Concept Summary:** This successional loblolly pine - oak forest of the Maryland and Virginia Coastal Plain occurs on coarse-textured, shallow dry soils. Abandoned loblolly pine plantations or early-successional loblolly pine forests established following cessation of agriculture often succeed to this vegetation as oaks are recruited and form variable proportions of the canopy. The canopy is dominated by *Pinus taeda* (loblolly pine) with varying amounts of *Quercus alba* (white oak), *Quercus falcata* (southern red oak), *Quercus velutina* (black oak), and *Quercus stellata* (post oak). *Liquidambar styraciflua* (sweetgum) may be present but not generally in quantity. The shrub layer is of variable closure and is often characterized by *Ilex opaca* var. *opaca* (American holly), *Morella cerifera* (wax myrtle), or *Persea palustris* (swamp bay). Vines such as *Smilax rotundifolia* (roundleaf greenbrier), *Vitis rotundifolia* (muscadine), and *Toxicodendron radicans* (eastern poison ivy) can contribute considerable cover in the tree canopy. The herbaceous layer is sparse to non-existent, or is made up of exotic species such as *Microstegium vimineum* (Nepalese browntop). This association is considered provisional because it has not been well-documented and plot data are limited. This association is somewhat similar to *Pinus taeda / Liquidambar styraciflua - Acer rubrum / Vaccinium stamineum* Forest (CEGL006011), and in fact may be preceded by it in successional sequence, but it has a higher component of hardwoods, especially oaks, in the canopy.
**Environmental Description:** This association occurs on sandy soils on the Mid-Atlantic Coastal Plain. It is a mid- to late-successional mixed forest that generally follows plantation abandonment or cessation of agriculture.
**Vegetation Description:** *Pinus taeda* (loblolly pine) is a constant canopy species. Oaks are generally codominant and can include *Quercus falcata* (southern red oak), *Quercus alba* (white oak), *Quercus stellata* (post oak), or *Quercus velutina* (black oak). *Liquidambar styraciflua* (sweetgum) is a less prevalent associate. The shrub layer is of variable closure and is often

characterized by *Ilex opaca* var. *opaca* (American holly), *Morella cerifera* (wax myrtle), or *Persea palustris* (swamp bay). Vines such as *Smilax rotundifolia* (roundleaf greenbrier), *Vitis rotundifolia* (muscadine), and *Toxicodendron radicans* (eastern poison ivy) can contribute considerable cover in the tree canopy. The herbaceous layer is sparse to non-existent, or is made up of exotic species such as *Microstegium vimineum* (Nepalese browntop).

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Needle-leaved tree | *Pinus taeda* (loblolly pine) |
| Shrub/sapling (tall & short) | Vine/Liana | *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy), *Vitis rotundifolia* (muscadine) |

**Characteristic Species:** *Ilex opaca* var. *opaca* (American holly), *Morella cerifera* (wax myrtle), *Persea palustris* (swamp bay), *Pinus taeda* (loblolly pine), *Quercus alba* (white oak), *Quercus falcata* (southern red oak), *Quercus velutina* (black oak), *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy), *Vitis rotundifolia* (muscadine).
**Other Noteworthy Species:** Information not available.
**USFWS Wetland System:** Not applicable.

### DISTRIBUTION

**Range:** This type could occur in the Piedmont or adjacent/related ecoregions (Atlantic Coastal Plain, Cumberlands / Southern Ridge and Valley).
**States/Provinces:** MD, VA.
**Federal Lands:** NPS (Colonial, Rock Creek).

### CONSERVATION STATUS

**Rank:** GNR (11-Sep-1997).
**Reasons:** Information not available.

### CLASSIFICATION INFORMATION

**Status:** Provisional.
**Confidence:** 3 - Weak.
**Comments:** Classification of this type is derived largely from Colonial National Historical Park. More data are needed to describe this type with greater confidence.
**Similar Associations:**

- *Pinus taeda / Liquidambar styraciflua - Acer rubrum* var. *rubrum / Vaccinium stamineum* Forest (CEGL006011)--has greater dominance by *Pinus taeda* in the canopy and has few to no oak species.

**Related Concepts:** Information not available.

### SOURCES

**Description Authors:** L. A. Sneddon.
**References:** Eastern Ecology Working Group, n.d.



Figure I20. Coastal Plain Loblolly Pine – Oak Forest at Colonial National Historical Park. July 2004. NAD 1983 / UTM easting 344051, northing 4119080.



Figure I21. Coastal Plain Loblolly Pine - Oak Forest (plot COLO.25) at Colonial National Historical Park. September 2004. NAD 1983 / UTM easting 343865, northing 4118691.

## COMMON NAME (PARK-SPECIFIC): TIDAL BALD CYPRESS FOREST / WOODLAND

**SYNONYMS**
**USNVC English Name:** **Bald-cypress / Shoreline Sedge Woodland**
**USNVC Scientific Name:** ***Taxodium distichum / Carex hyalinolepis* Woodland**
**USNVC Identifier:** **CEGL004654**

### LOCAL INFORMATION

**Environmental Description:** Tidal Bald Cypress Forest / Woodland occupies low tidal river shores, the upper reaches of tidal guts, and ecotones between tidal shore berms and tidal marshes. Soils are very poorly drained and always submerged by shallow water. These areas are regularly flooded by tidal water and are oligohaline to fresh in halinity.
**Vegetation Description:** This tidally influenced, needle-leaved deciduous woodland is dominated by *Taxodium distichum* (bald cypress) which dominates the open to very open overstory, with or without hardwood associates such as *Fraxinus pennsylvanica* (green ash), *Acer rubrum* (red maple), or *Nyssa biflora* (swamp tupelo). Shrub and herb layers are variable but generally contain a mixture of species characteristic of both marshes and swamps. *Morella cerifera* (wax myrtle) can form a dense to open shrub layer, and the herb layer is usually dominated by *Carex hyalinolepis* (shoreline sedge), often forming a continuous, nearly, monospecific stratum. Other typical herb associates include *Polygonum punctatum* (dotted smartweed), *Peltandra virginica* (green arrow arum), *Panicum virgatum* var. *virgatum* (switchgrass), *Triadenum walteri* (greater marsh St. Johnswort), *Rumex verticillatus* (swamp dock), *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow), *Cinna arundinacea* (sweet woodreed), and *Saururus cernuus* (lizard's tail). Submerged aquatic plants such as *Ceratophyllum demersum* (coon's tail) and floating aquatic species like *Lemna minor* (common duckweed), and *Azolla caroliniana* (Carolina mosquitofern)) can have high cover.

Stand structure and canopy cover range from closed forest to very open woodland. Stands of this type that have been artificially cut off from regular tides may have species suggestive of a longer, non-tidal hydroperiod: species such as *Cephalanthus occidentalis* (common buttonbush), *Fraxinus profunda* (pumpkin ash), *Populus heterophylla* (swamp cottonwood), and *Nyssa aquatica* (water tupelo).
**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Needle-leaved tree | *Taxodium distichum* (bald cypress) |
| Herb (field) | Graminoid | *Carex hyalinolepis* (shoreline sedge) |

**Characteristic Species:** *Carex hyalinolepis* (shoreline sedge), *Fraxinus pennsylvanica* (green ash), *Morella cerifera* (wax myrtle), *Peltandra virginica* (green arrow arum), *Taxodium distichum* (bald cypress).
**Other Noteworthy Species:** Information not available.
**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | 1 | Tidal Bald Cypress Forest / Woodland | Fleming et al. 2006 |

**Local Range:** Tidal Bald Cypress Forest / Woodland is found along the James River at Swanns Point with small, disturbed examples mapped at Jamestown Island. In total, it covers 12.0 hectare (29.6 acres).

**Classification Comments:** Tidal Bald Cypress Forest / Woodland is distinguished from most mapping units in Colonial National Historical Park by being dominated by *Taxodium distichum* (bald cypress). However, examples of Coastal Plain Calcareous Seepage Swamp at Swanns Point are also dominated by *Taxodium distichum* (bald cypress) and can have high coverage of *Carex hyalinolepis* (shoreline sedge) in areas ecotonal to tidal swamp. Stands of Coastal Plain Calcareous Seepage Swamp with *Taxodium distichum* (bald cypress) are distinguished from Tidal Bald Cypress Forest / Woodland by their non-tidal hydrology and having more species diversity in all strata, with high cover of species such as *Asimina triloba* (pawpaw), *Ilex opaca* var. *opaca* (American holly), *Carex bromoides* (bromelike sedge), *Lindera benzoin* (northern spicebush), and *Saururus cernuus* (lizard's tail).
**Other Comments:** Small areas within the map class Disturbed Tidal Hardwood Swamp may represent disturbed examples of Tidal Bald Cypress Forest / Woodland. Tidal Bald Cypress Forest / Woodland is a globally rare community with a restricted range. The example of this association at Swanns Point meets the criteria to be considered a Natural Heritage exemplary natural community occurrence.
**Local Description Authors:** K. D. Patterson.
**Plots:** COLO.26, COLO.27, COLO.103.
**Colonial National Historical Park Inventory Notes:** Information not available.

## 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 | Tidal cold-deciduous woodland (II.B.2.N.f.) |
| Alliance | *Taxodium distichum* Tidal Woodland Alliance (A.659) |
| Alliance (English name) | Bald-cypress Tidal Woodland Alliance |
| Association | *Taxodium distichum / Carex hyalinolepis* Woodland |
| Association (English name) | Bald-cypress / Shoreline Sedge Woodland |
| **Ecological System(s):** | Northern Atlantic Coastal Plain Tidal Swamp (CES203.282).<br>Southern Atlantic Coastal Plain Tidal Wooded Swamp (CES203.240). |

### GLOBAL DESCRIPTION

**Concept Summary:** This community occurs in narrow bands along the fringes of wind-tidal marshes on the Northwest River and North Landing River in southeastern Virginia, and likely occurs in northeastern North Carolina as well. It also occurs on the Pocomoke River of Maryland, where it is influenced by lunar, rather than wind tides. Substrates are poorly decomposed to moderately decomposed, root-rich peats. These sites are frequently flooded by wind tides or lunar tides and have some standing water throughout the growing season. This community usually develops in narrow ecotones between water-fringing marshes and tidal swamp forests, but may also occur between marshes and upland forests. *Taxodium distichum* (bald cypress) dominates the open to sparse canopy. Other less common tree species may include *Nyssa biflora* (swamp tupelo), *Liquidambar styraciflua* (sweetgum), and *Acer rubrum* (red maple). *Fraxinus profunda* (pumpkin ash) and occasional *Chamaecyparis thyoides* (Atlantic white cedar) also occur in Maryland examples. The sparse to moderately dense shrub layer is dominated by *Morella cerifera* (wax myrtle), *Clethra alnifolia* (coastal sweetpepperbush), *Rosa palustris* (swamp rose), and *Toxicodendron radicans* ssp. *radicans* (eastern poison ivy). The

herbaceous layer is very well-developed and is dominated by swards of *Carex hyalinolepis* (shoreline sedge). Despite the dense growth of this rhizomatous sedge, the herb layer is diverse. Herbaceous species include those more typical of forested swamps, such as *Saururus cernuus* (lizard's tail), *Triadenum walteri* (greater marsh St. Johnswort), and *Woodwardia areolata* (netted chainfern), and those typical of marshes, such as *Eleocharis fallax* (creeping spikerush), *Typha angustifolia* (narrowleaf cattail), *Panicum virgatum* (switchgrass), *Leersia oryzoides* (rice cutgrass), *Polygonum arifolium* (halberdleaf tearthumb), *Polygonum punctatum* (dotted smartweed), *Osmunda cinnamomea* (cinnamon fern), and *Schoenoplectus americanus* (chairmaker's bulrush). Some species, including the dominant *Carex hyalinolepis* (shoreline sedge), reach their nodal abundance in the landscape in this community.

**Environmental Description:** This association occurs on the slightly elevated alluvial floodplains on the oligohaline to freshwater tidal portions of tidal rivers. It forms a narrow band that is transitional to non-tidal wetlands or to uplands. In Virginia, wind tides are the prevalent dynamic, and in Maryland the tidal regime is lunar. The substrate is relatively firm, exhibiting slight to moderate hummock-and hollow-microtopography. In Maryland examples, salinity is typically less than 0.5 ppt but may be greater with storm tide salinity pulses or with lower river flow (Harrison et al. 2004).

**Vegetation Description:** The open canopy is dominated by *Taxodium distichum* (bald cypress), with less common associates including *Nyssa biflora* (swamp tupelo), *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), and in Maryland, *Fraxinus profunda* (pumpkin ash) and *Chamaecyparis thyoides* (Atlantic white cedar). The sparse to moderately dense shrub layer is dominated by *Morella cerifera* (wax myrtle), *Clethra alnifolia* (coastal sweetpepperbush), *Rosa palustris* (swamp rose), and *Toxicodendron radicans* ssp. *radicans* (eastern poison ivy). The herbaceous layer is very well-developed and is dominated by swards of *Carex hyalinolepis* (shoreline sedge). Despite the dense growth of this rhizomatous sedge, the herb layer is diverse. Herbaceous species include those more typical of forested swamps, such as *Saururus cernuus* (lizard's tail), *Triadenum walteri* (greater marsh St. Johnswort), and *Woodwardia areolata* (netted chainfern), and those typical of marshes, such as *Eleocharis fallax* (creeping spikerush), *Typha angustifolia* (narrowleaf cattail), *Panicum virgatum* (switchgrass), *Leersia oryzoides* (rice cutgrass), *Polygonum arifolium* (halberdleaf tearthumb), *Polygonum punctatum* (dotted smartweed), *Osmunda cinnamomea* (cinnamon fern), and *Schoenoplectus americanus* (chairmaker's bulrush). Some species, including the dominant *Carex hyalinolepis* (shoreline sedge), reach their nodal abundance in the landscape in this community. *Carex hyalinolepis* (shoreline sedge) often forms dense patches reaching 80% cover, although the herbaceous layer can achieve high species diversity overall. Exotic species *Lonicera japonica* (Japanese honeysuckle) and *Microstegium vimineum* (Nepalese browntop) are reported from some stands (Harrison et al. 2004).

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Needle-leaved tree | *Taxodium distichum* (bald cypress) |
| Herb (field) | Graminoid | *Carex hyalinolepis* (shoreline sedge) |

**Characteristic Species:** *Carex hyalinolepis* (shoreline sedge), *Cinna arundinacea* (sweet woodreed), *Clethra alnifolia* (coastal sweetpepperbush), *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow), *Morella cerifera* (wax myrtle), *Panicum virgatum* var. *virgatum* (switchgrass), *Peltandra virginica* (green arrow arum), *Polygonum punctatum* (dotted smartweed), *Rosa palustris* (swamp rose), *Rumex verticillatus* (swamp dock), *Saururus cernuus*

(lizard's tail), *Taxodium distichum* (bald cypress), *Toxicodendron radicans* ssp. *radicans* (eastern poison ivy), *Triadenum walteri* (greater marsh St. Johnswort).
**Other Noteworthy Species:** Information not available.
**USFWS Wetland System:** Estuarine.

**DISTRIBUTION**
**Range:** This association occurs on the Coastal Plain from Maryland to Virginia, with a likelihood of occurrence in North Carolina.
**States/Provinces:** MD:S1, NC?, VA.
**Federal Lands:** NPS (Colonial).

**CONSERVATION STATUS**
**Rank:** G2? (25-Jun-1997).
**Reasons:** Information not available.

**CLASSIFICATION INFORMATION**
**Status:** Standard.
**Confidence:** 2 - Moderate.
**Comments:** This association was part an analysis of over 300 tidal arboreal vegetation plots from Virginia and Maryland. It was classified based on five plots from Virginia and Maryland. This community most likely occurs in North Carolina; it is known from Virginia within a kilometer of the North Carolina state line.
**Similar Associations:** Information not available.
**Related Concepts:** Information not available.

**SOURCES**
**Description Authors:** L. A. Sneddon.
**References:** Coulling 2002, Fleming pers. comm., Harrison et al. 2004, Southeastern Ecology Working Group, n.d.



Figure I22. Tidal Bald Cypress Forest / Woodland (plot COLO.26) at Colonial National Historical Park. September 2004. NAD 1983 / UTM easting 339316, northing 4119161.



Figure I23. Tidal Bald Cypress Forest / Woodland (plot COLO.27) at Colonial National Historical Park. September 2004. NAD 1983 / UTM easting 338794, northing 4119155.

## COMMON NAME (PARK-SPECIFIC): GOLDEN BAMBOO SHRUBLAND

**SYNONYMS**
**USNVC English Name:** **Golden Bamboo Shrubland**
**USNVC Scientific Name:** ***Phyllostachys aurea* Shrubland**
**USNVC Identifier:** **CEGL008560**

### LOCAL INFORMATION

**Environmental Description:** This mapping class includes stands of *Phyllostachys aurea* (golden bamboo) which have either been planted or naturalized. These stands occur on disturbed lands, often near creeks and other mesic areas.
**Vegetation Description:** In Colonial National Historical Park, Golden Bamboo Shrubland is a dense monoculture of the exotic *Phyllostachys aurea* (golden bamboo), 10-20 m tall, with no other developed vegetation strata.
**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Bamboo | *Phyllostachys aurea* (golden bamboo) |

**Characteristic Species:** *Phyllostachys aurea* (golden bamboo).
**Other Noteworthy Species:** Information not available.
**Subnational Distribution with Crosswalk Data:** Information not available.
**Local Range:** Golden Bamboo Shrubland is mapped as three polygons in Yorktown Battlefield. There may be other areas dominated by *Phyllostachys aurea* (golden bamboo) in the park that are below minimum mapping unit (0.5 ha).
**Classification Comments:** Information not available.
**Other Comments:** Information not available.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Colonial National Historical Park Inventory Notes:** Information not available.

### GLOBAL INFORMATION

**USNVC CLASSIFICATION**

| | |
|---|---|
| Physiognomic Class | Shrubland (III) |
| Physiognomic Subclass | Evergreen shrubland (III.A.) |
| Physiognomic Group | Temperate broad-leaved evergreen shrubland (III.A.2.) |
| Physiognomic Subgroup | Natural/Semi-natural temperate broad-leaved evergreen shrubland (III.A.2.N.) |
| Formation | Temperate broad-leaved evergreen shrubland with a sparse cold-deciduous tree layer (III.A.2.N.f.) |
| Alliance | *Phyllostachys aurea* Shrubland Alliance (A.2010) |
| Alliance (English name) | Golden Bamboo Shrubland Alliance |
| Association | *Phyllostachys aurea* Shrubland |
| Association (English name) | Golden Bamboo Shrubland |
| **Ecological System(s):** | Information not available. |

**GLOBAL DESCRIPTION**
**Concept Summary:** This exotic bamboo association is comprised of uplands dominated by the exotic *Phyllostachys aurea* (golden bamboo), where it has been planted or naturalized. This association is typically densely vegetated with tall woody stems, almost to the exclusion of all

other species. The full range of this association is not well-documented, but it can potentially occur in most of the southeastern states north to southern New England.
**Environmental Description:** This association is found on disturbed lands, often near creeks and other mesic areas.
**Vegetation Description:** This shrubland is usually a monoculture of *Phyllostachys aurea* (golden bamboo) with little light or resources reaching the understory.
**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Bamboo | *Phyllostachys aurea* (golden bamboo) |
| Tall shrub/sapling | Bamboo | *Phyllostachys aurea* (golden bamboo) |

**Characteristic Species:** *Phyllostachys aurea* (golden bamboo).
**Other Noteworthy Species:** Information not available.
**USFWS Wetland System:** Not applicable.

**DISTRIBUTION**
**Range:** This vegetation is possible throughout the southeastern United States.
**States/Provinces:** AL?, AR?, FL, GA, LA?, MS?, NC?, SC, TN, TX, VA?
**Federal Lands:** NPS (Chickamauga-Chattanooga?, Colonial, Cowpens, Kings Mountain?, Ninety Six, Vicksburg?).

**CONSERVATION STATUS**
**Rank:** GNA (invasive) (3-Oct-2001).
**Reasons:** This shrubland represents vegetation dominated by an invasive exotic and thus does not receive a conservation status rank.

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

**SOURCES**
**Description Authors:** R. White, mod. L. A. Sneddon.
**References:** NatureServe Ecology - Southeastern U.S. unpubl. data, Schotz pers. comm., Southeastern Ecology Working Group, n.d., TDNH unpubl. data.



Figure I24. Golden Bamboo Shrubland at Colonial National Historical Park. July 2004. NAD 1983 / UTM easting 365048, northing 4122439.

## COMMON NAME (PARK-SPECIFIC): TIDAL SHRUB SWAMP (WAX MYRTLE TYPE)

**SYNONYMS**
**USNVC English Name:** **Wax-myrtle - Swamp Rose / Eastern Marsh Fern Shrubland**
**USNVC Scientific Name:** ***Morella cerifera - Rosa palustris / Thelypteris palustris* var. *pubescens* Shrubland**
**USNVC Identifier:** **CEGL004656**

### LOCAL INFORMATION

**Environmental Description:** Tidal Shrub Swamp (Wax Myrtle Type) includes tidally flooded shrublands of estuarine rivers and embayments. These shrub swamps frequently occur in fringes or ecotones between emergent tidal wetlands and swamp forests or uplands and typically contain species characteristic of both tidal marshes and swamp forests. The substrate is deep muck.
**Vegetation Description:** Tidal Shrub Swamp (Wax Myrtle Type) may have a very dense to open shrub canopy dominated by *Morella cerifera* (wax myrtle) in association with *Typha angustifolia* (narrowleaf cattail). There may be scattered trees, but canopy cover is less than 25% cover. *Acer rubrum* (red maple) is typical. Seedlings and saplings from adjacent swamp forest or other species from tidal marsh communities may also occur with low cover.
**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Shrub/sapling (tall & short) | Broad-leaved evergreen shrub | *Morella cerifera* (wax myrtle) |

**Characteristic Species:** *Morella cerifera* (wax myrtle).
**Other Noteworthy Species:** Information not available.
**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | 1 | Tidal Shrub Swamp | Fleming et al. 2006 |

**Local Range:** Tidal Shrub Swamp (Wax Myrtle Type) is found in small patches in the vicinity of Yorktown, along Colonial Parkway, Ringfield / King Creek, and at College Creek / Kingsmill. It covers a total of 4.2 hectares (10.4 acres).
**Classification Comments:** Tidal Shrub Swamp (Wax Myrtle Type) is distinguished from Salt Scrub by occurring adjacent to tidal marsh and being swampy (wet and mucky) without the sandy shrubland component found in Salt Scrub.
**Other Comments:** Tidal Shrub Swamp (Wax Myrtle Type) occurs as very small areas in Colonial National Historical Park, often developing where the Colonial Parkway has cut across tidal marsh.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Colonial National Historical Park Inventory Notes:** Information not available.

### GLOBAL INFORMATION

**USNVC CLASSIFICATION**

| | |
|---|---|
| Physiognomic Class | Shrubland (III) |
| Physiognomic Subclass | Evergreen shrubland (III.A.) |
| Physiognomic Group | Temperate broad-leaved evergreen shrubland (III.A.2.) |
| Physiognomic Subgroup | Natural/Semi-natural temperate broad-leaved evergreen shrubland (III.A.2.N.) |
| Formation | Tidal broad-leaved evergreen temperate shrubland (III.A.2.N.l.) |

| | |
|---|---|
| Alliance | *Morella cerifera - Rosa palustris* Tidal Shrubland Alliance (A.806) |
| Alliance (English name) | Wax-myrtle - Swamp Rose Tidal Shrubland Alliance |
| Association | *Morella cerifera - Rosa palustris / Thelypteris palustris* var. *pubescens* Shrubland |
| Association (English name) | Wax-myrtle - Swamp Rose / Eastern Marsh Fern Shrubland |
| **Ecological System(s):** | Atlantic Coastal Plain Embayed Region Tidal Freshwater Marsh (CES203.259). |

**GLOBAL DESCRIPTION**

**Concept Summary:** This shrub community occurs in ecotonal sites between tidal marshes and tidal swamps in fresh to oligohaline portions of coastal rivers and embayments. It occupies soupy peats. It is a natural community, but likely has a long-term and complicated successional relationship with other (primarily marsh communities) in the landscape in which it occurs, related to hydrology and fire. *Morella cerifera* (wax myrtle) is the characteristic dominant species (with 25-75% cover), with *Rosa palustris* (swamp rose), *Salix caroliniana* (coastal plain willow), and *Toxicodendron radicans* ssp. *radicans* (eastern poison ivy) as characteristic and constant companion species. Other woody species include *Persea palustris* (swamp bay), *Magnolia virginiana* (sweetbay), *Salix caroliniana* (coastal plain willow), *Vaccinium formosum* (southern blueberry), *Smilax walteri* (coral greenbrier), and saplings of *Acer rubrum* (red maple), *Pinus taeda* (loblolly pine), *Taxodium distichum* (bald cypress), and *Liquidambar styraciflua* (sweetgum). Herbaceous composition is diverse and varied, with many species 'recruited' from adjacent marshes and swamps. *Thelypteris palustris* var. *pubescens* (eastern marsh fern) is highly characteristic and appears to reach its nodal distribution in this landscape in this community. Other important species can include *Juncus roemerianus* (needlegrass rush), *Cladium mariscus* ssp. *jamaicense* (Jamaica swamp sawgrass), and *Decodon verticillatus* (swamp loosestrife). *Murdannia keisak* (wartremoving herb) is an aggressive alien weed.

**Environmental Description:** This shrub community occurs in ecotonal sites between tidal marshes and tidal swamps. It occupies soupy peats. According to Fleming et al. (2001), this community is part of a large group of tidal shrublands which occupy tidally flooded and wind-tidally flooded areas of freshwater to oligohaline rivers and embayments. These are tidal shrublands of oligohaline conditions bordering middle to upper sections of Coastal Plain rivers and tributaries (in Maryland). Salinity typically ranges from 0.5 to 5.0 ppt; however, pulses of higher salinity may occur during periods of spring high tides and low river discharge. Salinity data collected at time of study indicate a range of 0.5 to 11.0 ppt (mean ppt = 2.6) for 30 sample plots. These tidal shrublands form linear to irregular stands along tidal channels usually positioned between adjacent tidal marshes and swamp forests. Stands of narrow floodplains most often occur along ecotones as "fringes" intergrading with adjacent tidal swamp forests. Such stands are proximate to tidal channels and subject to regular tidal flooding. Stands occupying rather expansive marshes or large estuary meanders on broader floodplains are commonly fronted or surrounded by emergent marshes forming depositional islands. Slightly elevated and distanced from tidal influence, these stands tend to be less frequently flooded (regularly, for <6 months). Stand sizes range from 2 to 20 hectares. Hummock-and-hollow microtopography is characteristic of these shrublands and contributes to higher species richness, as does species recruitment from adjacent tidal marshes and tidal swamp forests. Soils are best characterized as slightly acidic tidal muck consisting of a mixture of silt, fine sands and partially decomposed peat.

**Vegetation Description:** *Morella cerifera* (wax myrtle) is the characteristic dominant species (with 25-75% cover), with *Rosa palustris* (swamp rose), *Salix caroliniana* (coastal plain willow), and *Toxicodendron radicans* ssp. *radicans* (eastern poison ivy) as characteristic and constant

companion species. Other woody species include *Persea palustris* (swamp bay), *Magnolia virginiana* (sweetbay), *Salix caroliniana* (coastal plain willow), *Vaccinium formosum* (southern blueberry), *Smilax walteri* (coral greenbrier), and saplings of *Acer rubrum* (red maple), *Pinus taeda* (loblolly pine), *Taxodium distichum* (bald cypress), and *Liquidambar styraciflua* (sweetgum). Herbaceous composition is diverse and varied, with many species 'recruited' from adjacent marshes and swamps. *Thelypteris palustris* var. *pubescens* (eastern marsh fern) is highly characteristic and appears to reach its nodal distribution in this landscape in this community. Other important species can include *Juncus roemerianus* (needlegrass rush), *Cladium mariscus* ssp. *jamaicense* (Jamaica swamp sawgrass), and *Decodon verticillatus* (swamp loosestrife). *Murdannia keisak* (wartremoving herb) is an aggressive alien weed.

In Maryland, these tidal oligohaline shrublands are characterized by a low (0.5-6 m tall), open (40-60% cover) to moderately dense (60-80% cover) shrub canopy dominated by *Morella cerifera* (wax myrtle) with *Rosa palustris* (swamp rose) as a frequent associate. *Morella cerifera* (wax myrtle) is most constant and typically occupies 25 to 50% of the shrub stratum. In general, *Rosa palustris* (swamp rose) is slightly less abundant (10-25% mean cover) than *Morella cerifera* (wax myrtle); however, it can occasionally be dominant (>75% cover) in some stands. Other less frequent taxa in the shrub stratum include *Acer rubrum* (red maple), *Viburnum recognitum* (southern arrowwood), *Baccharis halimifolia* (eastern baccharis), and dense vine growth of *Toxicodendron radicans* (eastern poison ivy) and *Mikania scandens* (climbing hempvine). Stands along ecotones or in less frequently flooded situations may contain emergent individuals of *Pinus taeda* (loblolly pine), *Liquidambar styraciflua* (sweetgum), *Fraxinus pennsylvanica* (green ash), *Fraxinus profunda* (pumpkin ash), *Nyssa biflora* (swamp tupelo), and *Juniperus virginiana* var. *virginiana* (eastern redcedar) in a scattered and very sparse (0-5% cover) overstory. Species richness in the herbaceous layer is very high and indicative of slight oligohaline conditions, species recruitment from adjacent communities, and considerable microtopographic variation. *Osmunda regalis* var. *spectabilis* (royal fern) is consistent and dominant in the herbaceous layer, with *Thelypteris palustris* var. *pubescens* (eastern marsh fern) in close association although not as abundant. Associated species include species characteristic of freshwater marshes, such as *Leersia oryzoides* (rice cutgrass), *Polygonum punctatum* (dotted smartweed), and *Peltandra virginica* (green arrow arum), and species more tolerant of mesohaline conditions, such as *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow) and *Carex hormathodes* (marsh straw sedge). Other characteristic herbs include *Apios americana* (groundnut), *Cuscuta gronovii* (scaldweed), *Sium suave* (hemlock waterparsnip), *Polygonum arifolium* (halberdleaf tearthumb), *Ptilimnium capillaceum* (herbwilliam), *Cinna arundinacea* (sweet woodreed), *Thalictrum pubescens* (king of the meadow), *Typha latifolia* (broadleaf cattail), *Cicuta maculata* (spotted water hemlock), and *Boehmeria cylindrica* (smallspike false nettle).

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tall shrub/sapling | Broad-leaved deciduous shrub | *Rosa palustris* (swamp rose), *Salix caroliniana* (coastal plain willow) |
| Tall shrub/sapling | Broad-leaved evergreen shrub | *Morella cerifera* (wax myrtle) |

**Characteristic Species:** *Morella cerifera* (wax myrtle), *Rosa palustris* (swamp rose), *Salix caroliniana* (coastal plain willow), *Thelypteris palustris* var. *pubescens* (eastern marsh fern), *Toxicodendron radicans* ssp. *radicans* (eastern poison ivy).

**Other Noteworthy Species:** Information not available.
**USFWS Wetland System:** Estuarine.

**DISTRIBUTION**
**Range:** This community occurs along the Atlantic Coast of Maryland, Virginia and North Carolina.
**States/Provinces:** MD:S4, NC, VA:SNR.
**Federal Lands:** NPS (Colonial); USFWS (Back Bay, Chesapeake Marshlands).

**CONSERVATION STATUS**
**Rank:** G4 (23-Jun-1997).
**Reasons:** Information not available.

**CLASSIFICATION INFORMATION**
**Status:** Standard.
**Confidence:** 2 - Moderate.
**Comments:** Information not available.
**Similar Associations:**
- *Morella cerifera - Toxicodendron radicans / Spartina bakeri* Shrubland (CEGL004789).

**Related Concepts:**
- *Morella cerifera - Rosa palustris / Thelypteris palustris* var. *palustris* Tidal Shrubland (Harrison and Stango 2003) =
- *Morella cerifera - Salix caroliniana / Thelypteris palustris* var. *pubescens* Tidal Shrubland (VDNH 2003) =
- *Myrica cerifera - Salix caroliniana / Thelypteris palustris* ssp. *pubescens* Tidally Flooded Shrubland (Fleming 1998) ?

**SOURCES**
**Description Authors:** G. Fleming, mod. J. Teague and E. Largay.
**References:** Coulling 2002, Fleming 1998, Fleming et al. 2001, Harrison 2004, Harrison and Stango 2003, Southeastern Ecology Working Group n.d., VDNH 2003.

## COMMON NAME (PARK-SPECIFIC): SALT SCRUB

**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:** Salt Scrub includes halophytic shrublands that form fringes along the lower James and York rivers. Salt Scrub occurs adjacent to the active river channel. In Colonial National Historical Park, this mapping unit commonly occupies high, only irregularly flooded landscape positions in a mosaic with lower, diurnally flooded salt marsh or fringe beach.
**Vegetation Description:** *Baccharis halimifolia* (eastern baccharis), *Iva frutescens* (Jesuit's bark), and *Morella cerifera* (wax myrtle) are the usual woody dominants, occurring singly or in combination. Other shrub species can include *Juniperus virginiana* var. *virginiana* (eastern redcedar) and *Pinus taeda* (loblolly pine). Tidal herbaceous vegetation and areas of bare sand beach often form a complex with these shrublands. *Distichlis spicata* (inland saltgrass), *Panicum virgatum* var. *virgatum* (switchgrass), *Phragmites australis* (common reed), *Solidago sempervirens* (seaside goldenrod), *Spartina alterniflora* (smooth cordgrass), *Spartina cynosuroides* (big cordgrass), *Spartina patens* (saltmeadow cordgrass), and *Typha angustifolia* (narrowleaf cattail) can occur as associates in Salt Scrub and even be locally dominant.

Salt Scrub occurs in small, linear patches on the Colonial National Historical Park landscape, often less than 0.5 ha in size, ranging to about 3 hectares.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Shrub/sapling (tall & short) | Broad-leaved deciduous shrub | *Baccharis halimifolia* (eastern baccharis) |
| Short shrub/sapling | Broad-leaved deciduous shrub | *Iva frutescens* (Jesuit's bark) |
| Herb (field) | Graminoid | *Spartina alterniflora* (smooth cordgrass) |

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

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | 1 | Salt Scrub | Fleming et al. 2006 |

**Local Range:** Salt Scrub occurs along the York River, north of Yorktown and along the James River in the vicinity of Kingsmill.
**Classification Comments:** This association is distinguished by being a tidal shrubland occurring as linear patches along rivers and having a complex of sandy shrublands and tidal herbaceous vegetation. A similar mapping unit, Tidal Shrub Swamp (Wax Myrtle Type), which always occurs adjacent to tidal marsh, is wet and mucky, not sandy.
**Other Comments:** Information not available.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Colonial National Historical Park Inventory Notes:** Information 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 | *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).<br>Atlantic Coastal Plain Northern Salt Pond Marsh (CES203.892).<br>Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519).<br>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* ssp. *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* ssp. *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, 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 diveristy, 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 2001, Fleming et al. 2001, Fleming pers. comm., Good 1965, Harrison 2004, Harrison and Stango 2003, Higgins et al. 1971, Hill 1986, J. Harrison pers. comm., Klemas et al. 1973, Klotz 1986, Martin 1959, Metzler and Barrett 2001, NRCS 2001, Rawinski 1984, Reschke 1990, Schafale 2000, Schafale and Weakley 1990, Sneddon et al. 1995, Swain and Kearsley 2001, TNC 1995, Tiner 1984, Tiner 1985a, Tiner 1985b, VDNH 2003.



Figure I26. Salt Scrub at Colonial National Historical Park. September 2004. NAD 1983 / UTM easting 362308, northing 4125637.

## COMMON NAME (PARK-SPECIFIC): CULTURAL MEADOW

**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 mapping unit includes herbaceous-dominated vegetation that is maintained as fields, lawns, and mowed roadsides throughout Colonial National Historical Park. These areas are vegetated by a mix of native and European grasses and forbs. Fields are maintained to keep an open landscape similar to the open farmland conditions found during the 18th century, and thus they are allowed to grow to a height of 50-75 cm (20-30 inches) before being mowed.

**Vegetation Description:** Cultural Meadow includes both fields and mowed areas. The fields are dense stands of sod-forming, mostly exotic grasses. Typical grasses in these fields include *Lolium pratense* (meadow ryegrass), *Andropogon virginicus* (broomsedge bluestem), and *Dactylis glomerata* (orchardgrass). Mowed roadsides are highly maintained grass-dominated areas next to the Colonial Parkway. A variety of exotic plant species are common in these areas, including *Viola arvensis* (European field pansy), *Taraxacum officinale* (common dandelion), *Allium ampeloprasum* var. *atroviolaceum* (broadleaf wild leek) (locally known as "Yorktown onion"), *Ranunculus bulbosus* (St. Anthony's turnip), and *Duchesnea indica* (Indian strawberry).

Areas mapped as Cultural Meadow may have below minimum mapping unit (<0.5 ha) inclusions of tree-dominated patches, windrows, shrub-dominated ditches or small wetland inclusions. These areas may also contain cultural earthworks.

**Most Abundant Species:** Information not available.

**Characteristic Species:** Information not available.

**Other Noteworthy Species:** Information not available.

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNA | . | . | [not crosswalked] | . |

**Local Range:** Cultural Meadow is found throughout Colonial National Historical Park. It is mapped over 363 hectares (897 acres).

**Classification Comments:** Cultural Meadow is distinguished from other associations by being non-tidal herbaceous-dominated vegetation. Lawns around buildings are mapped with the building and included in the mapping units Residential, Mixed Urban or Built-up Land, or Other Urban or Built-up Land. Mowed roadsides <0.5 ha occurring as linear strips along roadways are included in the mapping unit Transportation, Communications, and Utilities.

**Other Comments:** The comment field in the map attribute table indicates if a polygon classed as Cultural Meadow represents a mowed roadside or a field.

**Local Description Authors:** K. D. Patterson.

**Plots:** None.

**Colonial National Historical Park 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 | 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* spp. (hawkweeds), *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* (tall goldenrod), *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* spp. (clovers), 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* spp. (hawkweeds), *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* (tall goldenrod), *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* spp. (clovers), 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 altissima* (tall goldenrod), *Solidago canadensis* (Canada 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 I27. Cultural Meadow at Colonial National Historical Park. September 2004. NAD 1983 / UTM easting 364850, northing 4119073.

## COMMON NAME (PARK-SPECIFIC): TIDAL OLIGOHALINE MARSH (COMMON REED 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 association is a dense, tall grassland indicative of disturbance. It occurs on dredge spoils and other disturbed areas, generally in areas that are regularly flooded with tidal water. Species within and adjacent to this community are typical of oligohaline conditions where salt concentrations are between 0.5 and 5 ppt. Substrates range from muck or peat to sand.
**Vegetation Description:** This vegetation is characterized by dense stands of the invasive, nonnative grass *Phragmites australis* (common reed), typically to the exclusion of all other vascular plant species. Other species typical of oligohaline marsh may occur with low cover, such as *Peltandra virginica* (green arrow arum), *Typha angustifolia* (narrowleaf cattail), *Spartina cynosuroides* (big cordgrass), and *Polygonum punctatum* (dotted smartweed).
**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 |
|---|---|---|---|---|---|
| VA | SNR* | B | 1 | Tidal Oligohaline Marsh | Fleming et al. 2006 |

**Local Range:** Tidal Oligohaline Marsh (Common Reed Tidal Marsh) was noted at College Creek / Kingsmill, Jamestown Island, and in other areas as small patches. It is one of five associations included in the map class Tidal Oligohaline Marsh. The five associations cannot be mapped separately based on photo signatures, and a combined map class was used the vegetation map. Polygons of Tidal Oligohaline Marsh may, in some cases, include several associations.
**Classification Comments:** Tidal Oligohaline Marsh (Common Reed Tidal Marsh) is distinguished by being dominated by *Phragmites australis* (common reed).
**Other Comments:** Information not available.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Colonial National Historical Park 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 | *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).<br>Central Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270).<br>Atlantic Coastal Plain Embayed Region Tidal Freshwater Marsh (CES203.259).<br>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* sp. (a knotweed), 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* sp. (a knotweed), 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, 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, Colonial, Fire Island, Gateway, George Washington Birthplace, 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 1993) ?
- 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 1993, Edinger et al. 2002, Fleming 1998, Harrison 2001, Metzler and Barrett 1992, Metzler and Barrett 1996, Metzler and Barrett 2001, NRCS 2001, 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.

## COMMON NAME (PARK-SPECIFIC): TIDAL OLIGOHALINE MARSH (SALTMEADOW CORDGRASS - OLNEY THREE-SQUARE LOW INTERIOR MARSH TYPE)

**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 oligohaline marsh association is found on the upper reaches of tidal creeks where the hydrologic regime is primarily lunar tidal. The substrate is characterized by an unusual floating mat of partially decomposed organic matter, fine roots, and *Schoenoplectus* (bulrush) rhizomes to a depth of >40 cm. This vegetation may form extensive (>1000-square-meter) patches in the interior of marshes and is typically absent from a 20- to 50-m edge zone along tidal channels.

**Vegetation Description:** This species-diverse, relatively short-statured marsh contains a mixture of characteristically oligohaline and mesohaline species. This association is dominated by *Schoenoplectus americanus* (chairmaker's bulrush), occurring with *Spartina patens* (saltmeadow cordgrass). Other typical associates include *Amaranthus cannabinus* (tidalmarsh amaranth), *Cyperus odoratus* (fragrant flatsedge), *Distichlis spicata* (inland saltgrass), *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Panicum virgatum* var. *virgatum* (switchgrass), *Polygonum punctatum* (dotted smartweed), and *Typha angustifolia* (narrowleaf cattail).

**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:**

| Species | GRank | Type | Note |
|---|---|---|---|
| *Eleocharis rostellata* (beaked spikerush) | - | plant | VA watchlist (S3) |

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | . | Tidal Oligohaline Marsh | Fleming et al. 2006 |

**Local Range:** Tidal Oligohaline Marsh (Saltmeadow Cordgrass - Olney Three-Square Low Interior Marsh Type) is found at Jamestown Island. It is one of five associations included in the map class Tidal Oligohaline Marsh. The five associations cannot be mapped separately based on photo signatures, and a combined map class was used for the vegetation map. Polygons of Tidal Oligohaline Marsh may, in some cases, include several associations.

**Classification Comments:** This association is distinguished by being dominated by *Schoenoplectus americanus* (chairmaker's bulrush) and occurring in the interior of marshes.

**Other Comments:** Information not available.

**Local Description Authors:** K. D. Patterson.
**Plots:** COLO.115, COLO.116.
**Colonial National Historical Park 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 | *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* spp. (cattails) 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* ssp. *moscheutos* (crimsoneyed rosemallow), *Spartina alterniflora* (smooth cordgrass), *Spartina cynosuroides* (big cordgrass), *Distichlis spicata* (inland saltgrass), *Limonium carolinianum* (Carolina sealavender), and *Typha* spp. (cattails) *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?, MD:S4, NC?, NJ, SC?, VA.

**Federal Lands:** NPS (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 2001, Fleming et al. 2001, Harrison 2001, Harrison 2004, VDNH 2003.



Figure I28. Tidal Oligohaline Marsh (Saltmeadow Cordgrass - Olney Three-Square Low Interior Marsh Type) (plot COLO.115) at Colonial National Historical Park. October 2001. NAD 1983 / UTM easting 343779, northing 4119291.



Figure I29. Tidal Oligohaline Marsh (Saltmeadow Cordgrass - Olney Three-Square Low Interior Marsh Type) (plot COLO.115) at Colonial National Historical Park. July 2004. NAD 1983 / UTM easting 343779, northing 4119291.

## COMMON NAME (PARK-SPECIFIC): TIDAL MESOHALINE AND POLYHALINE MARSH (LOW SALT MARSH)

**SYNONYMS**
**USNVC English Name:** **Saltmarsh Cordgrass - Saltgrass Tidal Herbaceous Vegetation**
**USNVC Scientific Name:** ***Spartina alterniflora* - *Distichlis spicata* Tidal Herbaceous Vegetation**
**USNVC Identifier:** **CEGL006586**

### LOCAL INFORMATION

**Environmental Description:** Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) are salt marshes characterized by very low species diversity and low plant stature. Mesohaline conditions comprise salt concentrations between 5 and 18 ppt, whereas polyhaline conditions range from 18 to 30 ppt. In Colonial National Historical Park, these marshes occur as small riverine marshes fringing the mainland along the York River and in tidal reaches of its tributaries and are subject to regular, diurnal tides.

**Vegetation Description:** These marshes are strongly dominated by short-statured *Spartina alterniflora* (smooth cordgrass), generally less than 1 meter in height, often in association with *Distichlis spicata* (inland saltgrass) and *Spartina patens* (saltmeadow cordgrass). Other common associates include *Schoenoplectus robustus* (sturdy bulrush), *Symphyotrichum tenuifolium* (perennial saltmarsh aster), *Schoenoplectus americanus* (chairmaker's bulrush), and *Fimbristylis castanea* (marsh fimbry).

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Herb (field) | Graminoid | *Distichlis spicata* (inland saltgrass), *Spartina alterniflora* (smooth cordgrass) |

**Characteristic Species:** *Distichlis spicata* (inland saltgrass), *Spartina alterniflora* (smooth cordgrass), *Spartina patens* (saltmeadow cordgrass).

**Other Noteworthy Species:** Information not available.

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR | . | . | [not crosswalked] | . |

**Local Range:** Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) was noted along the York River from Ringfield / King Creek to Yorktown Creek. It is one of two associations included in the map class Tidal Mesohaline and Polyhaline Marsh. The two associations cannot be mapped separately based on photo signatures, and a combined map class was used for the vegetation map.

**Classification Comments:** Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) is distinguished by the dominance of *Spartina alterniflora* (smooth cordgrass) occurring with species indicative of mesohaline conditions such as *Spartina patens* (saltmeadow cordgrass) and *Distichlis spicata* (inland saltgrass).

**Other Comments:** Near-shore pocket marshes may have a fringe of Oligohaline Marsh dominated by *Typha angustifolia* (narrowleaf cattail) and *Spartina cynosuroides* (big cordgrass) next to shore that is too small to map separately.

**Local Description Authors:** K. D. Patterson.

**Plots:** None.

**Colonial National Historical Park 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 - Distichlis spicata* Tidal Herbaceous Vegetation |
| Association (English name) | Saltmarsh Cordgrass - Saltgrass Tidal Herbaceous Vegetation |
| **Ecological System(s):** | Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519). |

### GLOBAL DESCRIPTION

**Concept Summary:** This community represents low salt marsh vegetation dominated by the "short form" of *Spartina alterniflora* (smooth cordgrass) and *Distichlis spicata* (inland saltgrass), although the latter species may be somewhat less abundant. Diversity is exceedingly low, but some stands may be codominated by *Spartina patens* (saltmeadow cordgrass). Most occurrences of this community type are located in non-riverine, mesohaline marshes subject to regular, diurnal tides.

**Environmental Description:** Stands of this vegetation are located in mesohaline (5-18 ppt salinity), chiefly non-riverine marshes subject to regular, diurnal tides. The substrate typically consists of extremely dense, often firm, fibric peat rich in fine roots and rhizomes. This vegetation is documented from large estuaries that are somewhat more sheltered from storm overwash than similar vegetation of barrier island marshes.

**Vegetation Description:** This community is dominated by short-statured *Spartina alterniflora* (smooth cordgrass), generally much less than 1 m in height; *Distichlis spicata* (inland saltgrass) is a constant and typically codominant associate. *Spartina patens* (saltmeadow cordgrass) may attain moderate to high cover in some stands. Infrequent components of this vegetation include *Limonium carolinianum* (Carolina sealavender), *Schoenoplectus pungens* (common threesquare), *Iva frutescens* (Jesuit's bark), *Juncus roemerianus* (needlegrass rush), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Pluchea odorata* (sweetscent) and *Salicornia virginica* (Virginia glasswort). Species richness is very low, with an average of five species per 100 square meters.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Herb (field) | Graminoid | *Distichlis spicata* (inland saltgrass), *Spartina alterniflora* (smooth cordgrass) |

**Characteristic Species:** *Distichlis spicata* (inland saltgrass), *Spartina alterniflora* (smooth cordgrass).

**Other Noteworthy Species:** Information not available.

**USFWS Wetland System:** Estuarine.

### DISTRIBUTION

**Range:** This association has been documented from several, chiefly non-riverine sites on the eastern and western shores of the Chesapeake Bay in Maryland and Virginia.

**States/Provinces:** MD, VA.

**Federal Lands:** NPS (Colonial, George Washington Birthplace); USFWS (Chincoteague).

**CONSERVATION STATUS**
**Rank:** GNR (2-Jun-2007).
**Reasons:** Information not available.

**CLASSIFICATION INFORMATION**
**Status:** Provisional.
**Confidence:** 3 - Weak.
**Comments:** Stands of this vegetation generally occupy lower landscape positions than the typically adjacent high marsh represented by *Spartina patens - Distichlis spicata - (Juncus roemerianus)* Herbaceous Vegetation (CEGL004197) and are usually flooded daily. Salt pannes dominated by *Salicornia (virginica*, *bigelovii*, *maritima) - Spartina alterniflora* Herbaceous Vegetation (CEGL004308) may form at intermediate landscape positions, where salt concentrations are higher due to evaporation between less regular episodes of inundation, and hence halophytic forbs attain greater importance. This type is documented by 11 vegetation plots from Virginia and Maryland.
**Similar Associations:**
- *Salicornia (virginica, bigelovii, maritima) - Spartina alterniflora* Herbaceous Vegetation (CEGL004308).
- *Spartina patens - Distichlis spicata - (Juncus roemerianus)* Herbaceous Vegetation (CEGL004197).

**Related Concepts:** Information not available.

**SOURCES**
**Description Authors:** P. P. Coulling.
**References:** Coulling 2002, Eastern Ecology Working Group n.d.



Figure I30. Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) at Colonial National Historical Park. July 2004. NAD 1983 / UTM easting 358470, northing 4126476.

## COMMON NAME (PARK-SPECIFIC): TIDAL MESOHALINE AND POLYHALINE MARSH (TRANSITIONAL MARSH)

**SYNONYMS**

**USNVC English Name:** **Saltmarsh Cordgrass - Dotted Smartweed - Water-hemp Herbaceous Vegetation**

**USNVC Scientific Name:** ***Spartina alterniflora* - *Polygonum punctatum* - *Amaranthus cannabinus* Herbaceous Vegetation**

**USNVC Identifier:** **CEGL006418**

## LOCAL INFORMATION

**Environmental Description:** Tidal Mesohaline and Polyhaline Marsh (Transitional Marsh) occurs in mesohaline to oligohaline waters on the mid-tidal position of large tidal rivers and tidal guts. It receives freshwater input from alluvial sources inland and may also receive seepage from adjacent uplands. These marshes grow on silty mud and are subject to regular tidal flooding.

**Vegetation Description:** Tidal Mesohaline and Polyhaline Marsh (Transitional Marsh) is dominated by dense, saltmarsh grasses with local areas dominated by aquatic forbs. *Spartina alterniflora* (smooth cordgrass) is the dominant grass, occurring with *Spartina cynosuroides* (big cordgrass) and *Peltandra virginica* (green arrow arum), which may dominate in patches. This marsh vegetation may occur as linear bands along tidal channels or as large patches.

**Most Abundant Species:**

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

**Characteristic Species:** *Peltandra virginica* (green arrow arum), *Spartina alterniflora* (smooth cordgrass), *Spartina cynosuroides* (big cordgrass).

**Other Noteworthy Species:** Information not available.

**Subnational Distribution with Crosswalk Data:** Information not available.

**Local Range:** Tidal Mesohaline and Polyhaline Marsh (Transitional Marsh) is found in the vicinity of College Creek / Kingsmill. It is one of two associations included in the map class Tidal Mesohaline and Polyhaline Marsh. The two associations cannot be mapped separately based on photo signatures, and a combined map class was used for the vegetation map.

**Classification Comments:** Tidal Mesohaline and Polyhaline Marsh (Transitional Marsh) is distinguished by the dominance of *Spartina alterniflora* (smooth cordgrass) occurring with species indicative of more oligohaline or freshwater conditions such as *Spartina cynosuroides* (big cordgrass), *Peltandra virginica* (green arrow arum), and *Zizania aquatica* var. *aquatica* (annual wildrice).

**Other Comments:** Information not available.

**Local Description Authors:** K. D. Patterson.

**Plots:** None.

**Colonial National Historical Park 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 - Polygonum punctatum - Amaranthus cannabinus* Herbaceous Vegetation |
| Association (English name) | Saltmarsh Cordgrass - Dotted Smartweed - Water-hemp Herbaceous Vegetation |
| **Ecological System(s):** | Northern Atlantic Coastal Plain Brackish Tidal Marsh (CES203.894). |

**GLOBAL DESCRIPTION**

**Concept Summary:** This oligohaline to mesohaline marsh of the mid-Atlantic occurs in silty mud along meanders in tidal rivers and guts in the interiors of extensive marshes where there is significant freshwater input. The vegetation is diverse and variable but is characterized by the consistent presence of *Spartina alterniflora* (smooth cordgrass), *Schoenoplectus robustus* (sturdy bulrush), and *Polygonum punctatum* (dotted smartweed). Other associates include *Amaranthus cannabinus* (tidalmarsh amaranth), *Schoenoplectus tabernaemontani* (softstem bulrush), *Peltandra virginica* (green arrow arum), *Pluchea odorata* (sweetscent), *Bidens coronata* (crowned beggarticks), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Eleocharis palustris* (common spikerush), *Asclepias incarnata* (swamp milkweed), *Schoenoplectus americanus* (chairmaker's bulrush), *Ptilimnium capillaceum* (herbwilliam), and *Echinochloa walteri* (coast cockspur grass). *Spartina cynosuroides* (big cordgrass) is a common associate in Virginia examples and in some areas of Maryland.

**Environmental Description:** This oligohaline to mesohaline marsh of the mid-Atlantic occurs in silty mud along meanders in tidal rivers and guts in the interiors of extensive marshes where there is significant freshwater input.

**Vegetation Description:** The vegetation is diverse and variable but is characterized by the consistent presence of *Spartina alterniflora* (smooth cordgrass), *Schoenoplectus robustus* (sturdy bulrush), and *Polygonum punctatum* (dotted smartweed). Other associates include *Amaranthus cannabinus* (tidalmarsh amaranth), *Schoenoplectus tabernaemontani* (softstem bulrush), *Peltandra virginica* (green arrow arum), *Pluchea odorata* (sweetscent), *Bidens coronata* (crowned beggarticks), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Eleocharis palustris* (common spikerush), *Asclepias incarnata* (swamp milkweed), *Schoenoplectus americanus* (chairmaker's bulrush), *Ptilimnium capillaceum* (herbwilliam), and *Echinochloa walteri* (coast cockspur grass). *Spartina cynosuroides* (big cordgrass) is a common associate in Virginia examples and in some areas of Maryland. An unusually diverse example of this vegetation in Delaware occurs on Blackbird Creek and supports the additional species *Eleocharis parvula* (dwarf spikerush), *Cyperus filicinus* (fern flatsedge), *Sium suave* (hemlock waterparsnip), *Typha latifolia* (broadleaf cattail), *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow) and *Sagittaria latifolia* (broadleaf arrowhead).

**Most Abundant Species:** Information not available.

**Characteristic Species:** *Polygonum punctatum* (dotted smartweed), *Schoenoplectus robustus* (sturdy bulrush), *Spartina alterniflora* (smooth cordgrass).

**Other Noteworthy Species:**

| Species | GRank | Type | Note |
|---|---|---|---|
| *Aeschynomene virginica* (Virginia jointvetch) | G2 | plant | |

**USFWS Wetland System:** Estuarine.

**DISTRIBUTION**

**Range:** This vegetation occurs on the Coastal Plain of Maryland, Delaware and Virginia.
**States/Provinces:** DE, MD, NJ:S3.
**Federal Lands:** NPS (Colonial).

**CONSERVATION STATUS**

**Rank:** GNR (15-Nov-2000).
**Reasons:** Information not available.

**CLASSIFICATION INFORMATION**

**Status:** Standard.
**Confidence:** 3 - Weak.
**Comments:** This association includes the former *Spartina alterniflora - Amaranthus cannabinus* Herbaceous Vegetation (CEGL006147), now considered to be a depauperate variant of CEGL006418.
**Similar Associations:**

- *Spartina alterniflora - Lilaeopsis chinensis* Herbaceous Vegetation (CEGL004193).

**Related Concepts:**

- *Spartina alterniflora - Spartina cynosuroides* Herbaceous Vegetation (Coulling 2002) =
- Bishop-weed - Mixed Species Brackish Marsh (Bowman 2000) F
- Marsh Type II (Nicholson and Van Deusen 1954) B
- Smooth Cordgrass - Water Hemp Tidal Marsh (Bowman 2000) F

**SOURCES**

**Description Authors:** P. Bowman, mod. L. A. Sneddon.
**References:** Bowman 2000, Coulling 2002, Eastern Ecology Working Group n.d., Harrison 2004, Harrison and Stango 2003, Nicholson and Van Deusen 1954, Walz et al. 2006.



Figure I31. Tidal Mesohaline and Polyhaline Marsh (Transitional Marsh) at Colonial National Historical Park. September 2004. NAD 1983 / UTM easting 349432, northing 4121473.

## COMMON NAME (PARK-SPECIFIC): TIDAL OLIGOHALINE MARSH (BIG CORDGRASS TYPE)

**SYNONYMS**
**USNVC English Name:** **Giant Cordgrass Herbaceous Vegetation**
**USNVC Scientific Name:** ***Spartina cynosuroides* Herbaceous Vegetation**
**USNVC Identifier:** **CEGL004195**

### LOCAL INFORMATION

**Environmental Description:** This association is found in slightly brackish zones along tidal rivers and streams. Oligohaline conditions are defined as salt concentrations between 0.5 and 5 ppt, although pulses of higher halinity may occasionally occur. This type favors oligohaline habitats on narrow levees along tidal channels, beyond which vegetation grades to more diverse marsh.

**Vegetation Description:** Tidal Oligohaline Marsh (Big Cordgrass Type) is a tidal wetland strongly dominated by the grass *Spartina cynosuroides* (big cordgrass), which often forms tall, extensive, nearly monospecific stands, particularly along edges of the main tidal channels. *Peltandra virginica* (green arrow arum) is a frequent associated species and can sometimes dominate in patches. Other species that occur with inconsistently with low cover include species typical of oligohaline environments such as *Amaranthus cannabinus* (tidalmarsh amaranth), *Cyperus odoratus* (fragrant flatsedge), *Echinochloa walteri* (coast cockspur grass), *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow), *Phragmites australis* (common reed), *Pluchea odorata* (sweetscent), *Pontederia cordata* (pickerelweed), *Sagittaria lancifolia* ssp. *media* (bulltongue arrowhead), *Schoenoplectus robustus* (sturdy bulrush), *Spartina alterniflora* (smooth cordgrass), and *Typha angustifolia* (narrowleaf cattail).

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Herb (field) | Forb | *Peltandra virginica* (green arrow arum) |
| Herb (field) | Graminoid | *Spartina cynosuroides* (big cordgrass) |

**Characteristic Species:** *Peltandra virginica* (green arrow arum), *Spartina cynosuroides* (big cordgrass).

**Other Noteworthy Species:** Information not available.

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | 1 | Tidal Oligohaline Marsh | Fleming et al. 2006 |

**Local Range:** Tidal Oligohaline Marsh is mapped at Swanns Point, Jamestown Island, and at Ringfield / King Creek. Tidal Oligohaline Marsh (Big Cordgrass Type) is one of five associations included in the map class Tidal Oligohaline Marsh. The five associations cannot be mapped separately based on photo signatures, and a combined map class was used the vegetation map. Polygons of Tidal Oligohaline Marsh may, in some cases, include several associations.

**Classification Comments:** Tidal Oligohaline Marsh (Big Cordgrass Type) is by being dominated by *Spartina cynosuroides* (big cordgrass).

**Other Comments:** Information not available.

**Local Description Authors:** K. D. Patterson.

**Plots:** None.

**Colonial National Historical Park 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)<br>Central Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.376).<br>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* ssp. *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 (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 2001, 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 2003, Schafale and Weakley 1990, Southeastern Ecology Working Group n.d., Wharton 1978.



Figure I32. Tidal Oligohaline Marsh (Big Cordgrass Type) at Colonial National Historical Park. July 2004. NAD 1983 / UTM easting 345692, northing 4118834.



Figure I33. Tidal Oligohaline Marsh (Big Cordgrass Type) at Colonial National Historical Park. July 2004. NAD 1983 / UTM easting 345692, northing 4118834.

## COMMON NAME (PARK-SPECIFIC): TIDAL OLIGOHALINE MARSH (MIXED FORBS TYPE)

**SYNONYMS**

**USNVC English Name:** **Eastern Rosemallow - Dotted Smartweed - Green Arrow-arum Tidal Herbaceous Vegetation**

**USNVC Scientific Name:** ***Hibiscus moscheutos - Polygonum punctatum - Peltandra virginica* Tidal Herbaceous Vegetation**

**USNVC Identifier:** **CEGL006181**

### LOCAL INFORMATION

**Environmental Description:** This association is found in slightly brackish zones along tidal rivers and streams. Oligohaline conditions are defined as salt concentrations between 0.5 and 5 ppt, although pulses of higher halinity may occasionally occur. Substrate is muck or peat, and there is often an accumulation of *Typha* (cattail) litter.

**Vegetation Description:** This association is characterized by dense herbaceous vegetation dominated by mixtures of tidal forbs. This marsh vegetation is relatively diverse and variable in composition. *Polygonum punctatum* (dotted smartweed), *Peltandra virginica* (green arrow arum), and *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow) occur in most stands. *Typha angustifolia* (narrowleaf cattail), *Spartina cynosuroides* (big cordgrass), and *Schoenoplectus robustus* (sturdy bulrush) may form extensive dominance patches when present. Infrequently present are several species that are characteristic of chiefly oligohaline conditions, including *Echinochloa walteri* (coast cockspur grass), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Pluchea odorata* (sweetscent), *Rumex verticillatus* (swamp dock), and *Sagittaria lancifolia* ssp. *media* (bulltongue arrowhead).

Tidal Oligohaline Marsh varies in its species composition and dominant species as described above. Polygons mapped as Tidal Oligohaline Marsh may contain small inclusions of Freshwater Tidal Marsh.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Herb (field) | Graminoid | *Typha angustifolia* (narrowleaf cattail) |

**Characteristic Species:** *Polygonum punctatum* (dotted smartweed), *Typha angustifolia* (narrowleaf cattail).

**Other Noteworthy Species:** Information not available.

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | 1 | Tidal Oligohaline Marsh | Fleming et al. 2006 |

**Local Range:** Tidal Oligohaline Marsh (Mixed Forbs Type) is mapped at Jamestown Island and Ringfield / King Creek. It is one of five associations included in the map class Tidal Oligohaline Marsh. The five associations cannot be mapped separately based on photo signatures, and a combined map class was used for the vegetation map. Polygons of Tidal Oligohaline Marsh may, in some cases, include several associations.

**Classification Comments:** Information not available.

**Other Comments:** Information not available.

**Local Description Authors:** K. D. Patterson.

**Plots:** COLO.110, COLO.112.

**Colonial National Historical Park Inventory Notes:** Information 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 | Tidal temperate perennial forb vegetation (V.B.2.N.g.) |
| Alliance | *Peltandra virginica - Pontederia cordata* Tidal Herbaceous Alliance (A.1703) |
| Alliance (English name) | Green Arrow-arum - Pickerelweed Tidal Herbaceous Alliance |
| Association | *Hibiscus moscheutos - Polygonum punctatum - Peltandra virginica* Tidal Herbaceous Vegetation |
| Association (English name) | Eastern Rosemallow - Dotted Smartweed - Green Arrow-arum Tidal Herbaceous Vegetation |
| **Ecological System(s):** | Northern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.516). |

### GLOBAL DESCRIPTION

**Concept Summary:** This association is a diverse oligohaline marsh characterized by variable dominance of species found in the Chesapeake and Delaware bays. Species that form locally dominant patches can include *Polygonum arifolium* (halberdleaf tearthumb), *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow), *Polygonum punctatum* (dotted smartweed), *Peltandra virginica* (green arrow arum), *Leersia oryzoides* (rice cutgrass), *Polygonum sagittatum* (arrowleaf tearthumb), *Mikania scandens* (climbing hempvine), *Spartina cynosuroides* (big cordgrass), and *Toxicodendron radicans* (eastern poison ivy), among others. All of these species are able to tolerate a broad range of halinity, and the high mean species richness of this type suggests that it is generally restricted to only slightly oligohaline habitats. *Typha angustifolia* (narrowleaf cattail) and *Spartina cynosuroides* (big cordgrass) often form large dominance patches. Infrequently present are several species that are more specific to oligohaline conditions, including *Echinochloa walteri* (coast cockspur grass), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Pluchea odorata* (sweetscent), *Rumex verticillatus* (swamp dock), *Sagittaria lancifolia* (bulltongue arrowhead), and *Teucrium canadense* (Canada germander). The colonial sedge *Carex stricta* sometimes forms local dominance patches, characteristically on hummocks raised 20-25 cm above the primary marsh surface.

**Environmental Description:** Most stands are located near the edge of an extensive marsh but set by the main river channel and often bordered by scattered clumps of shrubs. There is often hummock-and-hollow microtopography.

**Vegetation Description:** These are diverse oligohaline marshes characterized by variable dominance patterns but generally containing *Polygonum arifolium* (halberdleaf tearthumb), *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow), *Polygonum punctatum* (dotted smartweed), *Peltandra virginica* (green arrow arum), *Leersia oryzoides* (rice cutgrass), *Polygonum sagittatum* (arrowleaf tearthumb), *Mikania scandens* (climbing hempvine), and *Toxicodendron radicans* (eastern poison ivy). *Bidens laevis* (smooth beggartick), *Cicuta maculata* (spotted water hemlock), *Cuscuta* sp. (a dodder), *Impatiens capensis* (jewelweed), *Lycopus americanus* (American water horehound), and *Sagittaria latifolia* (broadleaf arrowhead), and graminoids such as *Typha latifolia* (broadleaf cattail) and *Schoenoplectus fluviatilis* (river bulrush) may also be present at variable cover. *Typha angustifolia* (narrowleaf

cattail) and *Spartina cynosuroides* (big cordgrass) may form extensive dominance patches. All of these species are able to tolerate a broad range of halinity, and the high mean species richness of this type suggests that it is generally restricted to only slightly oligohaline habitats. Infrequently present are several species that are more specific to oligohaline conditions, including *Echinochloa walteri* (coast cockspur grass), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Pluchea odorata* (sweetscent), *Rumex verticillatus* (swamp dock), *Sagittaria lancifolia* (bulltongue arrowhead), and *Teucrium canadense* (Canada germander). *Spartina cynosuroides* (big cordgrass) occurs in approximately two-thirds of the representative vegetation sample plots and at times codominates. The colonial sedge *Carex stricta* (upright sedge) often forms local dominance patches, characteristically on hummocks raised 20-25 cm above the primary marsh surface. Such stands also characteristically contain scattered individuals of *Rosa palustris* (swamp rose) or *Cephalanthus occidentalis* (common buttonbush).
**Most Abundant Species:** Information not available.
**Characteristic Species:** *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow), *Leersia oryzoides* (rice cutgrass), *Mikania scandens* (climbing hempvine), *Peltandra virginica* (green arrow arum), *Polygonum arifolium* (halberdleaf tearthumb), *Polygonum punctatum* (dotted smartweed), *Polygonum sagittatum* (arrowleaf tearthumb), *Spartina cynosuroides* (big cordgrass), *Toxicodendron radicans* (eastern poison ivy).
**Other Noteworthy Species:** Information not available.
**USFWS Wetland System:** Estuarine.

**DISTRIBUTION**
**Range:** This association is currently described from Virginia, Maryland, and New Jersey.
**States/Provinces:** MD, NJ, VA.
**Federal Lands:** NPS (Colonial, George Washington Birthplace); USFWS (Chesapeake Marshlands).

**CONSERVATION STATUS**
**Rank:** GNR (12-May-2002).
**Reasons:** Information not available.

**CLASSIFICATION INFORMATION**
**Status:** Standard.
**Confidence:** 2 - Moderate.
**Comments:** In Virginia, occurrences are known from the Mattaponi (New and Gleason marshes), Pamunkey (Sweet Hall, Cousiac, and Cohoke marshes), and Rappahannock (Otterburn Marsh) rivers. In Maryland, an occurrence documented from the Pocomoke River (Cypress Swamp) is currently attributed to this type. In New Jersey, an occurrence is known from Rancocas Creek.
**Similar Associations:**
- *Impatiens capensis - Peltandra virginica - Polygonum arifolium - Schoenoplectus fluviatilis - Typha angustifolia* Tidal Herbaceous Vegetation (CEGL006325).

**Related Concepts:**
- *Hibiscus moscheutos - Polygonum arifolium - Leersia oryzoides - (Carex stricta)* Tidal Herbaceous Vegetation (Coulling 2002) ?
- *Hibiscus moscheutos - Polygonum punctatum - Peltandra virginica - (Typha angustifolia) - (Spartina cynosuroides)* Herbaceous Vegetation (Coulling 2002) =
- *Osmunda regalis - Rosa palustris* Herbaceous Vegetation (Bartgis 1986) ?

**SOURCES**

**Description Authors:** S.L. Neid, mod. L.A. Sneddon.

**References:** Bartgis 1986, Coulling 2002, Eastern Ecology Working Group n.d., Fleming et al. 2004, Harrison 2004, J. Harrison pers. comm., New Jersey Department of Environmental Protection 2001, Strakosch Walz et al. 2006.

## COMMON NAME (PARK-SPECIFIC): TIDAL FRESHWATER MARSH

**SYNONYMS**

**USNVC English Name:** **Green Arrow-arum - Pickerelweed Tidal Herbaceous Vegetation**

**USNVC Scientific Name:** ***Peltandra virginica* - *Pontederia cordata* Tidal Herbaceous Vegetation**

**USNVC Identifier:** **CEGL004706**

### LOCAL INFORMATION

**Environmental Description:** Tidal Freshwater Marsh includes herbaceous wetlands subject to regular diurnal flooding along the upper tidal reaches of large rivers and tributaries. Tidal Freshwater Marsh is found in the uppermost portion of the estuarine zone, where the inflow of saltwater from tidal influence is diluted by a much larger volume of freshwater from upstream. Strictly speaking, freshwater conditions have salt concentrations <0.5 ppt, but pulses of higher salinity may occur during spring tides or periods of unusually low river discharge.

**Vegetation Description:** The dominant species are *Peltandra virginica* (green arrow arum), *Pontederia cordata* (pickerelweed), *Polygonum punctatum* (dotted smartweed), and *Zizania aquatica* var. *aquatica* (annual wildrice). These species commonly form monospecific patches, but can also occur intermixed and with other species more commonly associated with Tidal Oligohaline Marsh. Low-statured, forb-dominated marshes with *Peltandra virginica* (green arrow arum) and *Pontederia cordata* (pickerelweed) occur in association with fresh pockets of open water, on low mudflats, or along second-order tributaries in the interior of extensive marshes. Tall (>1 m) graminoid-dominated Tidal Freshwater Marsh typically occurs along tidal river systems in shallow bays, at the heads of pocket marshes, or at the mouth of channels where *Zizania aquatica* var. *aquatica* (annual wildrice) dominates or codominates with other tidal marsh graminoids, such as *Typha angustifolia* (narrowleaf cattail). In Colonial National Historical Park, other species that may occur as minor associates, but not dominate, in the Freshwater Tidal Marsh include *Eleocharis palustris* (common spikerush), *Leersia oryzoides* (rice cutgrass), *Typha angustifolia* (narrowleaf cattail), *Sagittaria subulata* (awl-leaf arrowhead), *Schoenoplectus pungens* (common threesquare), *Schoenoplectus americanus* (chairmaker's bulrush), and *Spartina cynosuroides* (big cordgrass).

Tidal Freshwater Marsh can occur as zoned vegetation with *Typha angustifolia* (narrowleaf cattail) as a near-shore zone, grading to *Zizania aquatica* var. *aquatica* (annual wildrice), with *Peltandra virginica* (green arrow arum) in the middle, open-water zone. Small areas of Tidal Freshwater Marsh may occur as inclusions in Oligohaline Marsh and are not mapped separately.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Herb (field) | Forb | *Peltandra virginica* (green arrow arum) |
| Herb (field) | Graminoid | *Zizania aquatica* var. *aquatica* (annual wildrice) |

**Characteristic Species:** *Peltandra virginica* (green arrow arum), *Pontederia cordata* (pickerelweed), *Zizania aquatica* var. *aquatica* (annual wildrice).

**Other Noteworthy Species:** Information not available.

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | SNR* | B | 1 | Tidal Freshwater Marsh | Fleming et al. 2001 |

**Local Range:** Tidal Freshwater Marsh is mapped at Jamestown Island in the vicinity of Sandy Bay and the upper portions of the Back River, at Papermill Creek, and at College Creek / Kingsmill along Halfway Creek. In total it covers 125 hectares (308 acres) in Colonial National Historical Park.
**Classification Comments:** Tidal Freshwater Marsh is distinguished from other tidal marsh vegetation in Colonial National Historical Park by occurring in areas where there is enough freshwater input to influence the vegetation composition so that the dominant species include *Peltandra virginica* (green arrow arum) and *Zizania aquatica* var. *aquatica* (annual wildrice) and without dominance by *Spartina cynosuroides* (big cordgrass). Some areas mapped as Freshwater Tidal Marsh may be transitional to Oligohaline Marsh and have species composition intermediate between the two concepts.
**Other Comments:** Information not available.
**Local Description Authors:** K. D. Patterson.
**Plots:** COLO.111, COLO.119.
**Colonial National Historical Park Inventory Notes:** Information 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 | Tidal temperate perennial forb vegetation (V.B.2.N.g.) |
| Alliance | *Peltandra virginica - Pontederia cordata* Tidal Herbaceous Alliance (A.1703) |
| Alliance (English name) | Green Arrow-arum - Pickerelweed Tidal Herbaceous Alliance |
| Association | *Peltandra virginica - Pontederia cordata* Tidal Herbaceous Vegetation |
| Association (English name) | Green Arrow-arum - Pickerelweed Tidal Herbaceous Vegetation |
| **Ecological System(s):** | Northern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.516).<br>Acadian Estuary Marsh (CES201.579). |

### GLOBAL DESCRIPTION

**Concept Summary:** This freshwater low tidal marsh is dominated by variable mixtures of *Peltandra virginica* (green arrow arum) and *Pontederia cordata* (pickerelweed) that are best expressed along the North Atlantic Coast southward to Virginia. It occurs on mucky substrates of variable depth at low elevations within the freshwater tidal zone, often bordering open water. *Peltandra virginica* (green arrow arum) and *Pontederia cordata* (pickerelweed) are codominant. Associated species can include *Bidens* spp. (beggarticks), *Zizania aquatica* (annual wildrice), *Sagittaria latifolia* (broadleaf arrowhead), *Acorus americanus* (sweetflag), *Nuphar lutea* ssp. *advena* (yellow pond-lily), *Polygonum arifolium* (halberdleaf tearthumb), *Polygonum hydropiperoides* (swamp smartweed), and *Polygonum sagittatum* (arrowleaf tearthumb).
**Environmental Description:** This community occurs low within freshwater tidal marshes on muck substrates of variable depth. There is a long duration of tidal flooding, and the community is exposed only for a short period of time each day when the tide is out.
**Vegetation Description:** This community is codominated by leafy forbs *Peltandra virginica* (green arrow arum) and *Pontederia cordata* (pickerelweed). Associated species can include *Zizania aquatica* (annual wildrice), *Sagittaria latifolia* (broadleaf arrowhead), *Acorus americanus* (sweetflag), *Polygonum arifolium* (halberdleaf tearthumb), *Polygonum*

*hydropiperoides* (swamp smartweed), *Polygonum sagittatum* (arrowleaf tearthumb), and *Bidens* spp. (beggarticks). Species occurring less frequently can include *Typha* spp. (cattails) and *Impatiens capensis* (jewelweed). At the southern end of the range in Virginia, there is a well-marked variant in which *Nuphar lutea* ssp. *advena* (yellow pond-lily) is codominant with *Peltandra virginica* (green arrow arum) and *Pontederia cordata* (pickerelweed) in variable mixtures. This variant differs from the almost monospecific *Nuphar lutea* ssp. *advena* (yellow pond-lily) Tidal Herbaceous Vegetation (CEGL004472) in that it occurs on slightly higher landscape positions where the duration of inundation is shorter, supports higher mean species richness, and contains a number of taxa absent from the low intertidal portions of mudflats.

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Herb (field) | Forb | *Peltandra virginica* (green arrow arum), *Pontederia cordata* (pickerelweed) |

**Characteristic Species:** *Peltandra virginica* (green arrow arum), *Pontederia cordata* (pickerelweed).

**Other Noteworthy Species:** Information not available.

**USFWS Wetland System:** Estuarine.

**DISTRIBUTION**

**Range:** This freshwater tidal marsh occurs from Maine to Virginia, excluding Rhode Island and New Hampshire.

**States/Provinces:** CT, DE, MA, MD:S4?, NJ, NY, VA.

**Federal Lands:** DOD (Fort Belvoir); NPS (Colonial, George Washington Parkway, National Capital-East); USFWS (Chesapeake Marshlands, Prime Hook).

**CONSERVATION STATUS**

**Rank:** G3G4 (4-Nov-1998).

**Reasons:** This community is restricted in range (Atlantic Coast from Maine to Virginia, not including New Hampshire and Rhode Island) and available habitat (freshwater tidal rivers with broad shoreline expanses subjected to moderate to high tidal fluctuation), with a liberal estimate of <200 EOs and <35,000 acres rangewide. Many EOs have been impacted by the damming of tidal rivers and by pollution in urban areas.

**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) (Coulling 2002). This vegetation is best sampled later in the season. This community occurs in very similar environmental settings as *Nuphar lutea* ssp. *advena* (yellow pond-lily) Tidal Herbaceous Vegetation (CEGL004472), low freshwater tidal marshes with a long duration of flooding. Species composition has some overlap. These two associations are best expressed where the elevation gradient is very mild, allowing the associations to occupy different zones, with this association (CEGL004706) occurring at slightly higher elevation than CEGL004472. *Impatiens capensis - Peltandra virginica - Polygonum arifolium - Schoenoplectus fluviatilis - Typha angustifolia* Tidal Herbaceous Vegetation (CEGL006325) is a large-patch community that occupies higher elevations within freshwater marshes and differs in having a much more varied species composition.

**Similar Associations:**

- *Impatiens capensis - Peltandra virginica - Polygonum arifolium - Schoenoplectus fluviatilis - Typha angustifolia* Tidal Herbaceous Vegetation (CEGL006325).
- *Nuphar lutea* ssp. *advena* Tidal Herbaceous Vegetation (CEGL004472).
- *Pontederia cordata - Peltandra virginica - Sagittaria latifolia* Herbaceous Vegetation (CEGL006191).

**Related Concepts:**

- *Nuphar advena - Peltandra virginica* Tidal Herbaceous Vegetation (Coulling 2002) ?
- *Peltandra virginica - (Pontederia cordata)* Tidal Herbaceous Vegetation (Coulling 2002) ?
- Arrow-arum/Pickerelweed Community Type (Odum et al. 1984) ?

**SOURCES**

**Description Authors:** S. L. Neid, mod. G. P. Fleming.

**References:** Bowman 2000, Breden et al. 2001, Coulling 2002, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fleming 2001, Fleming et al. 2001, Harrison 2001, Harrison 2004, McCoy and Fleming 2000, Metzler and Barrett 2004, Odum et al. 1984, Peet et al. unpubl. data 2002.



Figure I34. Tidal Freshwater Marsh at Colonial National Historical Park. July 2004. NAD 1983 / UTM easting 344305, northing 4118854.

## COMMON NAME (PARK-SPECIFIC): TIDAL OLIGOHALINE MARSH (INTERIOR DEPRESSION MARSH)

**SYNONYMS**

**USNVC English Name:** **Arrow-arum - (Common Three Square, Softstem Bulrush) Vegetation**

**USNVC Scientific Name:** ***Peltandra virginica - Schoenoplectus (pungens, tabernaemontani)*** **Tidal Herbaceous Vegetation**

**USNVC Identifier:** **CEGL006578**

### LOCAL INFORMATION

**Environmental Description:** This oligohaline marsh association occupies small (generally <0.3 ha) depressions or open mudflats in the interior of marshes, where subsidence has locally lowered the level of the substrate and consequently increased the duration of inundation from diurnal lunar tides. The substrate consists of mucky clay or fine-textured silt, often with abundant organic matter.

**Vegetation Description:** This association occurs as sparsely vegetated interior depressions within a larger oligohaline marsh. The most constant and dominant species are *Peltandra virginica* (green arrow arum), *Schoenoplectus pungens* (common threesquare), and *Schoenoplectus tabernaemontani* (softstem bulrush), which may attain high cover. Characteristic associates include *Polygonum punctatum* (dotted smartweed), *Zizania aquatica* var. *aquatica* (annual wildrice), *Echinochloa walteri* (coast cockspur grass), *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow), *Leersia oryzoides* (rice cutgrass), *Pluchea odorata* (sweetscent), *Amaranthus cannabinus* (tidalmarsh amaranth), *Rumex verticillatus* (swamp dock), and *Pontederia cordata* (pickerelweed).

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Herb (field) | Graminoid | *Schoenoplectus pungens* (common threesquare), *Schoenoplectus tabernaemontani* (softstem bulrush) |

**Characteristic Species:** *Echinochloa walteri* (coast cockspur grass), *Polygonum punctatum* (dotted smartweed), *Schoenoplectus pungens* (common threesquare), *Schoenoplectus tabernaemontani* (softstem bulrush).

**Other Noteworthy Species:**

| Species | GRank | Type | Note |
|---|---|---|---|
| *Eleocharis rostellata* (beaked spikerush) | - | plant | VA watchlist (S3) |

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | Sname | Reference |
|---|---|---|---|---|---|
| VA | SNR | B | C | Tidal Oligohaline Marsh | Fleming et al. 2006 |

**Local Range:** Tidal Oligohaline Marsh (Interior Depression Marsh) is found at Jamestown Island and is below minimum mapping unit. It is one of five associations included in the map class Tidal Oligohaline Marsh. The five associations cannot be mapped separately based on photo signatures, and a combined map class was used for the vegetation map. Polygons of Tidal Oligohaline Marsh may, in some cases, include several associations.

**Classification Comments:** This association is distinguished by being in small subsidence zones within larger oligohaline marshes.

**Other Comments:** This association occurs as small patches within other Tidal Oligohaline Marsh types.
**Local Description Authors:** K. D. Patterson.
**Plots:** COLO.108, COLO113, COLO.114, COLO.118.
**Colonial National Historical Park Inventory Notes:** Information 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 | Tidal temperate perennial forb vegetation (V.B.2.N.g.) |
| Alliance | *Peltandra virginica - Pontederia cordata* Tidal Herbaceous Alliance (A.1703) |
| Alliance (English name) | Green Arrow-arum - Pickerelweed Tidal Herbaceous Alliance |
| Association | *Peltandra virginica - Schoenoplectus (pungens, tabernaemontani)* Tidal Herbaceous Vegetation |
| Association (English name) | Arrow-arum - (Common Three Square, Softstem Bulrush) Vegetation |
| **Ecological System(s):** | Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519). |

### GLOBAL DESCRIPTION

**Concept Summary:** This sparsely to densely vegetated herbaceous community occurs in low intertidal portions of marshes along tidal rivers and large tributaries in Virginia. It occupies both narrow zones along channel edges in chiefly freshwater regimes and in local subsidence areas in the interior of small to large marshes under freshwater to oligohaline conditions. *Peltandra virginica* (green arrow arum) is a constant and typically dominant or codominant constituent. Most stands also contain *Schoenoplectus pungens* (common threesquare) or *Schoenoplectus tabernaemontani* (softstem bulrush). Other common associates include *Polygonum punctatum* (dotted smartweed), *Zizania aquatica* (annual wildrice), *Leersia oryzoides* (rice cutgrass), *Pontederia cordata* (pickerelweed), and in freshwater habitats *Eleocharis quadrangulata* (squarestem spikerush). Stature of prevailing vegetation is generally <1 m, but emergent stems of *Schoenoplectus tabernaemontani* (softstem bulrush) or *Zizania aquatica* (annual wildrice) may reach 2 m.
**Environmental Description:** This association occurs in two distinct environments. Along freshwater to slightly oligohaline stretches of tidal rivers and large tidal tributaries, it forms narrow (typically 5- to 10-m) bands in the low intertidal zone adjacent to channel margins. This community also occupies small (generally <0.3 ha) depressions or open mudflats near the mouths of tidal guts or in the interior of marshes, where subsidence has locally lowered the level of the substrate and consequently increased the duration of inundation from diurnal lunar tides. If they are not proximate to an interior channel, such subsidence zones may not drain completely during every tidal cycle, thus resulting in a different salinity regime than the surrounding higher marsh. In prevailing fresh to slightly oligohaline conditions, these patches may concentrate salt, but more typically, lenses of less saline water may persist under a strongly oligohaline to mesohaline regime. Under both sets of environmental conditions, the substrate consists of mucky clay or fine-textured silt, often with abundant organic matter.
**Vegetation Description:** Composition, species richness, stem density and vegetation cover differ between freshwater and oligohaline variants. *Peltandra virginica* (green arrow arum) is a constant and generally dominant or codominant species in all stands. Where this vegetation

forms narrow bands under freshwater conditions, *Schoenoplectus pungens* (common threesquare) or *Schoenoplectus tabernaemontani* (softstem bulrush) typically attains high cover and density. *Eleocharis quadrangulata* (squarestem spikerush) and *Pontederia cordata* (pickerelweed) are codominant; common associates include *Leersia oryzoides* (rice cutgrass), *Polygonum punctatum* (dotted smartweed), *Polygonum arifolium* (halberdleaf tearthumb), *Zizania aquatica* (annual wildrice), *Bidens laevis* (smooth beggartick), *Asclepias incarnata* (swamp milkweed), *Amaranthus cannabinus* (tidalmarsh amaranth), *Impatiens capensis* (jewelweed), *Nuphar lutea* ssp. *advena* (yellow pond-lily), *Dulichium arundinaceum* (threeway sedge), *Sagittaria latifolia* (broadleaf arrowhead), *Galium obtusum* (bluntleaf bedstraw), and the exotic *Murdannia keisak* (wartremoving herb). In rare instances *Schoenoplectus fluviatilis* (river bulrush) or *Schoenoplectus americanus* (chairmaker's bulrush) may share dominance. Oligohaline variants are typically less diverse and more sparsely vegetated, although *Schoenoplectus pungens* (common threesquare) or *Schoenoplectus tabernaemontani* (softstem bulrush) may attain high cover. Characteristic associates include *Polygonum punctatum* (dotted smartweed), *Zizania aquatica* (annual wildrice), *Echinochloa walteri* (coast cockspur grass), *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow), *Leersia oryzoides* (rice cutgrass), *Pluchea odorata* (sweetscent), *Amaranthus cannabinus* (tidalmarsh amaranth), *Rumex verticillatus* (swamp dock), and *Pontederia cordata* (pickerelweed).

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Herb (field) | Forb | *Peltandra virginica* (green arrow arum) |

**Characteristic Species:** *Peltandra virginica* (green arrow arum), *Schoenoplectus pungens* (common threesquare), *Schoenoplectus tabernaemontani* (softstem bulrush).
**Other Noteworthy Species:** Information not available.
**USFWS Wetland System:** Estuarine.

**DISTRIBUTION**
**Range:** This association has been documented from several tidal river systems in Virginia. Its potential occurrence outside Virginia has not been evaluated.
**States/Provinces:** VA.
**Federal Lands:** NPS (Colonial).

**CONSERVATION STATUS**
**Rank:** GNR (2-Jun-2007).
**Reasons:** Information not available.

**CLASSIFICATION INFORMATION**
**Status:** Provisional.
**Confidence:** 3 - Weak.
**Comments:** This community exhibits considerable variation in composition and structure, largely as functions of prevailing salinity and hydroperiod. *Schoenoplectus pungens* (common threesquare) Tidal Herbaceous Vegetation (CEGL004188) forms similarly narrow patches and occupies similar habitats along channel margins, as do freshwater variants of this association, but is typically much less diverse and is restricted to gravelly or otherwise coarse-textured substrates on shorelines frequently subject to ice-scour. *Peltandra virginica - Pontederia cordata* Tidal Herbaceous Vegetation (CEGL004706) occurs in similarly low landscape positions, often adjacent to open water, but generally lacks emergent graminoids (*Schoenoplectus* spp. (bulrushs), *Eleocharis quadrangulata* (squarestem spikerush)) as important associates, and

patches are not characteristically linear. This type is documented by more than 20 vegetation plots from the James, Mattaponi, Pamunkey, Potomac, Rappahannock and York river drainages in Virginia.

**Similar Associations:**

- *Schoenoplectus pungens* Tidal Herbaceous Vegetation (CEGL004188).

**Related Concepts:**

- *Eleocharis quadrangulata - Pontederia cordata - Schoenoplectus (pungens, tabernaemontani)* (Coulling 2002) F
- *Peltandra virginica - Echinochloa walteri - Schoenoplectus (pungens, tabernaemontani)* (Coulling 2002) F

**SOURCES**

**Description Authors:** P. P. Coulling.

**References:** Coulling 2002, Eastern Ecology Working Group, n.d.



Figure I35. Tidal Oligohaline Marsh (Interior Depression Marsh) (plot COLO.114) at Colonial National Historical Park. September 2001. NAD 1983 / UTM easting 344977, northing 4117908.

## COMMON NAME (PARK-SPECIFIC): DENSE HARDWOOD REGENERATION

**SYNONYMS**
**USNVC English Name:** **Not Applicable**
**USNVC Scientific Name:** **Not Applicable**
**USNVC Identifier:** **Nonstandard**

### LOCAL INFORMATION

**Environmental Description:** This mapping unit includes dense, shrubby regeneration of hardwood species on areas that have been cleared in the recent past (less than 20 years).
**Vegetation Description:** Deciduous sprouts from stumps and small trees form an impenetrable thicket 4-6 m tall, often intertwined with woody vines. Occasional mature trees may be scattered in the canopy. Species composition varies from stand to stand, but typical species include *Acer rubrum* (red maple), *Carpinus caroliniana* (American hornbeam), *Carya alba* (mockernut hickory), *Cornus florida* (flowering dogwood), *Liquidambar styraciflua* (sweetgum), *Liriodendron tulipifera* (tuliptree), *Nyssa sylvatica* (blackgum), *Prunus serotina* var. *serotina* (black cherry), *Quercus phellos* (willow oak), *Quercus rubra* (northern red oak), *Robinia pseudoacacia* (black locust), *Smilax* spp. (greenbriers), and *Viburnum prunifolium* (blackhaw).

Species composition varies depending on the composition of the original and surrounding forests.
**Most Abundant Species:** Information not available.
**Characteristic Species:** Information not available.
**Other Noteworthy Species:** Information not available.
**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | NA | . | . | [not crosswalked, not ranked] | . |

**Local Range:** Dense Hardwood Regeneration is mapped as two small patches at Ringfield / King Creek and Yorktown Battlefield.
**Classification Comments:** This mapping unit is deciduous and is dominated by small trees and shrubs. It is distinguished from Successional Mixed Scrub by being predominately native species.
**Other Comments:** Information not available.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Colonial National Historical Park Inventory Notes:** Information not available.

### GLOBAL INFORMATION

Dense Hardwood Regeneration is a park-specific, nonstandard type and has no global information.

## COMMON NAME (PARK-SPECIFIC): DISTURBED CALCAREOUS FOREST

**SYNONYMS**
**USNVC English Name:** **Not Applicable**
**USNVC Scientific Name:** **Not Applicable**
**USNVC Identifier:** **Nonstandard**

### LOCAL INFORMATION

**Environmental Description:** Disturbed Calcareous Forest is mapped along a 4-km (2.5-mile) stretch of Colonial Parkway along the York River. These forests have extensive wind damage, have been invaded by exotic plants, and have been bisected by the construction of the Colonial Parkway.

**Vegetation Description:** Disturbed Calcareous Forest is a deciduous forest dominated by species indicative of disturbance or associated with early-successional forests, but with a high frequency of species indicative of calcareous or fertile. The canopy is often dominated by early-successional species such as *Liriodendron tulipifera* (tuliptree), *Liquidambar styraciflua* (sweetgum), *Pinus taeda* (loblolly pine), and *Quercus falcata* (southern red oak). Additional trees species indicative of a calcareous soil influence include *Quercus muehlenbergii* (chinkapin oak), *Acer barbatum* (southern sugar maple), *Carya cordiformis* (bitternut hickory), and *Juglans nigra* (black walnut). Other tree species, such as *Quercus rubra* (northern red oak), *Quercus alba* (white oak), *Fraxinus americana* (white ash), and *Platanus occidentalis* (American sycamore), may also occur but are not dominant. Species in the subcanopy include those from the canopy, along with *Ostrya virginiana* (hophornbeam), *Ulmus rubra* (slippery elm), and *Celtis occidentalis* (common hackberry). Typical tall shrubs are the exotic shrub *Ailanthus altissima* (tree of heaven), as well as *Ostrya virginiana* (hophornbeam), *Lindera benzoin* (northern spicebush), *Acer barbatum* (southern sugar maple), and *Cornus florida* (flowering dogwood). Short shrubs include *Asimina triloba* (pawpaw), and *Juniperus virginiana* var. *virginiana* (eastern redcedar). The herb layer is dominated by the exotic grass *Microstegium vimineum* (Nepalese browntop) and the exotic vine *Lonicera japonica* (Japanese honeysuckle). Other species can include *Arabis laevigata* (smooth rockcress), *Bromus pubescens* (hairy woodland brome), *Campsis radicans* (trumpet creeper), *Elymus villosus* (hairy wildrye), *Elymus virginicus* (Virginia wildrye), and *Verbesina alternifolia* (wingstem).

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Liriodendron tulipifera* (tuliptree) |
| Herb (field) | Vine/Liana | *Lonicera japonica* (Japanese honeysuckle) |
| Herb (field) | Graminoid | *Microstegium vimineum* (Nepalese browntop) |

**Characteristic Species:** *Liriodendron tulipifera* (tuliptree), *Lonicera japonica* (Japanese honeysuckle), *Microstegium vimineum* (Nepalese browntop), *Quercus muehlenbergii* (chinkapin oak).

**Other Noteworthy Species:** Information not available.

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | NA | . | . | [not crosswalked, not ranked] | . |

**Local Range:** Disturbed Calcareous Forest is mapped along a 4-km (2.5-mile) stretch of Colonial Parkway along the York River. It is mapped as six polygons ranging in size from 0.6 to 2.6 ha (1.6 to 6.4 acres).

**Classification Comments:** Forests mapped as Disturbed Calcareous Forest may have formerly been either Coastal Plain Mesic Calcareous Ravine Forest or Coastal Plain Dry Calcareous Forest, but now have a species composition too altered to assign them a natural community classification. The plot COLO.10 was originally analyzed with the mesic acidic forest group, but was determined to be an outlier and was removed from the analysis and reclassified as Disturbed Calcareous Forest.
**Other Comments:** Information not available.
**Local Description Authors:** K. D. Patterson.
**Plots:** COLO.10.
**Colonial National Historical Park Inventory Notes:** Information not available.

## GLOBAL INFORMATION

Disturbed Calcareous Forest is a park-specific, nonstandard type and has no global information.

## COMMON NAME (PARK-SPECIFIC): DISTURBED DEPRESSIONAL WETLAND

**SYNONYMS**
**USNVC English Name:** **Not Applicable**
**USNVC Scientific Name:** **Not Applicable**
**USNVC Identifier:** **Nonstandard**

### LOCAL INFORMATION

**Environmental Description:** Disturbed Depressional Wetland is a seasonally flooded wetland that is flooded to a depth of 1 meter in the early part of the growing season and may dry out completely later in the season. It is an isolated wetland, occurring in an otherwise upland landscape with no fluvial inputs. Its origin may have been anthropogenic, resulting from silvicultural operations on an area with a perched water table, or as a borrow pit or farm pond that has since filled in.
**Vegetation Description:** Disturbed Depressional Wetland has an open, forested canopy composed of deciduous trees and shrubs, mainly *Liquidambar styraciflua* (sweetgum) and *Acer rubrum* (red maple). Trees are young and short-statured. The herb layer is composed of various grasses and sedges, such as *Juncus effusus* (common rush).
**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Liquidambar styraciflua* (sweetgum) |

**Characteristic Species:** *Juncus effusus* (common rush), *Liquidambar styraciflua* (sweetgum).
**Other Noteworthy Species:** Information not available.
**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | NA | . | . | [not crosswalked, not ranked] | . |

**Local Range:** Disturbed Depressional Wetland is mapped as a single polygon at Green Spring covering a total of 1.5 hectares (3.7 acres).
**Classification Comments:** This map class was developed for a single stand of disturbed wetland forest. Unlike Coastal Plain Depression which forms through the dissolution of underlying carbonate-rich, shell marl deposits, Disturbed Depressional Wetland is thought to have originated from anthropogenic disturbance.
**Other Comments:** This seasonally flooded wetland is used as breeding habitat for amphibians.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Colonial National Historical Park Inventory Notes:** Information not available.

### GLOBAL INFORMATION

Disturbed Depressional Wetland is a park-specific, nonstandard type and has no global information.



Figure I36. Disturbed Depressional Wetland at Colonial National Historical Park. May 2004. NAD 1983 / UTM easting 339923, northing 4125297.

## COMMON NAME (PARK-SPECIFIC): DISTURBED SEEPAGE SWAMP

**SYNONYMS**
**USNVC English Name:** **Not Applicable**
**USNVC Scientific Name:** **Not Applicable**
**USNVC Identifier:** **Nonstandard**

### LOCAL INFORMATION

**Environmental Description:** Disturbed Seepage Swamp is a forested wetland with saturated hydrology. These forests have developed in areas where the natural hydrology has been altered by impoundments or roads. In Colonial National Historical Park, this map class is found where the Colonial Parkway bisects former bottomlands or in the upper reaches of impounded ravine systems where exotic plants have invaded the ravine bottoms.
**Vegetation Description:** Disturbed Seepage Swamp may occur as a well-formed forest or as dense regeneration of hardwood trees. The canopy is typically dominated by *Acer rubrum* (red maple) with associates such as *Platanus occidentalis* (American sycamore), *Liquidambar styraciflua* (sweetgum), or *Fraxinus pennsylvanica* (green ash). Shrubs are variable but can include *Asimina triloba* (pawpaw), *Salix nigra* (black willow), and *Liquidambar styraciflua* (sweetgum). The herb layer is often dominated by *Leersia virginica* (whitegrass) or the exotic grass *Microstegium vimineum* (Nepalese browntop). Other characteristic herbs include *Boehmeria cylindrica* (smallspike false nettle), *Cardamine pensylvanica* (Pennsylvania bittercress), *Cinna arundinacea* (sweet woodreed), *Circaea lutetiana* ssp. *canadensis* (broadleaf enchanter's nightshade), *Hedera helix* (English Ivy), *Impatiens capensis* (jewelweed), *Saururus cernuus* (lizard's tail), *Packera aurea* (golden ragwort), and *Woodwardia areolata* (netted chainfern).
**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Acer rubrum* (red maple) |
| Herb (field) | Graminoid | *Microstegium vimineum* (Nepalese browntop) |

**Characteristic Species:** *Acer rubrum* (red maple), *Microstegium vimineum* (Nepalese browntop).
**Other Noteworthy Species:** Information not available.
**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | NA | . | . | [not crosswalked, not ranked] | . |

**Local Range:** Disturbed Seepage Swamp is mapped along Colonial Parkway near Papermill Creek and in Yorktown and in the upper reaches of Yorktown Creek ravines.
**Classification Comments:** Forests mapped as Disturbed Seepage Swamp may have formerly been Coastal Plain Calcareous Seepage Swamp or other seepage wetlands, but now have a species composition too altered to assign them a natural community classification.
**Other Comments:** Information not available.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Colonial National Historical Park Inventory Notes:** Information not available.

## GLOBAL INFORMATION

Disturbed Seepage Swamp is a park-specific, nonstandard type and has no global information.

## COMMON NAME (PARK-SPECIFIC): DISTURBED TIDAL HARDWOOD SWAMP

**SYNONYMS**
**USNVC English Name:** **Not Applicable**
**USNVC Scientific Name:** **Not Applicable**
**USNVC Identifier:** **Nonstandard**

### LOCAL INFORMATION

**Environmental Description:** Disturbed Tidal Hardwood Swamp includes formerly tidal wetlands that have been cut off from all or most of their tidal influence, either by roads or berms. The hydrology is now semipermanently flooded. These wetlands may periodically be flooded by storm surge and can have somewhat oligohaline waters. Most examples have sustained heavy wind damage from past hurricanes.

**Vegetation Description:** Disturbed Tidal Hardwood Swamp has an open deciduous canopy with 25-50% cover dominated by *Acer rubrum* (red maple), sometimes with *Pinus taeda* (loblolly pine), *Nyssa biflora* (swamp tupelo), and *Liquidambar styraciflua* (sweetgum). Fallen and standing dead trees are common. Shrub dominants are *Morella cerifera* (wax myrtle) and *Persea palustris* (swamp bay). Other shrubs include *Baccharis halimifolia* (eastern baccharis) and *Cornus foemina* (stiff dogwood). *Decodon verticillatus* (swamp loosestrife), a suffrutescent (shrubby) herb, can be a patch dominant. Vines are common and include *Mikania scandens* (climbing hempvine), *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy), and *Vitis rotundifolia* (muscadine). Areas of deep water may have floating aquatic plants such as *Lemna minor* (common duckweed). A variety of wetland plants may be found in the herb layer: rooted aquatic plants such as *Hydrocotyle verticillata* var. *verticillata* (whorled marshpennywort), *Murdannia keisak* (wartremoving herb), *Pontederia cordata* (pickerelweed), *Typha angustifolia* (narrowleaf cattail), and *Typha latifolia* (broadleaf cattail); many wetland grasses and grasslike plants such as *Carex crinita* (fringed sedge), *Carex hyalinolepis* (shoreline sedge), *Cinna arundinacea* (sweet woodreed), *Elymus virginicus* var. *halophilus* (Virginia wildrye), *Juncus effusus* (common rush), *Leersia virginica* (whitegrass), and *Panicum virgatum* var. *virgatum* (switchgrass); as well as other plants of mesic to wet habitats, including *Polygonum arifolium* (halberdleaf tearthumb), *Polygonum punctatum* (dotted smartweed), *Teucrium canadense* (Canada germander), and *Thelypteris palustris* var. *pubescens* (eastern marsh fern).

**Most Abundant Species:**

| Stratum | Lifeform | Species |
|---|---|---|
| Tree canopy | Broad-leaved deciduous tree | *Acer rubrum* (red maple) |
| Shrub/sapling (tall & short) | Broad-leaved deciduous shrub | *Morella cerifera* (wax myrtle) |
| Herb (field) | Graminoid | *Typha latifolia* (broadleaf cattail) |

**Characteristic Species:** *Acer rubrum* (red maple), *Morella cerifera* (wax myrtle), *Murdannia keisak* (wartremoving herb), *Typha latifolia* (broadleaf cattail).

**Other Noteworthy Species:** Information not available.

**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | NA | . | . | [not crosswalked, not ranked] | . |

**Local Range:** Disturbed Tidal Hardwood Swamp is mapped as three polygons on Jamestown Island, covering a total of 4.6 hectares (11.4 acres). Small areas below minimum mapping unit may occur as inclusions in the surrounding landscapes.

**Classification Comments:** Forests mapped as Disturbed Tidal Hardwood Swamp are semipermanently flooded and have a species composition suggestive of oligohaline vegetation, as well as components of disturbed freshwater wetlands. These wetland forests have a species composition too altered to assign a natural community classification.
**Other Comments:** Polygons classed as Disturbed Tidal Hardwood Swamp may have small inclusions of Tidal Bald Cypress Forest / Woodland.
**Local Description Authors:** K. D. Patterson.
**Plots:** COLO.117.
**Colonial National Historical Park Inventory Notes:** Information not available.

## GLOBAL INFORMATION

Disturbed Tidal Hardwood Swamp is a park-specific, nonstandard type and has no global information.



Figure I37. Disturbed Tidal Hardwood Swamp at Colonial National Historical Park. July 2004. NAD 1983 / UTM easting 345429, northing 4118602.

## COMMON NAME (PARK-SPECIFIC): SEMIPERMANENT IMPOUNDMENT

**SYNONYMS**
**USNVC English Name:** **Not Applicable**
**USNVC Scientific Name:** **Not Applicable**
**USNVC Identifier:** **Nonstandard**

### LOCAL INFORMATION

**Environmental Description:** Semipermanent Impoundment includes non-tidal complexes of open water with areas of shrubby and coarse herbaceous vegetation associated with both beaver ponds and persistent man-made impoundments. Over time, or more rapidly when drained, these wetlands tend to fill in with sediment and undergo invasion by emergent and woody vegetation.
**Vegetation Description:** In Colonial National Historical Park, these areas commonly have standing dead trees with areas of open water and emergent vegetation dominated by *Peltandra virginica* (green arrow arum), *Decodon verticillatus* (swamp loosestrife), *Phragmites australis* (common reed), and *Typha latifolia* (broadleaf cattail) with floating aquatics such as *Lemna* sp. (a duckweed).

Semipermanent Impoundment can vary in structure from very shrubby to emergent herbaceous vegetation with scattered trees. Some examples may have been formerly tidal but are now cut off from any tidal influence. Species composition can vary from site to site.
**Most Abundant Species:** Information not available.
**Characteristic Species:** Information not available.
**Other Noteworthy Species:** Information not available.
**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | NA | . | . | [not crosswalked, not ranked] | . |

**Local Range:** Semipermanent Impoundment is mapped at Green Springs, in the vicinity of Yorktown Battlefield, and in various locations along Colonial Parkway.
**Classification Comments:** Semipermanent Impoundment is distinguished by being non-tidal with a semipermanent to permanent flooded hydrology.
**Other Comments:** This is not a natural / semi-natural community type, although various associations may apply to small areas within these impoundments.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Colonial National Historical Park Inventory Notes:** Information not available.

### GLOBAL INFORMATION

Semipermanent Impoundment is a park-specific, nonstandard type and has no global information.



Figure I38. Semipermanent Impoundment at Colonial National Historical Park. April 2005. NAD 1983 / UTM easting 365977, northing 4121227.

## COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL MIXED SCRUB

**SYNONYMS**
**USNVC English Name:** **Not Applicable**
**USNVC Scientific Name:** **Not Applicable**
**USNVC Identifier:** **Nonstandard**

### LOCAL INFORMATION

**Environmental Description:** This mapping unit is not a natural / semi-natural vegetation type and includes successional shrubby areas bordering roadways and Cultural Meadow.
**Vegetation Description:** Successional Mixed Scrub can vary from a tangle of native and exotic vines over short trees to dense mixtures of shrubby, successional and exotic species. Species composition and dominance vary greatly from site to site. Vines found in this mapping unit can include *Hedera helix* (English ivy), *Lonicera japonica* (Japanese honeysuckle), *Parthenocissus quinquefolia* (Virginia creeper), *Rubus* spp. (blackberries), *Vinca minor* (common periwinkle), *Vitis vulpina* (frost grape), and *Wisteria sinensis* (Chinese wisteria). Other shrubby species can include *Ailanthus altissima* (tree of heaven), *Diospyros virginiana* (common persimmon), *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Ligustrum sinense* (Chinese privet), *Paulownia tomentosa* (princesstree), *Prunus serotina* var. *serotina* (black cherry), and *Sassafras albidum* (sassafras).

This mapping unit varies from vine thickets to tall shrublands. Species composition varies from site to site.
**Most Abundant Species:** Information not available.
**Characteristic Species:** Information not available.
**Other Noteworthy Species:** Information not available.
**Subnational Distribution with Crosswalk Data:**

| State | SRank | Rel | Conf | SName | Reference |
|---|---|---|---|---|---|
| VA | NA | . | . | [not crosswalked, not ranked] | . |

**Local Range:** Successional Mixed Scrub is mapped as seven polygons in the vicinity of Yorktown Battlefield and Yorktown Village.
**Classification Comments:** This mapping unit is distinguished from other shrublands by occurring on uplands adjacent to roadways and Cultural Meadow and being composed of exotic and successional vines and shrubs.
**Other Comments:** Successional Mixed Scrub can occur as small inclusions within forests that have sustained heavy wind damage.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Colonial National Historical Park Inventory Notes:** Information not available.

### GLOBAL INFORMATION

Successional Mixed Scrub is a park-specific, nonstandard type and has no global information.



Figure I39. Successional Mixed Scrub at Colonial National Historical Park. September 2004. NAD 1983 / UTM easting 362364, northing 4125454.

## COMMON NAME (PARK-SPECIFIC): BEACHES

**SYNONYMS**
**USNVC English Name:** **Not applicable**
**USNVC Scientific Name:** **Not applicable**
**USNVC Identifier:** **Not applicable**

### LOCAL DESCRIPTION

**Local Range:** Beaches are mapped along the shoreline throughout Colonial National Historic Park. Erosion control structures such as riprap, seawalls, and jetties are mapped as Other Urban and Built-up Land.
**Classification Comments:** This map class includes accumulations of sand along shorelines. Beaches may have small areas of shrubby vegetation, but is considered a non-vegetated map class. It is equal to the Anderson (1976) Level II unit 72 - Beaches.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Citation:** Anderson et al. 1976.

## COMMON NAME (PARK-SPECIFIC): INDUSTRIAL AND COMMERCIAL COMPLEXES

**SYNONYMS**
**USNVC English Name:** **Not applicable**
**USNVC Scientific Name:** **Not applicable**
**USNVC Identifier:** **Not applicable**

### LOCAL DESCRIPTION

**Local Range:** Industrial and Commercial Complexes is mapped in the vicinity of Yorktown Battlefield.
**Classification Comments:** This map class includes areas with buildings or structures associated with functions such as warehousing, wholesaling, and retailing. It includes all buildings, walkways, minor roads, and their associated lawns and vegetation. This map class is equal to the Anderson et al. (1976) Level II unit 15, Industrial and Commercial Complexes.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Citation:** Anderson et al. 1976.

## COMMON NAME (PARK-SPECIFIC): OTHER URBAN OR BUILT-UP LAND

**SYNONYMS**
**USNVC English Name:** **Not applicable**
**USNVC Scientific Name:** **Not applicable**
**USNVC Identifier:** **Not applicable**

### LOCAL DESCRIPTION

**Local Range:** Other Urban or Built-up Land is mapped at Yorktown Battlefield, Colonial Parkway in the vicinity of Williamsburg, Jamestown Island, and Swanns Point.
**Classification Comments:** Other Urban or Built-up Land includes areas with buildings or structures associated with park maintenance, recreation, or historic interpretation, as well as urban parks, golf courses, cemeteries, and water control structures (e.g. spillways, riprap). This map class includes all buildings, walkways, minor roads, and their associated lawns and vegetation. This map class is equal to the Anderson et al. (1976) Level II unit 17, Other Urban or Built-up Land.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Citation:** Anderson et al. 1976.

## COMMON NAME (PARK-SPECIFIC): RESIDENTIAL

**SYNONYMS**
**USNVC English Name:** **Not applicable**
**USNVC Scientific Name:** **Not applicable**
**USNVC Identifier:** **Not applicable**

### LOCAL DESCRIPTION

**Local Range:** Areas mapped as Residential occur at Swanns Point and Yorktown Battlefield.
**Classification Comments:** This map class includes single family dwellings and associated outbuildings, maintained lawns and plantings. This map class is equal to the Anderson (1976) Level II unit 11, Residential.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Citation:** Anderson et al. 1976.

## COMMON NAME (PARK-SPECIFIC): MIXED URBAN OR BUILT-UP LAND

**SYNONYMS**
**USNVC English Name:** **Not applicable**
**USNVC Scientific Name:** **Not applicable**
**USNVC Identifier:** **Not applicable**

### LOCAL DESCRIPTION

**Local Range:** Mixed Urban or Built-up Land is mapped at Yorktown Village and in the vicinity of Yorktown Battlefield at Moore House and Hickory Hill.
**Classification Comments:** Mixed Urban or Built-up Land is used to map areas where individual Anderson level II land uses cannot be separated at mapping scale. It includes areas that could be classed as Residential or as Other Urban or Built-up Land. This map class is equal to the Anderson et al. (1976) Level II unit 15, Mixed Urban or Built-up Land.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Citation:** Anderson et al. 1976.

## COMMON NAME (PARK-SPECIFIC): TRANSPORTATION, COMMUNICATIONS, AND UTILITIES

**SYNONYMS**
**USNVC English Name:** **Not applicable**
**USNVC Scientific Name:** **Not applicable**
**USNVC Identifier:** **Not applicable**

### LOCAL INFORMATION

**Local Range:** Areas mapped as Transportation, Communications, and Utilities occur throughout Colonial National Historical Park.
**Classification Comments:** This map class includes major paved roads, interchanges, parking areas and utility line corridors. Mowed roadsides < 0.5 ha are included in this map class, including those that are forested with a mowed ground layer. This map class is equal to the Anderson (1976) Level II unit 14, Transportation, Communications, and Utilities.
**Other Comments:** The comment field in the map attribute table indicates if a polygon represents transportation or utilities.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Citation:** Anderson et al. 1976.

## COMMON NAME (PARK-SPECIFIC): WATER

**SYNONYMS**
**USNVC English Name:** **Not applicable**
**USNVC Scientific Name:** **Not applicable**
**USNVC Identifier:** **Not applicable**

### LOCAL INFORMATION

**Local Range:** Water is mapped in the vicinity of Yorktown Battlefield at Wormley Pond, along Colonial Parkway where the park boundary crosses the York River and its tributaries, at College Creek / Kingsmill where the park boundary includes portions of College Creek, the tidal creeks at Jamestown Island, and at Swanns Point where the park boundary includes portions of the James River.
**Classification Comments:** This map class includes large areas of open water within the boundary of Colonial National Historic Park. This map class is equal to the Anderson (1976) Level II units 54, Bays and Estuaries; 53, Reservoirs; and 51, Streams and Canals.
**Local Description Authors:** K. D. Patterson.
**Plots:** None.
**Citation:** Anderson et al. 1976.

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Appendix J. Field definitions for local and global descriptions of vegetation associations and other vegetaion-map classes.

Local descriptions describe vegetation associations as they occur at specific national parks. Data from field observation points and quantitative plots were used to write the local, park-specific descriptions. These descriptions were entered into NatureServe Central Databases, and reports with local and global descriptions for each association were generated for each park. The following document lists the content of those reports with definitions of each field in the report.

**COMMON NAME (PARK-SPECIFIC):** A common or colloquial name for the Association or map class. These names follow the Natural Communities of Virginia (Fleming et al 2006) or, if no appropriate name exists in Fleming et al (2006), the Association common name from the U.S. National Vegetation Classification (USNVC) was used, or a park-specific common name was assigned. Names for map classes not representing natural or semi-natural vegetation follow the Anderson Level II land use and land cover classification scheme (Anderson et al. 1976).

**SYNONYMS**

**USNVC English Name:** The standard Association name from USNVC databases, but with a translation of the scientific names using standard NatureServe Central Ecology-accepted common names for the plant taxa used in the name (see below).

**USNVC Scientific Name:** The standard Association name from USNVC databases, based on Latin names of dominant and diagnostic plant species. The Association is the finest level of the USNVC. 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.

**USNVC Identifier:** A unique identifier code for the Association from USNVC databases. Associations have a code that begins with the string "CEGL" (Community Element GLobal) followed by a unique 6-digit number. Units that are not defined in the USNVC are listed as "nonstandard" in this field.

**LOCAL INFORMATION**

**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 in the park.

**Most Abundant Species:** Component plant species that are dominant (i.e., most abundant in terms of percent cover) for the Association as it occurs in the park.

Stratum: For each component plant species, the stratum (or strata) in which it occurs in the Association within the park. Values for Stratum are:

| | |
|---|---|
| Tree (canopy & subcanopy) | Short shrub/sapling |
| Tree canopy | Herb (field) |
| Tree subcanopy | Nonvascular |
| Shrub/sapling (tall & short) | Floating aquatic |
| Tall shrub/sapling | 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. Values for Lifeform are:

| | |
|---|---|
| Needle-leaved tree | Palm shrub |
| Broad-leaved deciduous tree | Dwarf-shrub |
| Broad-leaved evergreen tree | Semi-shrub |
| Thorn tree | Succulent shrub |
| Evergreen schlerophyllous tree | Ephiphyte |
| Succulent tree | Vine/Liana |
| Palm tree | Forb |

| | |
|---|---|
| Tree fern | Graminoid |
| Bamboo | Succulent forb |
| Needle-leaved shrub | Aquatic herb (floating & submergent) |
| Broad-leaved deciduous shrub | Moss |
| Broad-leaved evergreen shrub | Alga |
| Thorn shrub | Lichen |
| Evergreen schlerophyllous shrub | Fern or fern ally |
| Other/unknown | Other herbaceous |
| Other shrub | Liverwort/hornwort |

Species: Global scientific name (and common name) for each floristic component species of the Association as it occurs within the park.

**Characteristic Species:** Component plant species that are characteristic for the Association as it occurs within the park.

**Other Noteworthy Species:** Other noteworthy species (i.e., species that are not necessarily diagnostic of the Association, but that are worth noting for some other reasons, such as those that are rare species or nonnative invasives) that are found within the Association in the park.

**Subnational Distribution with Crosswalk Data**

State: The two-letter postal code of the for U.S. state(s) in which the park occurs.

State Rank (SRank): The Heritage Conservation Subnational Rank that best characterizes the relative rarity or endangerment of the Association within the specified state. Values for State Rank are listed in Appendix D. An asterisk (*) indicates that the Subnational Rank is for the Natural Heritage Program (NHP) Element (nonstandard), not the USNVC Association (standard) (see below).

Relationship (Rel): The State Name (see below) is the name that the state NHP 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 (USNVC). 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

Confidence (Conf): Values for Confidence are: C - Certain; S - Somewhat certain; N - Not certain (null) - Not assessed or unknown.

State Name (SName): If the USNVC Association has been crosswalked to a state classification type and it is equivalent to the USNVC 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 USNVC Association has been identified. If a state type has been identified that is NOT equivalent to the USNVC 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.

**Classification Comments:** Comments about classification criteria used to define the Association or description of any remaining issues associated with its classification in the park.

**Other Comments:** Additional comments about the Association within the park.

**Local Description Authors:** Name(s) of the person(s) primarily responsible for authorship of the current description of this Association in the park.

**Plots:** List of plot codes for plots used in the identification and classification of the Association in the park.

**Inventory Notes:** Information regarding the sampling of the Association in the park.

**GLOBAL INFORMATION**

**USNVC Classification**

Physiognomic Class: The second level of the USNVC which is a vegetation structural classification adapted from UNESCO 1973 and Driscoll et al. 1984. This level is based on the structure of the vegetation. This is determined by the height and relative percentage of cover of the dominant life-forms: tree, shrub, dwarf-shrub, herbaceous, and nonvascular.

Physiognomic Subclass: The third level of the USNVC. This level is determined by the predominant leaf phenology of classes defined by a tree, shrub, or dwarf-shrub stratum, the persistence and growth form of herbaceous and nonvascular vegetation, and particle size of the substrate for sparse vegetation (e.g., consolidated rocks, gravel/cobble).

Physiognomic Group: The fourth level of the USNVC. The group generally represents a grouping of vegetation units based on leaf characters, such as broad-leaf, needle-leaf,

microphyllous, and xeromorphic. These units are identified and named with broadly defined macroclimatic types to provide a structural-geographic orientation, but the ecological climate terms do not define the groups per se.

Physiognomic Subgroup: The fifth level of the USNVC represents a distinction between natural vegetation, including natural, semi-natural and some modified vegetation, and cultural vegetation (planted/cultivated).

Formation: The sixth level of the USNVC; represents a grouping of community types that share a definite physiognomy or structure and broadly defined environmental factors, such as elevation and hydrologic regime.

Classification Code (parenthetical following each of the above levels): The U. S. National Vegetation Classification (USNVC) 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: Level of USNVC reflecting a physiognomically uniform group of plant Associations sharing one or more diagnostic species (dominant, differential, indicator, or character), which (generally) are found in the uppermost stratum of the vegetation. 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 (parenthetical following Alliance): A unique identifier from the USNVC central database 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 NatureServe 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 diagnostic 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.

**Ecological System(s):** A list of the Ecological Systems of which the Association is a member (NatureServe 2003). 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 USNVC Alliance and Formation scales).

**GLOBAL DESCRIPTION**

**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 distinguish 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.

**Most Abundant Species:** Component plant species that are dominant (i.e., most abundant in terms of percent cover) for the Association as it occurs rangewide.

Stratum: For each component plant species, the stratum (or strata) in which it occurs in the Association rangewide. Values for Stratum are:

| | |
|---|---|
| Tree (canopy & subcanopy) | Short shrub/sapling |
| Tree canopy | Herb (field) |
| Tree subcanopy | Nonvascular |
| Shrub/sapling (tall & short) | Floating aquatic |
| Tall shrub/sapling | 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. Values for Lifeform are:

| | |
|---|---|
| Needle-leaved tree | Palm shrub |
| Broad-leaved deciduous tree | Dwarf-shrub |
| Broad-leaved evergreen tree | Semi-shrub |
| Thorn tree | Succulent shrub |
| Evergreen schlerophyllous tree | Ephiphyte |
| Succulent tree | Vine/Liana |
| Palm tree | Forb |
| Tree fern | Graminoid |
| Bamboo | Succulent forb |
| Needle-leaved shrub | Aquatic herb (floating & submergent) |
| Broad-leaved deciduous shrub | Moss |
| Broad-leaved evergreen shrub | Alga |
| Thorn shrub | Lichen |
| Evergreen schlerophyllous shrub | Fern or fern ally |
| Other/unknown | Other herbaceous |
| Other shrub | Liverwort/hornwort |

Species: Global scientific name (and common name) for each floristic component species of the Association as it occurs rangewide.

**Characteristic Species:** Component plant species that are characteristic for the Association as it occurs rangewide.

**Other Noteworthy Species:** Other noteworthy species (i.e., species that are not necessarily diagnostic of the Association, but that are worth noting for some other reasons, such as those that are rare species or nonnative invasives) that are found within the Association rangewide.

**USFWS Wetland System:** Systems developed for the classification of wetlands by the U.S. Fish and Wildlife Service. 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 ac).

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**

**Rank:** The Heritage Conservation Status Global Rank which best characterizes the relative rarity or endangerment of the Association worldwide and the date the Global Rank was last reviewed (regardless of whether the rank was changed); values for Global Rank are listed in Appendix D.

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 USNVC.

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).

**Reasons:** Reasons that the Heritage Conservation Status Global Rank for the Association was assigned, including key ranking variables and other considerations used.

**CLASSIFICATION INFORMATION**

**Status:** The status of the Association in relation to the standard USNVC. Values for Classification Status are:

Standard - the Association has been formally recognized, described, and accepted by NatureServe Central Ecology as a standard Association in the USNVC.
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 NatureServe Central Ecology.

**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.

**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 Association concept 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 Association 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 USNVC 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 Associations 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 USNVC 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

Note: Names used by the NHPs are listed in the section entitled Subnational Distribution with Crosswalk data.

**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.

**References:** Short citations of all references used in documenting the classification/concept and characterization of this Association.

Appendix K. Key to the vegetation classes[2] at Colonial National Historical Park.

1a Vegetation dominated by trees and shrubs. ..... 2
1b Vegetation dominated by herbaceous plants; woody species absent or very sparse. ..... 34

WOODY VEGETATION

2a Woody vegetation dominated by native species in the upper stratum (exotics may be present, but not dominant). ..... 3
2b Woody vegetation (forests or shrublands) dominated by exotic species in the uppermost stratum, e.g. golden bamboo (*Phyllostachys aurea*), tree of heaven (*Ailanthus altissima*), Chinese wisteria (*Wisteria sinensis*), princesstree (*Paulownia tomentosa*), Japanese honeysuckle (*Lonicera japonica*), or English ivy (*Hedera helix*). ..... 20

3a Upland forest and shrubland, not influenced by flooding or groundwater. ..... 4
3b Woody vegetation of wetlands. ..... 22

4a Forest with canopy dominated by oaks (*Quercus* spp.), hickories (*Carya* spp.), American beech (*Fagus grandifolia*), tuliptree (*Liriodendron tulipifera*), and/or sweetgum (*Liquidambar styraciflua*); loblolly pine (*Pinus taeda*) may be present in some stands. ..... 5
4b Forest or shrubland not dominated by oaks (*Quercus* spp.), hickories (*Carya* spp.), American beech (*Fagus grandifolia*), or tuliptree (*Liriodendron tulipifera*). ..... 15

5a Forest with shrub layer dominated by dense ericaceous (heath) species such as blueberries (*Vaccinium* spp.), mountain laurel (*Kalmia latifolia*), or huckleberry (*Gaylussacia* spp.) forming a nearly continuous shrub strata. ..... 6
5b Forest not characterized by heath-dominated shrub layer (heaths may be present, but not dominant). ..... 7

6a Heath species are deciduous; blueberries (*Vaccinium* spp.) or huckleberries (*Gaylussacia* spp.). ..... **Piedmont / Low Elevation Mixed Oak / Heath Forest**
6b Heath species are evergreen; mountain laurel (*Kalmia latifolia*) dominant shrub. ..... **Piedmont / Coastal Plain Oak – Beech / Heath Forest**

7a Forest dominated by mesophytic trees such as tuliptree (*Liriodendron tulipifera*), American beech (*Fagus grandifolia*), white oak (*Quercus alba*), northern red oak (*Quercus rubra*), bitternut hickory (*Carya cordiformis*), white ash (*Fraxinus americana*), and sweetgum (*Liquidambar styraciflua*); mesic sites on slopes, flats, or low lying areas. ..... 8
7b Forest dominated by white oak (*Quercus alba*), chestnut oak (*Quercus prinus*), chinkapin oak (*Quercus muehlenbergii*), southern red oak (*Quercus falcata*), or sand hickory (*Carya pallida*); sites submesic to subxeric slopes or low sandy ridges. ..... 9

[2] If a vegetation-map class name differs from the vegetation class common name (i.e. Common Name (Park-specific) used in Appendix I), the vegetation-map class name follows in brackets.

8a Forest on disturbed flats and disturbed slopes, often with extensive wind damage and high cover by nonnative species in the shrub and herb strata; Canopy dominance by tuliptree (*Liriodendron tulipifera*) and/or sweetgum (*Liquidambar styraciflua*), with or without loblolly pine (*Pinus taeda).* ..... 10

8b Forests on undisturbed slopes and flats. Tree canopy diverse (many different species present); mixed age classes; a mixture of oaks (*Quercus* spp.), hickories (*Carya* spp.), American beech (*Fagus grandifolia*), and others; pines absent, or of very low cover. ..... 11

9a Forest on slopes with canopy somewhat open or interupted; dominated by chinkapin oak (*Quercus muehlenbergii),* sometimes with bitternut hickory (*Carya cordiformis*) and southern sugar maple (*Acer barbatum*). ..... 12

9b Closed forests on slopes or low sandy ridges adjacent to salt marshes; chinkapin oak (*Quercus muehlenbergii*) and other calciphylic species absent; pines can be present and abundant. ..... 13

10a Forest of small, disturbed stands on slopes bisected by the Colonial Parkway; high cover by exotics species, especially the vine japanese honeysuckle (*Lonicera japonica*), but also with species indicative of calcareous soil such as common hackberry (*Celtis occidentalis*), white ash (*Fraxinus americana*), black walnut (*Juglans nigra*), souther sugar maple (*Acer barbatum*), and bitternut hickory (*Carya cordiformis*). ..... **Disturbed Calcareous Forest**

10b Forest on disturbed flats; tree canopy of low diversity, mostly even-aged, most often characterized by dominance of tuliptree (*Liriodendron tulipifera*), loblolly pine (*Pinus taeda*), or both; common associates include sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), and southern red oak (*Quercus falcata*); in general, oaks (*Quercus* spp.) and American beech (*Fagus grandifolia*) absent or of low cover; herb layer often characterized by weeds such as Nepalese browntop (*Microstegium vimineum*). ..... **Successional Tuliptree – Loblolly Pine Forest**

11a Forest on mesic slopes or undisturbed flats. ..... 14

11b Forest on low lying areas surrounded by tidal wetlands; dominated by sweetgum (*Liquidambar styraciflua*) and loblolly pine (*Pinus taeda*) with white oak (*Quercus alba*), southern red oak (*Quercus falcata*), cherrybark oak (*Quercus pagoda*), American holly (*Ilex opaca* var. *opaca*), and slender woodoats (*Chasmanthium laxum*). ..... **Coastal Plain Loblolly Pine – Oak Forest**

12a Forest with wind disturbance and dominance by exotic species in the shrub and herb layers; Japanese honeysuckle (*Lonicera japonica*) and Nepalese browntop (*Microstegium vimineum*) common; pines (*Pinus* spp.) can be common. ..... **Disturbed Calcareous Forest**

12b Oak – hickory forest on slopes, often with exposed shell fragments; canopy somewhat open or interrupted; herb layer sparse but species rich and dominated by native species; calciphylic species evident including chinkapin oak (*Quercus muehlenbergii*), red columbine (*Aquilegia canadensis*), smooth rockcress (*Arabis laevigata*), and others; grasses such as Bosc's panicgrass (*Dichanthelium boscii*), blackseed speargrass (*Piptochaetium avenaceum*), little bluestem (*Schizachyrium scoparium*), slender Indiangrass (*Sorghastrum elliottii*), and others prevalent; pines (*Pinus* spp.) absent or very sparse. ..... **Coastal Plain Dry Calcareous Forest**

13a Loblolly pine (*Pinus taeda*) usually present and often abundant; substrate typically sandy; oaks include white oak (*Quercus alba*), black oak (*Quercus velutina*), southern red oak (*Quercus falcata*), or post oak (*Quercus stellata*); shrub layer characterized by wax myrtle (*Morella cerifera*) or swamp bay (*Persea palustris*); vines prevalent and often form part of shrub or tree strata. ..... **Coastal Plain Loblolly Pine – Oak Forest**

13b Forests on short slopes and flats often adjacent to salt marshes; chestnut oak (*Quercus prinus*) or white oak (*Quercus alba*) dominant; sand hickory (*Carya pallida*) often present; Virginia pine (*Pinus virginiana*) often in understory; herb layer very sparse, mostly graminoid with mosses and includes poverty oatgrass (*Danthonia spicata*), cypress panicgrass (*Dichanthelium dichotomum*), rattlesnakeweed (*Hieracium venosum*), and striped prince's pine (*Chimaphila maculata*). ..... **Acidic Oak – Hickory Forest**

14a Herbaceous layer sparse to absent; or may be dominated by Nepalese browntop (*Microstegium vimineum*); canopy dominated by American Beech (*Fagus grandifolia*), white oak (*Quercus alba*), or tuliptree (*Liriodendron tulipifera*) without calciphilic species such as southern sugar maple (*Acer barbatum*), eastern redbud (*Cercis canadensis* var. *canadensis*), and chinkapin oak (*Quercus muehlenbergii*); Christmas fern (*Polystichum acrostichoides*) and partridgeberry (*Mitchella repens*) are characteristic. ..... **Mesic Mixed Hardwood Forest**

14b Herbaceous and shrub cover moderate to very dense, tree species can include southern sugar maple (*Acer barbatum*), redbud (*Cercis canadensis*), common hackberry (*Celtis occidentalis*), and chinkapin oak (*Quercus muehlenbergii*); lush herb layer characterized by patch-dominance of clonal forbs and ferns and with species indicative of rich conditions; includes species such as Jack in the pulpit (*Arisaema triphyllum*), mayapple (*Podophyllum peltatum*), bloodroot (*Sanguinaria canadensis*), roundlobe hepatica (*Hepatica nobilis* var. *obtusa*), northern maidenhair (*Adiantum pedatum)* [note: some herbs may not be evident late in the growing season]; shrub species can include northern spicebush (*Lindera benzoin*) and pawpaw (*Asimina triloba*); often a forest of ravine slopes cutting into shell deposits. ..... **Coastal Plain Mesic Calcareous Ravine Forest**

15a Loblolly pine (*Pinus taeda*) abundant. ..... 16

15b Loblolly pine (*Pinus taeda*) absent or of low cover. ..... 18

16a Loblolly pine (*Pinus taeda*) in dense, even-aged stands, or in obvious rows; virtually no other trees present, with shrub and herbaceous layers essentially lacking. ..... **Loblolly Pine Plantation**

16b Loblolly pine (*Pinus taeda*) mixed with other tree species (although loblolly pine may be dominant); shrub layer present. ..... 17

17a Loblolly pine (*Pinus taeda*) growing in association with oaks; shrub layer comprised of wax myrtle (*Morella cerifera*) or swamp bay (*Persea palustris*). ..... **Coastal Plain Loblolly Pine – Oak Forest**

17b Loblolly pine (*Pinus taeda*) growing in association with tuliptree (*Liriodendron tulipifera*) and / or sweetgum (*Liquidambar styraciflua*); shrub layer comprised of northern spicebush (*Lindera benzoin*) and pawpaw (*Asimina triloba*). ..... **Successional Tuliptree – Loblolly Pine Forest**

18a Open forest characterized by abundant black walnut (*Juglans nigra*); shrub layer poorly developed, and lawn-like herbaceous layer with weedy or exotic grasses. ..... **Successional Black Walnut Forest**
18b Closed forest, tall shrub thicket, or vine-dominated vegetation. ..... 19

19a Sweetgum (*Liquidambar styraciflua*) dominated vegetation occurring as young even-aged forest stands or tall shrublands; often occurring adjacent to cultural meadows. ..... **Successional Sweetgum Forest**
19b Dense thicket of tall shrubs or vines, or combination of both; bordering roads and meadows; can include the native species frost grape (*Vitis vulpina*), Virginia creeper (*Parthenocissus quinquefolia*), and blackberries (*Rubus* spp.) as well as the nonnative species Chinese wisteria (*Wisteria sinensis*), tree of heaven (*Ailanthus altissima*), and princesstree (*Paulownia tomentosa*). ..... **Successional Mixed Scrub**

20a Forest strongly dominated by tree of heaven (*Ailanthus altissima*); taller, emergent loblolly pine (*Pinus taeda*) may be present or even abundant. ..... **Successional Tree-of-Heaven Forest**
20b Vegetation shrubby, forming a more or less, single height stratum. ..... 21

21a Golden bamboo (*Phyllostachys aurea*) strongly dominant. ..... **Golden Bamboo Shrubland**
21b Shrubland a mixture of species, including Chinese wisteria (*Wisteria sinensis*), tree of heaven (*Ailanthus altissima*), princesstree (*Paulownia tomentosa*), and others. ..... **Successional Mixed Scrub**

22a Woody vegetation tidally flooded; wetlands along rivers that are influenced by marine tides. ..... 23
22b Woody vegetation of non-tidal wetlands not influenced by tidal flooding; includes non-tidal portion of larger rivers or areas that may have formerly been tidal but are now cut off from regular tidal waters. ..... 25

23a Vegetation dominated by shrubs. ..... 24
23b Vegetation dominated by trees; tidal forest or woodland dominated by bald cypress. ..... **Tidal Bald Cypress Forest / Woodland**

24a Mucky, very wet shrubland adjacent to tidal marsh and in tidally flooded ravine bottoms; wax myrtle (*Morella cerifera*) dominant; halophytes such as saltmeadow cordgrass (*Spartina patens*), inland saltgrass (*Distichlis spicata*), eastern baccharis (*Baccharis halimifolia*), and Jesuit's bark (*Iva frutescens*) absent; narrowleaf cattail (*Typha angustifolia*) often present. ..... **Tidal Shrub Swamp (Wax Myrtle Type)**
24b Adjacent to active river channel; dominated by eastern baccharis (*Baccharis halimifolia*) and Jesuit's bark (*Iva frutescens*), sometimes mixed with wax myrtle (*Morella cerifera*) ); other halophytic species often present; narrowleaf cattail (*Typha angustifolia*) absent. ..... **Salt Scrub**

25a Semipermanently flooded vegetation with surface water present throughout most of the growing season; vegetation may be disturbed, with standing dead trees or with shrubby structure. ..... 26
25b Forested wetland with saturated, seasonally flooded, or temporarily flooded hydrology. ..... 27

26a Patchy and variable wetland altered by beavers or humans; shrubs and herbaceous vegetation, often with standing dead trees; open water present, with wetland forbs such as pickerelweed (*Pontederia cordata*), cattails (*Typha* spp.), and swamp loosestrife (*Decodon verticillatus*); common reed (*Phragmites australis*) often present. ..... **Semipermanent Impoundment**

26b Open forest or woodland cut off from regular tidal waters; dominated by red maple (*Acer rubrum*) with loblolly pine (*Pinus taeda*), swamp tupelo (*Nyssa biflora*), and sweetgum (*Liquidambar styraciflua*), with standing dead trees; shrubs include wax myrtle (*Morella cerifera*) and swamp bay (*Persea palustris*). ..... **Disturbed Tidal Hardwood Forest**

27a Forested wetland occurring on the floodplains of small streams and rivers, with at least occasional overland flooding. ..... 28

27b Forested wetland of low-lying areas situated away from or well above rivers or streams; vegetation is groundwater flooded (seepage fed) and rarely, if ever, flooded by rivers or streams. ..... 29

28a Forested wetland of small stream floodplains; soils well-drained; canopy characterized by sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), and tuliptree (*Liriodendron tulipifera*); diverse herbs but WITHOUT hydrophytic forbs characteristic of mucky substrates, such as lizard's tail (*Saururus cernuus*); Nepalese browntop (*Microstegium vimineum*) may dominate along with herbs characteristic of more well-drained floodplains such as sweet woodreed (*Cinna arundinacea*), nodding fescue (*Festuca subverticillata*), white avens (*Geum canadense*), and New York fern (*Thelypteris noveboracensis*). ..... **Coastal Plain / Piedmont Small-Stream Floodplain Forest**

28b Forested wetland occurring on the outer edges of large floodplains; substrate mucky with standing water; canopy characterized by green ash (*Fraxinus pennsylvanica*) and red maple (*Acer rubrum*); hydrophytic forbs such as lizard's tail (*Saururus cernuus*), rice cutgrass (*Leersia oryzoides*), blunt broom sedge (*Carex tribuloides*), greater marsh St. Johnswort (*Triadenum walteri*), and threeway sedge (*Dulichium arundinaceum*). ..... **Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash – Red Maple Type)**

29a Small forested wetland of topographic basins surrounded by uplands. ..... 30

29b Forested wetland of ravine bottoms or broad, flat terraces. ..... 32

30a Isolated pond of anthropogenic origin, dominated by small diameter red maple (*Acer rubrum*) and sweetgum (*Liquidambar styraciflua*) in the vincity of Green Spring. ..... **Disturbed Depressional Wetland**

30b Seasonally flooded forested wetland of natural sinkhole ponds in the vicinity of Yorktown Battlefield. ..... 31

31a Canopy characterized by swamp tupelo (*Nyssa biflora*), red maple (*Acer rubrum*), and sweetgum (*Liquidambar styraciflua*); shrub layer (if present) characterized by swamp doghobble (*Leucothoe racemosa*) and common buttonbush (*Cephalanthus occidentalis*). ..... **Coastal Plain Depression Wetland (Swamp Tupelo Type)**

31b Canopy characterized by sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*), and/or willow oak (*Quercus phellos*); shrub layer characterized by American holly (*Ilex opaca* var. *opaca*) and highbush blueberry (*Vaccinium corymbosum*). ..... ..... **Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type)**

32a Narrow, seepage-influenced forest of disturbed, roadside wetlands or in the upper reaches of impounded ravine systems; exotic plant species common. ..... **Disturbed Seepage Swamp**

32b Wetland forest of undisturbed ravine bottoms or seasonally flooded to saturated broad, flat terraces. ..... 33

33a Wetland forest of ravine bottoms; substrate very mucky, with pronounced hummock and hollow microtopography; canopy characterized by green ash (*Fraxinus pennsylvanica*) and red maple (*Acer rubrum*); hydrophytic oak species absent; golden ragwort (*Packera aurea*), drooping bulrush (*Scirpus lineatus*), lizard's tail (*Saururus cernuus*), and lesser clearweed (*Pilea fontana*) are characteristic; bald cypress (*Taxodium distichum*) may be important in some stands. ..... **Coastal Plain Calcareous Seepage Swamp**

33b Wetland forest of broad flat terraces; sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), and green ash (*Fraxinus pennsylvanica*) present in combination with the hydrophytic oak species swamp chestnut oak (*Quercus michauxii*), willow oak (*Quercus phellos*), water oak (*Quercus nigra*), or pin oak (*Quercus palustris*). ..... **Non-Riverine Saturated Forest**

HERBACEOUS VEGETATION

34a Upland herbaceous vegetation; meadow dominated by the sod-forming exotic grass species meadow ryegrass (*Lolium pratense*), orchard grass (*Dactylis glomerata*), and broomsedge bluestem (*Andropogon virginicus*); and the forb species European field pansy (*Viola arvensis*), common dandelion (*Taraxacum officinale*), and others; may include scattered trees and shrubs, windrows, ditches, and small isolated wetland areas. ..... **Cultural Meadow**

34b Herbaceous wetland. ..... 35

35a Nontidal wetland; wetland associated with beaver or anthropogenic impoundments; open water, herbaceous, and shrubby patches; may have standing dead trees. ..... **Semipermanent Impoundment**

35b Tidal wetland; herbaceous wetland of rivers influenced by tidal flooding. ..... 36

36a Tidal marsh dominated by smooth cordgrass (*Spartina alterniflora*), often less than 1 m tall. ..... 37

36b Tidal marsh dominated by grasses and/or forbs other than smooth cordgrass (*Spartina alterniflora*); typically greater than 1 m tall. ..... 38

37a Tidal marsh dominated by smooth cordgrass (*Spartina alterniflora*), typically less than 1 m tall; often in association with inland saltgrass (*Distichlis spicata*) and/or saltmeadow cordgrass (*Spartina patens*). ..... **Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) [Tidal Mesohaline and Polyhaline Marsh]**

37b Tidal marsh dominated by smooth cordgrass (*Spartina alterniflora*) occurring with big cordgrass (*Spartina cynosuroides*) and green arrow arum (*Peltandra virginica*); often as linear bands along tidal channels. ..... **Tidal Mesohaline and Polyhaline Marsh (Transitional Marsh) [Tidal Mesohaline and Polyhaline Marsh]**

38a Tidal marsh dominated by annual wild rice (*Zizania aquatica* var. *aquatica*) or green arrow arum (*Peltandra virginica*), pickerelweed (*Pontederia cordata*), or dotted smartweed (*Polygonum punctatum*). ..... **Tidal Freshwater Marsh**

38b Tidal marsh dominated by big cordgrass (*Spartina cynosuroides*), narrowleaf cattail (*Typha angustifolia*), or common reed (*Phragmites australis*); associates can include chairmaker's bulrush (*Schoenoplectus americanus*), crimsoneyed rosemallow (*Hibiscus moscheutos* ssp. *moscheutos*), and others. ..... 39

39a Tidal marsh dominated by common reed (*Phragmites australis*); typically monospecific stands with few associates. ..... **Tidal Oligohaline Marsh (Common Reed Tidal Marsh) [Tidal Oligohaline Marsh]**

39b Tidal marsh dominated by big cordgrass (*Spartina cynosuroides*), narrowleaf cattail (*Typha angustifolia*), or various species of bulrushes (*Schoenoplectus* spp.) with or without other associates. ..... 40

40a Tidal marsh strongly dominated by big cordgrass (*Spartina cynosuroides*); may have patch dominance by green arrow arum (*Peltandra virginica*). ..... **Tidal Oligohaline Marsh (Big Cordgrass Type) [Tidal Oligohaline Marsh]**

40b Tidal marsh dominated by grasses and/or forbs with variable dominance by narrowleaf cattail (*Typha angustifolia*), chairmaker's bulrush (*Schoenoplectus americanus*), common threesquare (*Schoenoplectus pungens* var. *pugens*), or softstem bulrush (*Schoenoplectus tabernaemontani*), or with no clear dominant. ..... 41

41a Tidal marsh dominated by mixtures of the tidal forbs narrow leaf cattail (*Typha angustifolia*), dotted smartweed (*Polygonum punctatum*), green arrow arum (*Peltandra virginica*), crimsoneyed rosemallow (*Hibiscus moscheutos* ssp. *moscheutos*), and others. ..... **Tidal Oligohaline Marsh (Mixed Forbs Type) [Tidal Oligohaline Marsh]**

41b Tidal marsh located within the interior of another marsh type, well away from tidal channels and sometimes in depressions; dominated by the tidal grasses chairmaker's bulrush (*Schoenoplectus americanus*), common threesquare (*Schoenoplectus pungens* var. *pungens*), or softstem bulrush (*Schoenoplectus tabernaemontani*), sometimes with saltmeadow cordgrass (*Spartina patens*). ..... 42

42a Interior tidal marsh away from tidal channels; on spongy, organic substrate and dominated by chairmaker's bulrush (*Schoenoplectus americanus*) with saltmeadow cordgrass (*Spartina patens*). ..... ..... **Tidal Oligohaline Marsh (Saltmeadow Cordgrass - Olney Three-Square Low Interior Marsh Type**) **[Tidal Oligohaline Marsh]**

42b Interior tidal marsh on small depressions or mudflats with common threesquare (*Schoenoplectus pungens* var. *pungens*) or softstem bulrush (*Schoenoplectus tabernaemontani*) and other species. ..... ..... **Tidal Oligohaline Marsh (Interior Depression Marsh) [Tidal Oligohaline Marsh]**

As the nation's primary conservation agency, the Department of the Interior has responsibility for most of our nationally owned public land and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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