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Northeast Region
Philadelphia, Pennsylvania



Vegetation Classification and Mapping at Fredericksburg and Spotsylvania National Military Park, Virginia

Technical Report NPS/NER/NRTR—2008/126



ON THE COVER

Top photo: Coastal Plain / Piedmont Small-Stream Floodplain Forest along Wilderness Run; Bottom left: Dense Coastal Plain / Piedmont Acidic Seepage Swamp in Fredericksburg Battlefield; Bottom right: Civil War canon in meadow in Wilderness Battlefield. Photographs by: Gary P. Fleming.

Vegetation Classification and Mapping at Fredericksburg and Spotsylvania National Military Park, Virginia

Technical Report NPS/NER/NRTR—2008/126

Kristin Taverna

Virginia Department of Conservation and Recreation
Division of Natural Heritage
217 Governor Street, 3rd Floor
Richmond, VA 23219

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

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Contacts and Contributors



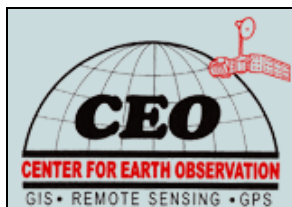
Virginia Department of Conservation and Recreation
Division of Natural Heritage
Governor Street, 3rd Floor
Richmond, VA 23219
www.dcr.virginia.gov/dnh/index.html

Kristin Taverna
Vegetation Ecologist, Principal Investigator
(804) 692-0252
kristin.taverna@dcr.virginia.gov

Karen D. Patterson
Vegetation Ecologist, Project Manager
(804) 786-5990
karen.patterson@dcr.virginia.gov

J. Christopher Ludwig
Chief Biologist, Inventory Manager
(804) 371-6206
chris.ludwig@dcr.virginia.gov

Contributors: Gary P. Fleming, Kirsten Hazler, John Townsend, Philip Coulling, Dean Walton, Gina Pisoni.



Center for Earth Observation
North Carolina State University
5112 Jordan Hall, Box 7106
Raleigh, NC 27695
<http://www.ceo.ncsu.edu/>

Hugh A. Devine
Associate Director / Professor
(919) 515-3682
hugh_devine@ncsu.edu

Contributors: Bill Millinor, Bill Slocumb, Beth Eastman, Mark Smith.

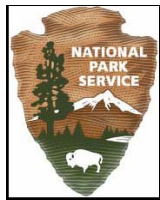


1101 Wilson Boulevard
15th Floor
Arlington, VA 22209
www.natureserve.org

Lesley Sneddon
Senior Regional Ecologist
(617) 542-1908 x245
lesley_sneddon@natureserve.org

Boston Office:

11 Avenue de Lafayette
5th Floor
Boston, MA 02111



National Park Service
Northeast Region (NER)
www.nps.gov/nero/science/

NER Natural Resources Stewardship and Science

John F. Karish
Chief Scientist
(814) 865-7974
John_Karish@nps.gov

Beth Johnson
Research Biologist
(401) 874-7060
Beth_Johnson@nps.gov

Fredericksburg and Spotsylvania
National Military Park

Gregg Kneipp, Natural Resource Specialist
(540) 654-5331
Gregg_Kneipp@nps.gov

Keith Kelly, Chief Ranger
(540) 654-5535
Keith_Kelly@nps.gov

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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 those seven national parks.

This report documents the classification and mapping of vegetation and other land-use classes at Fredericksburg and Spotsylvania National Military Park. Twenty-one map classes representing 19 USNVC associations, two nonstandard, park-specific classes, and three Anderson Level II land-use categories were used to map the 3,157 ha (7,800 ac) park. Vegetation map classes were determined through extensive field reconnaissance, data collection, and analysis. Aerial photography from 2002 served as the base map, and field sampling was conducted from 2002–2005. 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-ha minimum mapping unit.

Ten map classes represent later successional forests and cover approximately 48% (1,510 ha [3,731 ac]) of the park. These map classes can be broadly characterized based on different environmental settings, such as upland forests, alluvial floodplain forests, and non-alluvial wetlands. Early successional or transitional vegetation covers 31% (966 ha [2,387 ac]) of the land in the park. Cultural map classes cover 21% (680 ha [1,680 ac]) of the park, and include the Anderson land-use categories and other man-made or maintained areas in the park.

A vegetation map of Fredericksburg and Spotsylvania National Military 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. The thematic accuracy of the vegetation map was assessed using a stratified random sampling approach, distributing the sampling effort across the map classes. The number and distribution of accuracy assessment sampling points was determined by map class abundance and frequency as recommended in the USGS-NPS Vegetation Mapping Program protocols, with one regional modification to accommodate the vegetation pattern seen in the park. Two hundred and seventeen randomly selected accuracy assessment sampling points were collected throughout the park. The map was edited based on initial accuracy assessment results to better represent the vegetation in the park. The Kappa Index for the final vegetation map was $78.3\% \pm 4.8\%$, with an overall accuracy of 81.1%.

A field key to the vegetation and detailed descriptions for map classes or vegetation 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, database of vegetation plot 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 Fredericksburg and Spotsylvania National Military 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, Fredericksburg and Spotsylvania National Military 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 & 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 1990s, the NPS and the U.S. Geological Survey (USGS) have worked cooperatively to classify, describe, and map vegetation communities in more than 250 national park units 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 are 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, spatial databases of vegetation communities, hardcopy maps of vegetation communities, metadata for spatial databases, and complete accuracy assessment of the vegetation map. Vegetation information includes vegetation classification, dichotomous field key of vegetation classes, formal description of each vegetation class, ground photos of vegetation classes, and field data in database format. 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 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 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 (TNC and ESRI 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 TNC and ESRI (1994a), includes types that “occur spontaneously without regular management, maintenance, or planting and have a strong component of native species.” Cultural vegetation includes planted/cultivated vegetation types such as orchards, pastures, 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 the 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 were collected from all seven park units and combined with existing data from throughout the Mid-Atlantic Piedmont and Coastal Plain.

The goal of the mapping effort at Fredericksburg and Spotsylvania National Military 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 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 map class descriptions, and field keys to the map 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

Fredericksburg and Spotsylvania National Military Park is a 3,157 ha (7,800 ac) unit of the National Park Service located in Orange, Spotsylvania, Caroline, and Stafford counties, Virginia, and in the City of Fredericksburg, Virginia (Figure 1). The park has eight principal units spread out over 285 km² (110 mi²) of the Virginia Piedmont and Atlantic Coastal Plain. The park was originally established in 1927 to commemorate four major engagements of the Civil War, the battles of Fredericksburg, Spotsylvania Court House, Wilderness, and Chancellorsville (NPS 1986). The original park boundary also included the Fredericksburg National Cemetery, created in 1869 to recognize the soldiers who fought in the four battles. The park was initially under the direction of the Secretary of War and it was the duty of the commissioners to survey and preserve the lines of opposing armies in each battle (NPS 1986). An Executive Order in 1933 transferred the park from the responsibility of the War Department to the Department of the Interior. Since that time, the four battlefields have grown by several thousand acres and additional park units have been added: Stonewall Jackson Shrine (1937), Salem Church (1965), and Chatham Manor (1977).

Today the park serves as an important resource for public education and historic interpretation of the battles and the maneuvers employed by the Union and Confederate armies. It also preserves an important area of open space in the midst of increasing modern development. Facilities at the park include two visitor centers, self-guided tours of the battlefields and historic buildings, picnic areas, and a number of different walking trails that meander through the historic areas and many forested acres. The park also has an active farm program that currently manages over 364 ha (900 ac) of park historic scene. Another 113 ha (280 ac) are managed as open fields.

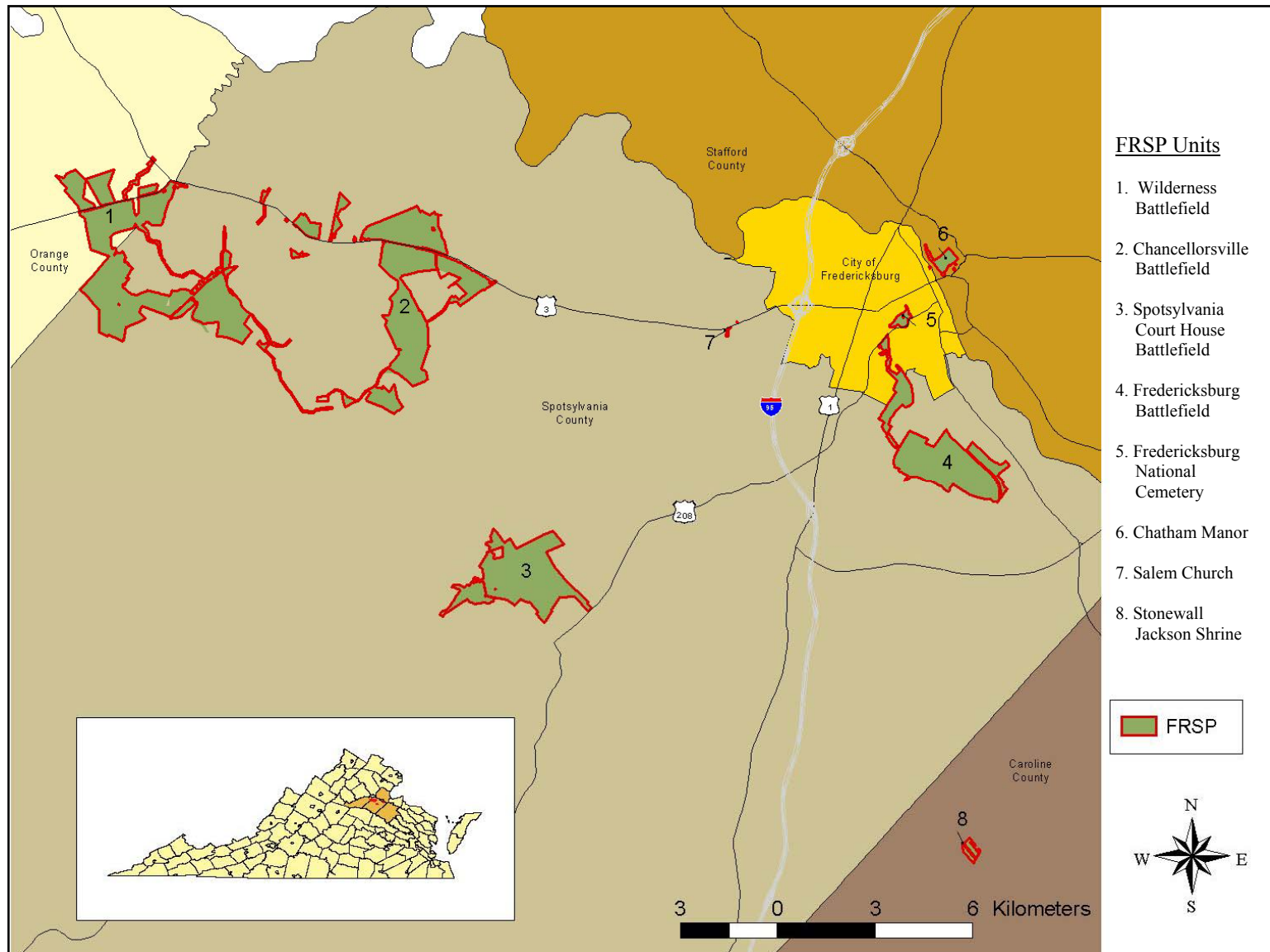


Figure 1. Location of Fredericksburg and Spotsylvania National Military Park (FRSP), Virginia.

Project Area

Location and Regional Setting

Fredericksburg and Spotsylvania National Military Park is located, with the exception of the Fredericksburg Battlefield and Stonewall Jackson Shrine, within the northern Piedmont of Virginia (Figure 2). Fredericksburg Battlefield and Stonewall Jackson Shrine are located on the western margin of the northern Coastal Plain of Virginia. Approximately 90% of the park is in the northern Piedmont physiographic province, and about 10% is in the northern Coastal Plain. The fall line dividing the two physiographic provinces runs roughly from Chatham Manor through Fredericksburg Battlefield, with Lee Drive being the line of demarcation (Kneipp 2003). The park boundaries fall within seven USGS quadrangle maps: Mine Run, Chancellorsville, Salem Church, Fredericksburg, Brokenburg, Spotsylvania, and Guinea (Figure 3).

The landscape of the northern Piedmont is rolling to locally hilly, with elevations ranging from 30–150 m (100–500 ft). This portion of the northern Piedmont crosses through the Charlotte Belt, Lynchburg Belt, and Piedmont Transition subsections of the ecological units for the eastern United States (Keys et al. 1995). The northern Coastal Plain is part of the Atlantic Southern Loam Hills subsection and contains relatively flat to gently rolling terrain with broad wetlands and elevations ranging from 15–60 m (50–200 ft) (Keys et al. 1995). Historic climate data from Fredericksburg and Spotsylvania National Military Park, Virginia (38°18'N / 77°28'W) from the years 1930–1997 report mean monthly minimum temperature is 6.6° C (44.0° F), and the mean monthly maximum is 20.3° C (68.6° F). The mean January minimum temperature is -4.3° C (24.2° F), and the mean July maximum is 31.8° C (89.3° F). Annual precipitation averages 104.4 cm (41.12 in), with snowfall of 37 cm (14.6 in) (Southeast Regional Climate Center 2008).

The vegetation of the Piedmont Plateau has been severely altered by a long history of clearing, agriculture, logging, and other anthropogenic disturbances. Except in the increasingly large urban and suburban areas, the province currently has a patchwork of secondary forests, pastures, and fields used for the production of feed grains or tobacco. Most Piedmont forests have a history of repeated cutting, or have regenerated on former agricultural lands, some of which were abandoned more than 150 years ago. Recently, disturbed Piedmont forests tend to have a large component of pines, Virginia pine (*Pinus virginiana*) and/or shortleaf pine (*Pinus echinata*), and shade-intolerant hardwoods such as tuliptree (*Liriodendron tulipifera*) and sweetgum (*Liquidambar styraciflua*). The composition of more mature hardwood forest communities varies with soils and topography. Dry, acidic soils support oak / heath forests, while more basic upland soils usually support oak-hickory forests. White oak (*Quercus alba*) is a ubiquitous dominant in both groups. Mixed forests of American beech (*Fagus grandifolia*), oaks (*Quercus* sp.), and tuliptree are common in mesic, acidic ravines throughout the Piedmont. Forests of silver maple (*Acer saccharinum*), American sycamore (*Platanus occidentalis*), American elm (*Ulmus americana*), box-elder (*Acer negundo*), and other flood-tolerant trees are well developed along the larger rivers that cross the Piedmont, such as the Rappahannock River, which crosses the park boundary near Fredericksburg (Fleming et al. 2006).

The upland forests that originally covered much of the Coastal Plain have been extensively cleared or altered, so much so that it is now difficult to determine which species and natural

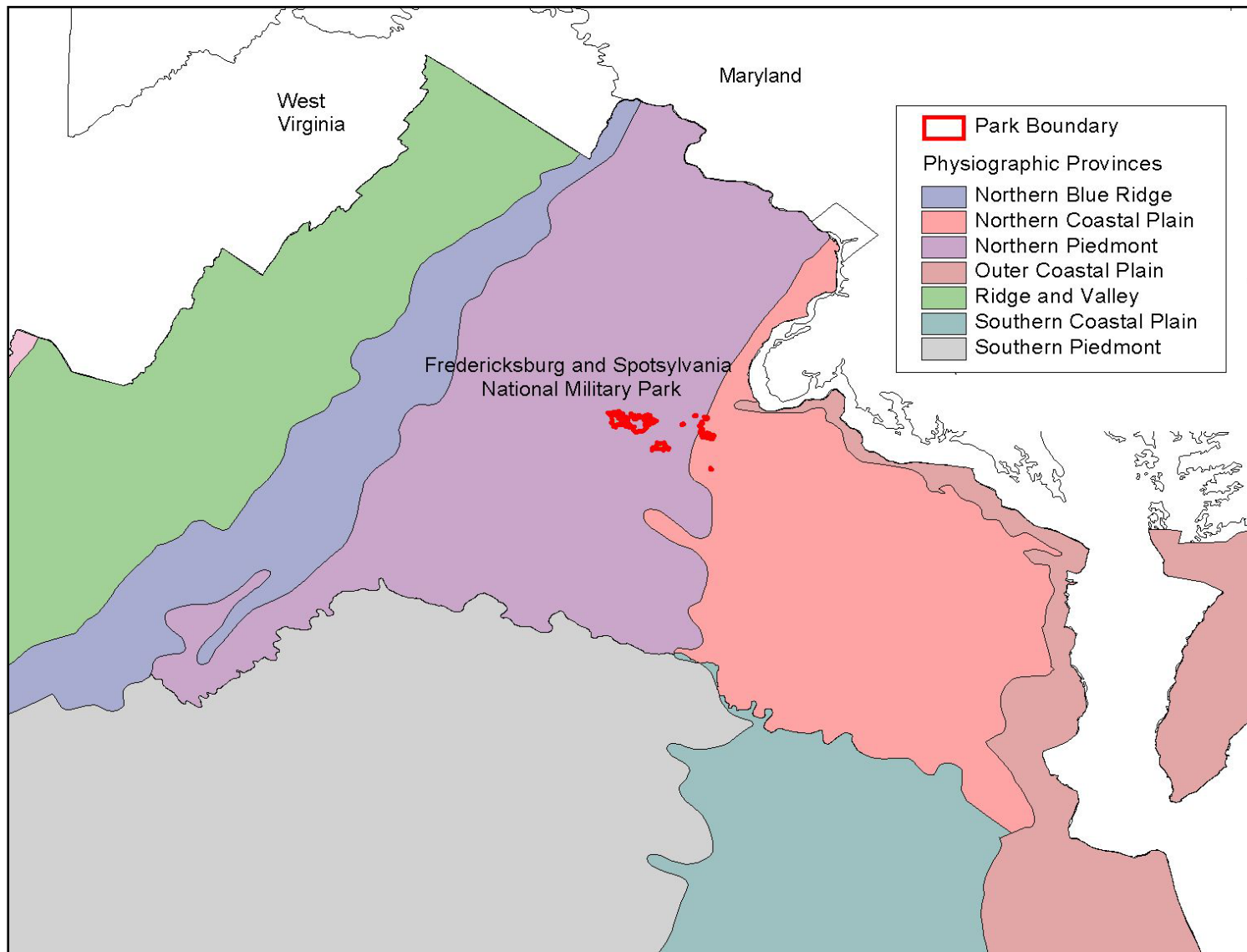


Figure 2. Physiographic provinces of Virginia showing the location of Fredericksburg and Spotsylvania National Military Park in the northern Piedmont and northern Coastal Plain.

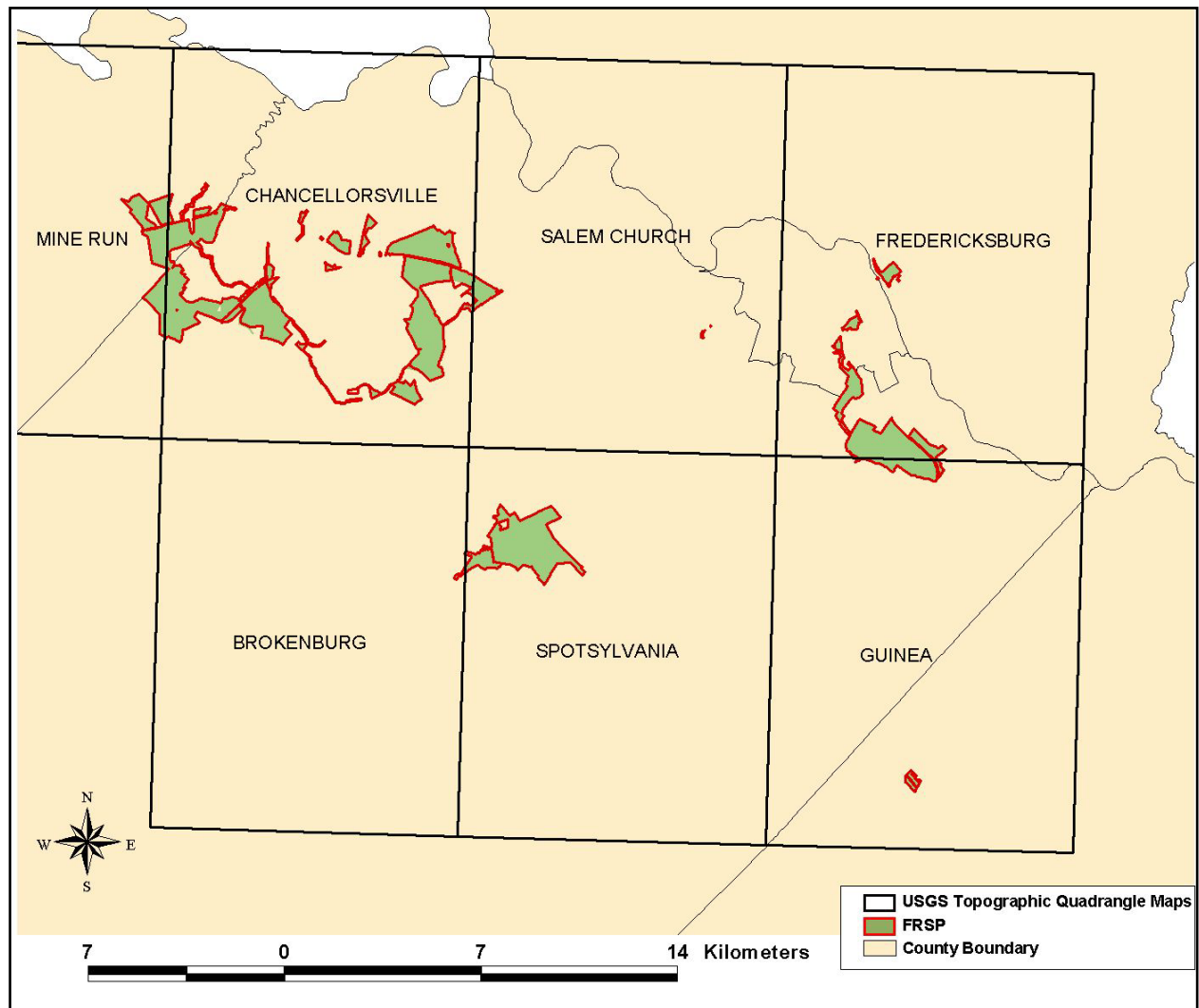


Figure 3. Location of Fredericksburg and Spotsylvania National Military Park (FRSP), Virginia, on seven 1:24,000 USGS topographic quadrangle maps.

communities were 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*). Patches of drier oak-dominated forest are fairly common in the dissected inner Coastal Plain, especially north of the James River. 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 (Fleming et al. 2006).

Park Environmental Attributes

Many environmental factors, such as geology, soils, topography, and hydrology, affect the types and distribution of vegetation within Fredericksburg and Spotsylvania National Military Park.

The bedrock geology of the park in the northern Piedmont physiographic province consists of a variety of igneous and metamorphic rocks from the Paleozoic and Precambrian ages that have undergone a history of deposition, uplift, and deformation (Figure 4). In general, the rocks of the northern Piedmont are strongly weathered by the Piedmont's humid climate, and bedrock is generally buried under a thick (2–20 m; 7–66 ft) blanket of saprolite (College of William and Mary 2007). The geology in the western end of the park in Wilderness Battlefield is primarily of the Mine Run Complex (schist and phyllite matrix with local beds of metasandstone), Chopawamsic Formation (felsic and mafic metavolcanic rock), and undivided Metasedimentary rocks (includes phyllite, metasiltstone, quartzite and schist). Chancellorsville Battlefield is largely underlain by the Chopawamsic Formation and Quantico Formation (slate and schist). The geology of Spotsylvania Court House Battlefield is primarily the Ta River Metamorphic Suite (amphibolite gneiss) (Virginia Division of Mineral Resources [VADMR] 1993).

The geology of the park shifts in the northern Coastal Plain at the Fall Line near Fredericksburg (Figures 2 and 4). Here the geology changes from crystalline bedrock of the Piedmont to unconsolidated sediments largely deposited during the Tertiary and Quaternary periods. The geology of Fredericksburg Battlefield, Stonewall Jackson Shrine, and Chatham Manor largely consists of mixtures of interbedded gravel, sand, silt, and clay (Virginia Division of Mineral Resources 1993). This includes the sediments of the Potomac Formation and Chesapeake Group (Figure 4). The sediments were deposited in interglacial marine environments under conditions similar to those that exist in the modern Chesapeake Bay and its tidal tributaries (College of William and Mary 2007).

Soils in the park vary with geology and topographic position. In general, the crystalline rocks of the Piedmont and unconsolidated sediments of the Coastal Plain weather to acidic soils with low fertility. Isolated pockets of richer soils with higher levels of calcium and magnesium can occur in areas with mafic rocks (e.g. amphibolite).

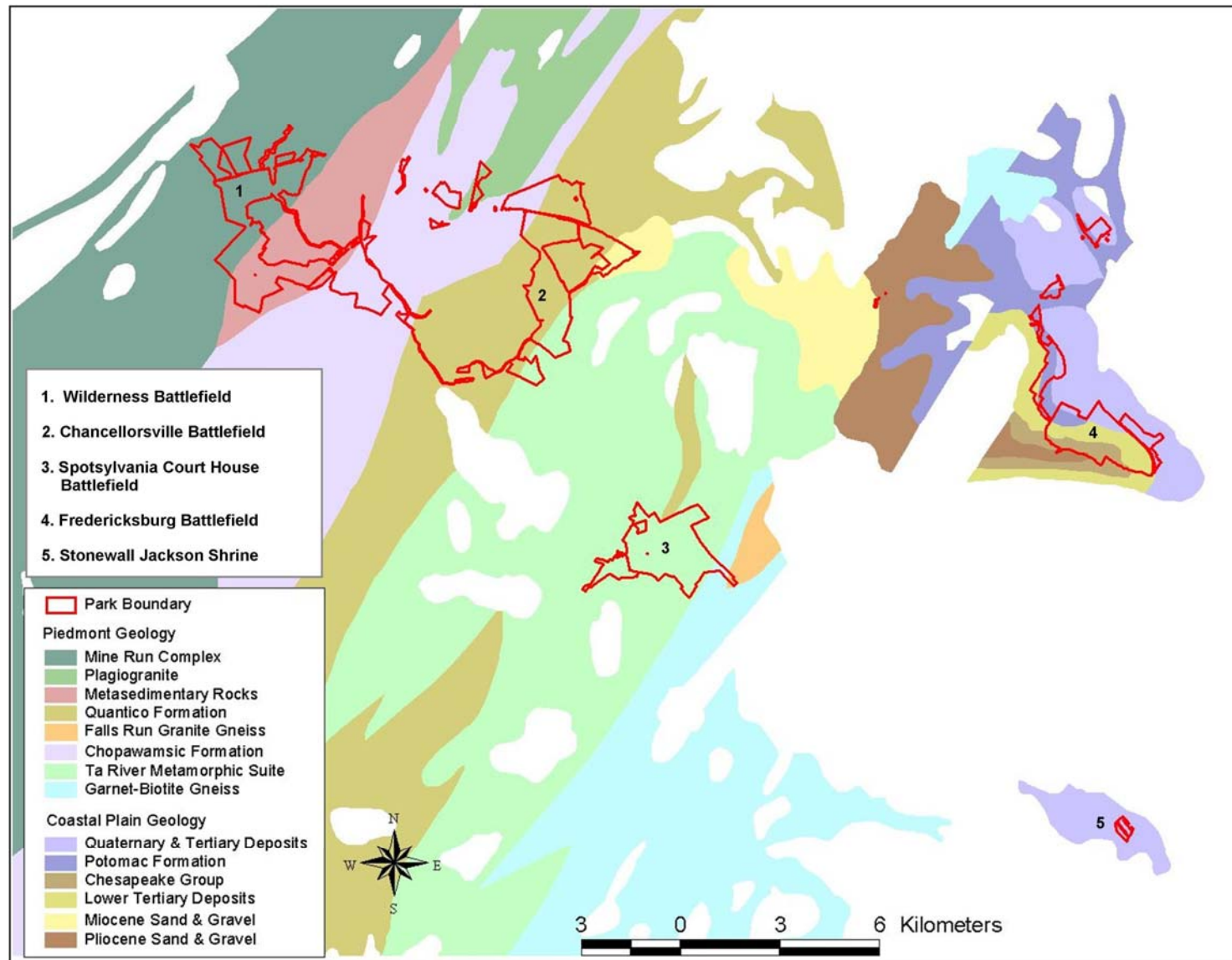


Figure 4. Geology in Fredericksburg and Spotsylvania National Military Park.

The soils in the park are classed as Ultisols, Alfisols, and Entisols. The floodplains and drainages of the park are typically very deep, poorly drained, hydric sandy loams and silt loams. They are largely mapped as the Fluvaquents-Udifluvents complex, Partlow sandy loam, Toddstav silt loam, and Aquults with gravelly substratum (USDA, NRCS 2006). The uplands of the park are typically deep, well-drained sandy loams with loamy or clayey subsoil. The majority of the side slopes (7–15% slopes) are mapped as Appling-Wedowee sandy loam, Fluvanna fine sandy loam, Goldsboro sandy loam, Kempsville gravelly sandy loam, and Nason silt loam. The upper slopes and ridges are mapped primarily as Appling sandy loam, Brockroad silt loam, Catharpin silt loam, and Faceville-Varina complex (USDA, NRCS 2006).

The elevation of Fredericksburg and Spotsylvania National Military Park gradually decreases heading across the Piedmont and into the Coastal Plain from west to east. Elevations range from roughly 140 m (460 ft) near the western boundary of Wilderness Battlefield, to near sea level along the Rappahannock River below Chatham Manor. The elevations within Wilderness and Chancellorsville battlefields are approximately 8095 m (262–310 ft) along stream valleys up to 135 m (450 ft) on scattered ridge crests. The elevation of Spotsylvania Court House Battlefield generally ranges from 75 m (250 ft) along stream valleys up to 110 m (360 ft) on local ridges. Fredericksburg Battlefield, Chatham Manor, and Stonewall Jackson Shrine have the lowest overall elevation in the park. The highest ridges in the southern end of Fredericksburg Battlefield are no higher than 80 m (260 ft) and the elevation drops to near sea level along the Rappahannock River.

The Rappahannock, Ni, and Po rivers, along with their tributaries, are the prevailing aquatic features at the park. Numerous streams and swamps dissect the gently rolling topography of the park. Chancellorsville Battlefield lies on the divide separating the watershed of the Rappahannock River from the Po and the Ni rivers, and Spotsylvania Court House Battlefield lies between the drainage areas of the Po and the Ni rivers (Kneipp 2003). Together, the streams of the park total about 32 km (20 mi) of permanent streams and 32 km (20 mi) of intermittent streams (Davis et al. 2006).

The Rappahannock River runs primarily along the eastern end of the park and is directly adjacent to the Chatham Manor boundary. Wilderness Run and Keatons Run in Wilderness Battlefield flow into the Rapidan River to the northwest, a major tributary to the Rappahannock River. The Ni River and its tributaries are located in the south-central region of the park and flow from the Chancellorsville Battlefield south along the eastern side of the Spotsylvania Court House Battlefield. The Po River flows along the western edge of Spotsylvania Court House Battlefield. Tributaries to the Po River originate in both the southern end of the Wilderness Battlefield and the Spotsylvania Court House Battlefield.

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 [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]). Later that year, a meeting was convened with representatives from NPS Northeast Region Inventory and Monitoring, 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 worked cooperatively and with the NPS 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, and map validation and editing. They developed the local association descriptions and the field key to map 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 assisted in the development of or reviewed field keys to the mapping units, 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 Fredericksburg and Spotsylvania National Military Park were reviewed for information pertinent to the park's vegetation. These included species lists and reports compiled by various researchers (Anderson et al. 1981; Orwig and Abrams 1991; Orwig 1995) and previous inventories by Virginia Natural Heritage (Wright 1990, 1991; Ludwig and Pague 1993; Walton 2002). Existing aerial photography (Virginia Geographic Information Network 2002), topographic maps and digital raster graphics (DRGs), National Wetland Inventory maps, county soil surveys, and digital soil survey data (SSURGO) were gathered for use in planning fieldwork and to use as ancillary data layers. A preliminary classification of vegetation in Virginia's Piedmont and inner Coastal Plain (Fleming 2001) was used to develop a list of vegetation likely to occur in the park. Lists of the USNVC formations and alliances likely to occur in the park were generated from NatureServe databases. Leaf-on and leaf-off photomosaics and the formation-level line work were obtained from NCSU-CEO in May 2004.

Aerial Photography Acquisition and Processing

Two sets of digital orthophoto mosaics, leaf-on (fall) and leaf-off (spring), were created for Fredericksburg and Spotsylvania National Military Park. To achieve manageable file sizes, the

spring set is made up of four files and the fall 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 19, 2001 and for the leaf-off mosaics on February 18, 2002. The photography was delivered to the NPS, quality checked, accepted as provided, and sent to North Carolina State University (NCSU). Upon receipt at NCSU, the air photos were counted to make sure that none were missing, scanned and saved in .tif format, and placed in the data archive maintained at NCSU for the NPS Northeast Region Inventory and Monitoring Program. Associated data and information provided by Kucera International that are also stored in the data 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 383 and 332 color infrared air photos, respectively, scanned at 600 dpi with 24-bit color depth. For each of the nine mosaics (five leaf-on and four leaf-off), scanned .tif images of the relevant air photos were imported into ERDAS IMAGINE (.img) format, where a photo block was created using the 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 contained the color balancing information and the cutlines created for each of the final mosaics. Band interleaved by line (.bil) image and header files for each mosaic were generated in ER Mapper, 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 data archive.

Preliminary Photointerpretation

A preliminary vegetation dataset for Fredericksburg and Spotsylvania National Military Park was created by interpreting the digital orthophoto mosaics to delineate vegetation polygons to the formation level defined in the National Vegetation Classification System (FGDC 1997; Grossman et al. 1998). To create the formation-level vegetation dataset, a photointerpreter, 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 ha (1.25 ac); however, the photointerpreter was able to delineate polygons as small as 0.2 ha (0.5 ac). After polygons were delineated for the entire park area, the photointerpreter created and populated three fields in the attribute table, entering a unique polygon identification number, the formation-level vegetation class or other 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 the USGS-NPS VMP, the Level II land use and land cover classification scheme developed by Anderson (Anderson et al. 1976) was used to attribute non-vegetated land cover (USGS 1994). In addition, a user-defined code was used to attribute agricultural areas. Next, the photointerpreter examined each formation-level vegetation 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 dataset is archived in ESRI personal geodatabase and shapefile formats in the NCSU data archive.

Field Data Collection

Ecologists from VADNH conducted field data collection in Fredericksburg and Spotsylvania National Military Park in May through August of 2002–2005. 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 GarminMap76 GPS. If satellite reception was poor, a topographic map and compass were used to navigate to a polygon, and locations were marked on the map. 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, 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.

Qualitative data collected from vegetation polygons were also used to describe and map early successional forests and heavily disturbed areas within 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 species composition is 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.

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 mostly native species composition and a consistent environmental setting. Specific plot locations were chosen subjectively in order to distribute plots across a range of site conditions and to capture stands that were relatively dominant, homogenous, and covered a minimum mapping unit area of half a hectare. Sites below minimum mapping unit were sampled only if they represented a special feature or unique vegetation type targeted for the regional classification. An attempt was made to find at least one undisturbed sampling location for each middle-to-late successional community type in 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 m² (119.59 yd²) plots with 10×10 m (32.8×32.8 ft) (or 5×20 m [16.4×65.6 ft]) configurations were used to sample shrubland or herbaceous vegetation, and 400 m² (478.39 yd²) plots were used to sample forested vegetation. The configuration of the plot is flexible (e.g. 20×20 m [65.6×65.6 ft], 16×25 m [62.5×82 ft], 13.33×30 m [43.73×98.4 ft], 10×40 m [32.8×131.2 ft]) to accommodate special site conditions and vegetation pattern. If a forest had particularly large diameter trees or a diverse canopy composition, a 1,000 m² (1,195.99 yd²) plot (20×50 m [65.6×164 ft]) 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 [1.64 ft])
- short shrub layer (woody plants 0.5–1 m [1.64–3.28 ft])
- tall shrub layer, >1–6 m (3.28–19.68 ft)
- tree layer, >6–10 m (19.68–32.8 ft)
- tree layer, >10–20 m (32.8–68.6 ft)
- tree layer, >20–35 m (68.6–114.8 ft)
- tree layer, >35 m (114.8 ft)

The overall cover of mosses, lichens, and liverworts was estimated, but the individual cover of non-vascular taxa was not estimated. The cover for vines climbing into the canopy 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. The taxonomic 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).

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 through 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).

Vegetation Classification and Characterization

The vegetation classification used to map seven mid-Atlantic NPS parks 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.

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

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

All plot data collected in mid-Atlantic national parks as of November 2002 were combined into a regional data set of 1,342 plots from throughout the VA 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 and 798 tidal).

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 $A' = \cos(45^\circ - A) + 1$, where A' represents transformed aspect and A represents 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°) have the lowest values and moist, sheltered slopes (NE, 45°)

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

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

have 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 $\times 10$
- 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, Inc., New Knoxville, OH. 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 $\times$ 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 tree-like 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 abundance 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 the 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) ($\text{Mean Cover} - \text{Total Mean Cover}$). 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 ($=[\text{Frequency}/\text{Number of samples in group}] \times 100$).
- Fidelity – the degree to which a species is restricted to a group, expressed as the proportion of total frequency that frequency in a given group constitutes ($=[\text{Frequency}/\text{Total Frequency}] \times 100$). 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) ($=[\text{Constancy} \times \text{Fidelity}]/100$) – 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]) ($=[\text{Diagnostic Value} \times \text{Mean Cover}]/9$) – by dividing DV $\times$ 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]) ($=\text{Diagnostic Value} \times 2^{\text{relative cover}}$) – 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.

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 type. In a few cases, species that were less constant in a type but that 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 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 Fredericksburg and Spotsylvania National Military Park were drafted using data from field observation points and quantitative plots. A dichotomous key to the vegetation classes occurring in Fredericksburg and Spotsylvania National Military 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 descriptions to confirm that the class selected with the key is appropriate.

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-ac)
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 sulphur (in parts-per-million)
Zn	extractable zinc (in parts-per-million)

Vegetation Map Preparation

Spatial data from field observation points and quantitative plots were used to edit the formation-level maps of Fredericksburg and Spotsylvania National Military 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 Fredericksburg and Spotsylvania National Military Park map was assigned to one of twenty-one map classes based on plot data, field observations, aerial photography signatures, and topographic maps. Occasionally, information from a digital soil survey or National Wetland

Inventory was used to inform the mapping. The mapping boundary was based on park boundary data obtained from Fredericksburg and Spotsylvania National Military Park in April 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 (TNC and ESRI 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

Researchers at NCSU-CEO assessed the horizontal positional accuracy of the digital photo mosaics. 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 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. Field staff recorded the ground control point coordinates with a Trimble Pro XR/XRS or GeoXT. Mapped ground control points that were physically inaccessible were also noted. The field crew collected accuracy assessment data at 24 ground control points for both the leaf-on and 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, two ground control points for the leaf-on mosaics and two ground control points for the leaf-off mosaics were identified as outliers with SAS's JMP program and removed. The field-collected GPS coordinates for the remaining 22 points for the leaf-on mosaics and 22 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 5 and 6 show the distribution of the ground control points for the leaf-on and leaf-off mosaics, respectively.

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 vegetation map classes. The thematic accuracy of polygons attributed to Anderson Level II land-use categories was not assessed. Additionally, the two cultural map classes, Cultural Meadow

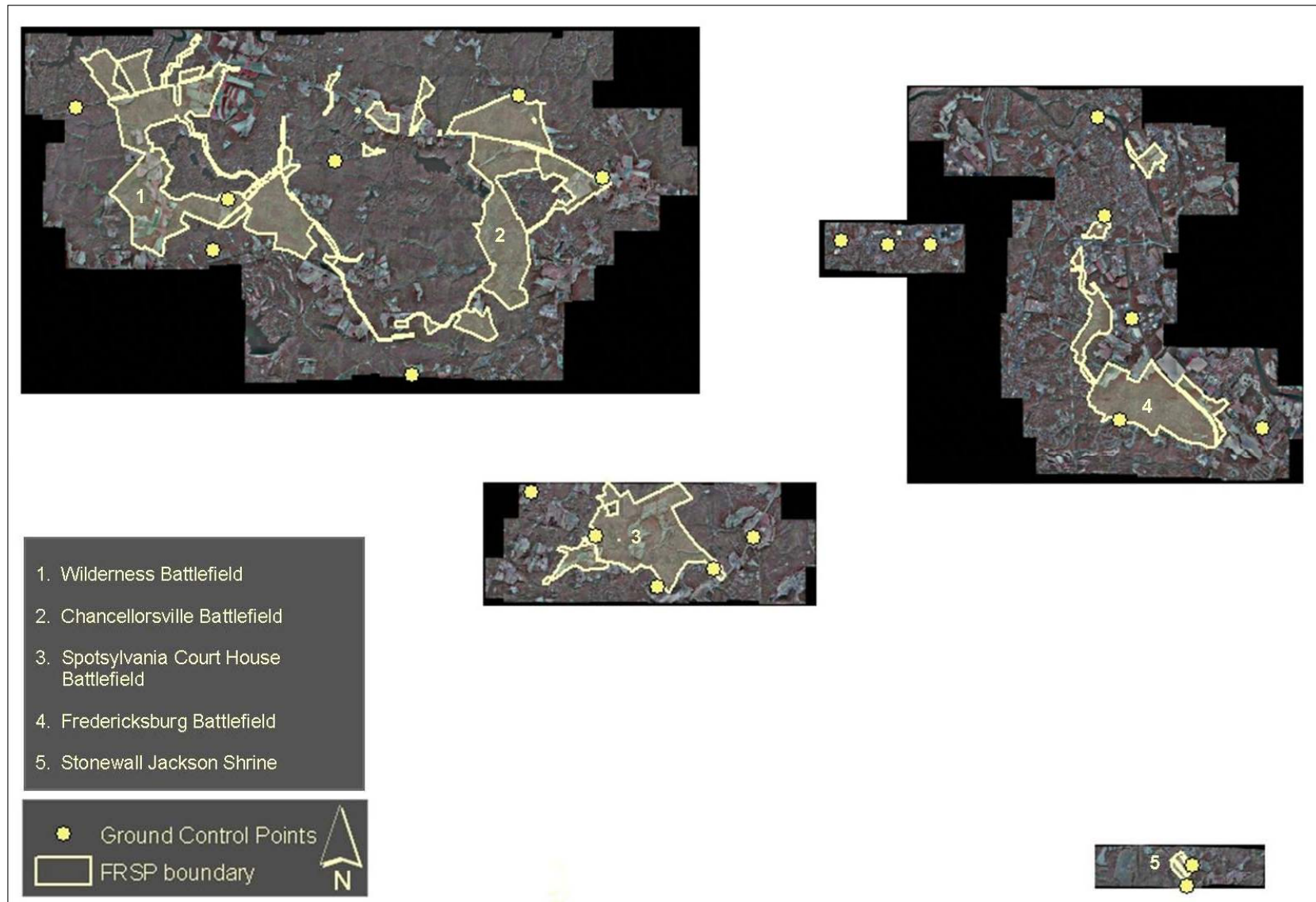


Figure 5. Ground control points used to calculate horizontal positional accuracy of the Fredericksburg and Spotsylvania National Military Park (FRSP) leaf-on (fall) mosaics.

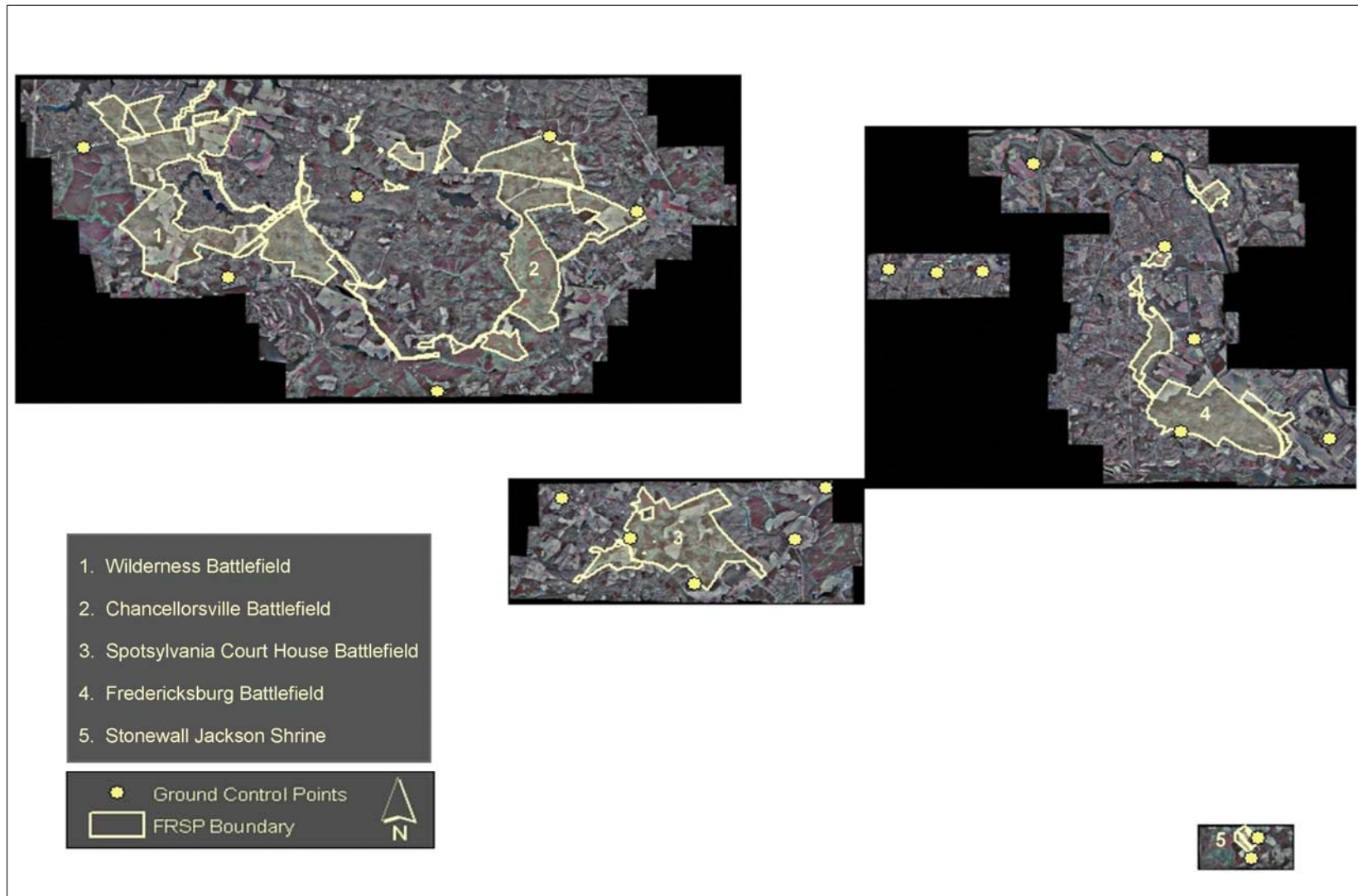


Figure 6. Ground control points used to calculate horizontal positional accuracy of the Fredericksburg and Spotsylvania National Military Park (FRSP) leaf-off (spring) mosaics.

and Semipermanent Impoundment, were not assessed. All polygons less than the minimal mapping unit (0.5 ha [1.24 ac]) were also excluded from the sampling design. Sample size was determined by class abundance and frequency as recommended in section 4.4.2 of the USGS-NPS VMP standards (TNC and ESRI 1994c), 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 the park. The number of accuracy assessment points for each map class is shown in Table 7. Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type) was also excluded from the accuracy assessment because all polygons of this association were visited and verified during the mapping phase of the project.

Prior to selecting sampling locations, all points visited 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. The ArcView 3.3 extension, Random Point Generator v. 1.3 (Jenness 2005), was used to randomly select the location of the accuracy assessment points within polygons of each map class. This extension generates random points within a specified distance for a set of input theme features (such as polygons), producing a new ArcView shapefile and/or 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 of 30, 20, or 10 m (98, 66, or 33 ft) were used, as necessary, based on polygon size and shape. All points were reviewed over topographic maps and aerial photos. Points were reassigned if the randomly selected point fell on a road, outside the park boundary, or if there were potential access limitations. The resulting 217 thematic accuracy assessment sampling points are shown in Figure 7.

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. From May through July 2006, each accuracy assessment point was located in the field using a Garmin Map76 WAAS enabled GPS. Field staff determined the map class at the accuracy assessment point using the dichotomous key and the 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 or a circle with a radius of approximately 40 m. The accuracy assessment data form used in this study is shown in Appendix B.

Data from the 217 accuracy assessment points were entered into an Excel spreadsheet listing accuracy assessment point ID, vegetation map polygon ID, map class, and first and second (if available) map class determination from accuracy assessment. The thematic accuracy of the vegetation map was then tabulated using a contingency matrix that compared the mapped

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 scenario 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 Scenario B	$\geq 5, \leq 20$	≥ 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.	$\geq 5, \leq 30$	< 50 ha	5
E	Very rare. Map class has too few polygons to permit statistical assessment.	< 5	< 50 ha	Visit all and confirm

Table 7. Thematic accuracy assessment (AA) strategy for Fredericksburg and Spotsylvania National Military 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 within the park boundary	Number of AA points sampled
Acidic Oak - Hickory Forest	60	59	463.9	30
Beaver Wetland Complex	2	2	7.1	2
Coastal Plain / Piedmont Acidic Seepage Swamp	15	11	27.3	5
Coastal Plain / Piedmont Floodplain Forest	56	49	188.1	35
Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type)	3	3	72.6	3
Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type)	4	4	7.8	0
Eastern White Pine - Hardwood Forest	1	1	4.0	1
Mesic Mixed Hardwood Forest	14	14	72.1	20
Non-Riverine Saturated Forest	12	11	125.3	15
Oak / Heath Forest	67	64	678.6	30
Piedmont / Mountain Floodplain Forest	2	1	8.9	1
Successional Mixed Scrub	16	15	72.2	10
Successional Red-cedar Forest	7	7	8.3	5
Successional Tuliptree Forest	44	42	238.0	30
Successional Virginia Pine	140	135	502.3	30
TOTAL	443	418	2476.4	217

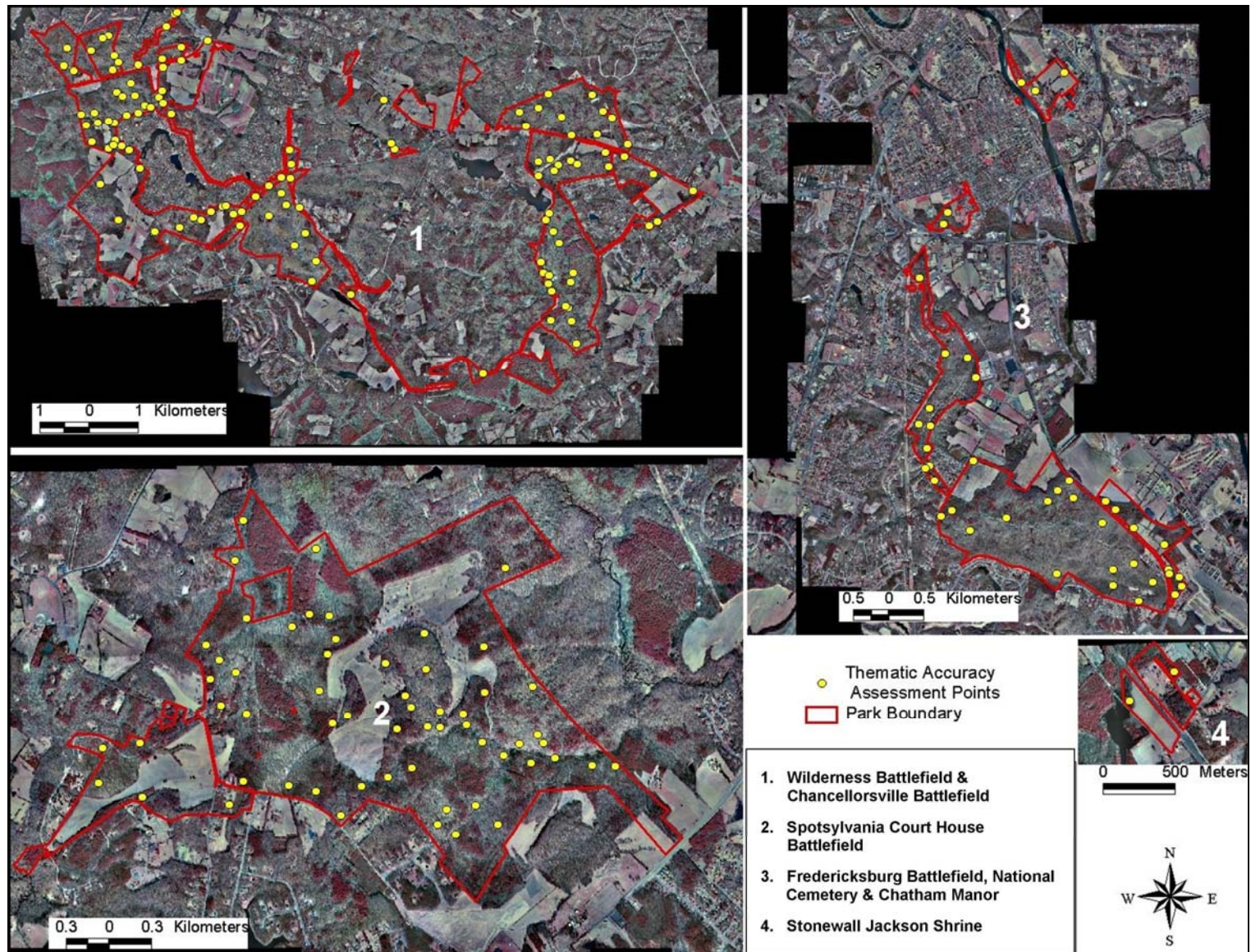


Figure 7. Locations of thematic accuracy assessment sampling points in Fredericksburg and Spotsylvania National Military Park.

vegetation classes with the actual vegetation classes observed in the field. Overall percent accuracy and Kappa index were calculated for the map (TNC and ESRI 1994c). Overall percent accuracy was calculated by dividing the number of correctly classified accuracy assessment points by the total number of accuracy assessment points. The Kappa index is the preferred method of reporting overall thematic accuracy because it takes into account that a certain number of correct classifications will occur by chance (Foody 1992). The USGS-NPS VMP protocol requires that the Kappa index of vegetation maps exceed 80% (TNC and ESRI 1994c).

Errors of omission and errors of commission were also calculated for each map class. Both of these errors are calculated by dividing the number of correctly classified points in one map class by the total number of points sampled in that map class. 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 indicate the probability that mapped vegetation actually represents the vegetation on the ground. Errors of omission and errors of commission should exceed 80%, according to the USGS-NPS VMP protocol (TNC and ESRI 1994c).

Metadata Preparation

All map products are accompanied by detailed FGDC compliant metadata (FGDC 1998a). Metadata are data about data. They describe 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.

Metadata records for each photo mosaic 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. Key information for the leaf-on (fall) and leaf-off (spring) mosaics is summarized in Tables 8 and 9, respectively.

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 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 8. Summary of key information for Fredericksburg and Spotsylvania National Military Park leaf-on (fall) mosaics.

Title of metadata record:	Fredericksburg and Spotsylvania National Military 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 19, 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:	383
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:	1.099 meters, meets Class 1 National Map Accuracy Standard
Number of ground control points upon which estimated accuracy is based:	22
Method of calculating positional accuracy:	Root mean square error
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)

Table 9. Summary of key information for Fredericksburg and Spotsylvania National Military Park leaf-off (spring) mosaics.

Title of metadata record:	Fredericksburg and Spotsylvania National Military 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:	February 18, 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:	332
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:	0.815 meters, meets Class 1 National Map Accuracy Standard
Number of ground control points upon which estimated accuracy is based:	22
Method of calculating positional accuracy:	Root mean square error
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)

Results

Field Surveys

Fieldwork was completed in Fredericksburg and Spotsylvania National Military Park in 2005. Data were collected from 28 quantitative vegetation plots throughout the park (Figure 8). Species observed during quantitative plot sampling and in accuracy assessment observation points are listed in Appendix C. This list only includes species recorded in quantitative plots or in accuracy assessment points. It should not be considered a comprehensive flora for the park, but could be used to add to existing vascular plant lists for the area.

One vascular plant species, dwarf huckleberry (*Gaylussacia dumosa*) was determined to be a county distributional record for Spotsylvania County, Virginia, according to the Digital Atlas of the Virginia Flora (Wieboldt et al. 2005). One new occurrence of the federally threatened vascular plant, small whorled pogonia (*Isotria medeoloides*), was found in Spotsylvania Court House Battlefield during accuracy assessment. Dwarf huckleberry was observed during general reconnaissance and small whorled pogonia was observed in route to an accuracy assessment observation point. Of the 335 vascular plant species noted during fieldwork and accuracy assessment, 14 were nonnative species, and, of those, 13 are considered invasive by the Virginia Department of Conservation and Recreation (VADCR 2003).

Vegetation Classification and Characterization

Initial cluster analysis of the 2,250 plot regional dataset divided the data into three 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 analysis was extracted and used to illustrate results pertaining to the seven national parks in Virginia. A table showing the distribution of vegetation classes across all seven parks, including Fredericksburg and Spotsylvania National Military 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 classes representing disturbed, cultural, or exotic vegetation were also recognized from the seven parks, but were not represented by quantitative plot data, and thus are not included in the quantitative analyses. Global and subnational (state) conservation ranks used in Appendix D are defined in Appendix E, and a summary of select environmental variables by association is presented in Appendix F.

The major vegetation groups represented at Fredericksburg and Spotsylvania National Military Park are 1) oak / heath forests, 2) pine – oak forests, 3) mesic acidic forests, 4) oak – hickory forests, 5) seepage wetlands, 6) alluvial forests, 7) swamp forests, and 8) nonriverine forests.

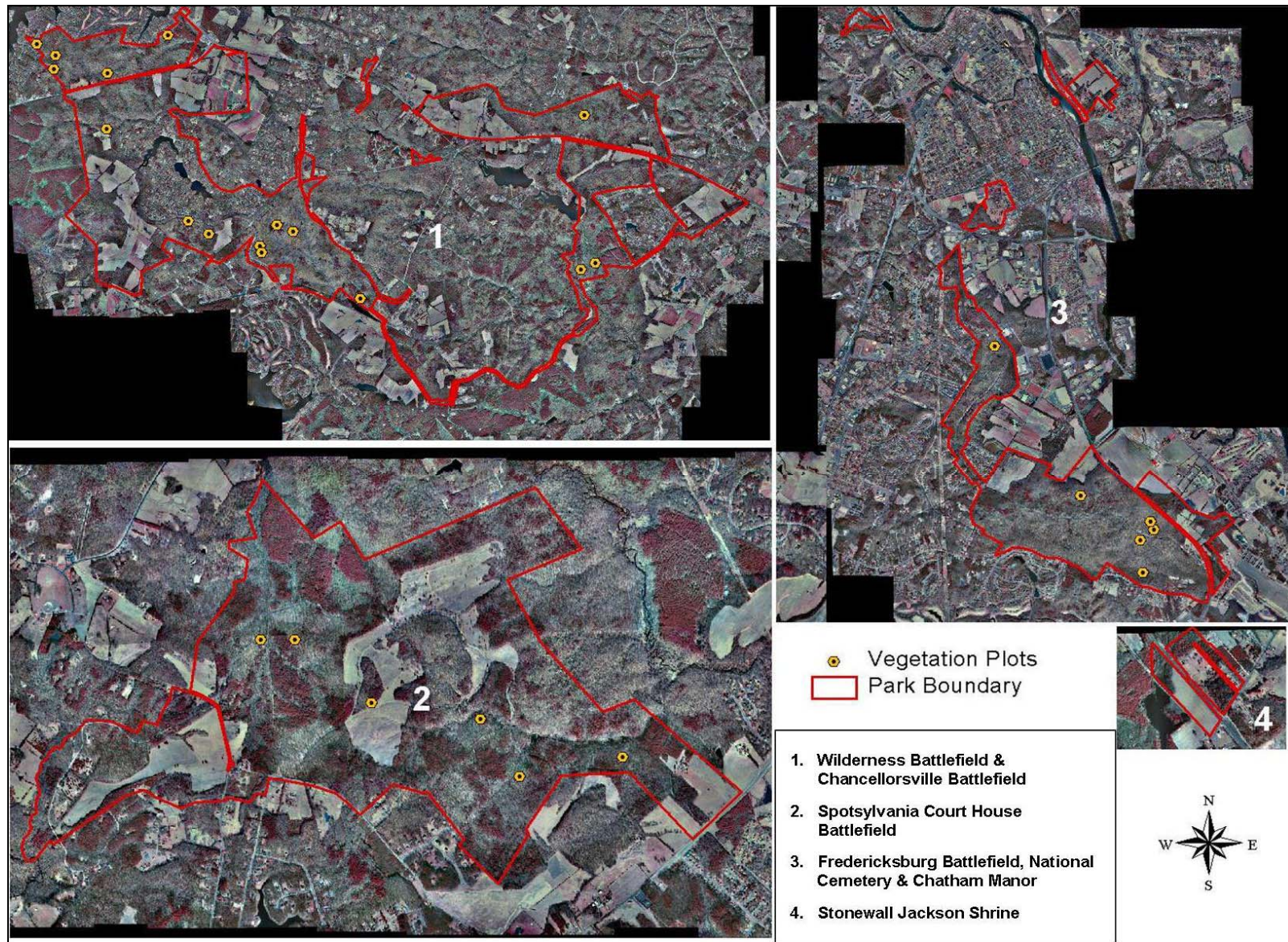


Figure 8. Locations of quantitative vegetation plots in Fredericksburg and Spotsylvania National Military Park.

Cluster dendrograms, ordination scatterplots, and joint plots resulting from quantitative analysis of plots from these groups are presented in Appendix G. Compositional summary statistics for each association present in Fredericksburg and Spotsylvania National Military Park are presented in Appendix H. The analysis results presented in Appendix G support the classification of plot samples into the eight major vegetation groups represented at Fredericksburg and Spotsylvania National Military 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 Fredericksburg and Spotsylvania National Military Park. In this way, species and environmental relationships among associations can be examined in a regional context.

The results of the regional analysis of oak / heath forests are presented in Figures G1 and G2 of Appendix G. There are two associations in the group, Coastal Plain Mixed Oak / Heath Forest (CEGL006269) and Piedmont / Low Elevation Mixed Oak / Heath Forest (CEGL008521), and both are present in Fredericksburg and Spotsylvania National Military Park. Each association is common in the region it occurs, but this is the only park of the seven national parks in this study that contain both oak / heath forest associations, given its position within both the Piedmont and Coastal Plain physiographic provinces. Appendix G, Figure G2, shows the clear separation of the two associations along axis 1 of the ordination. The differences in species composition are largely related to their occurrence in different physiographic provinces. The associations often occur in similar environmental settings and there were no significant environmental variables separating the types.

Figures G3 and G4 of Appendix G illustrate the classification of plots in the pine-oak forest group into two associations. Only Eastern White Pine – Hardwood Forest (CEGL008539) occurs in Fredericksburg and Spotsylvania National Military Park and it is clearly distinct from the other pine-oak association, Coastal Plain Loblolly Pine – Oak Forest (CEGL004766) (Appendix G, Figure G4). The strong separation between the two associations is also represented by the high coefficient of determination (r^2) of 0.602 for axis 1 of the ordination (Table 10). Eastern White Pine – Hardwood Forest is more common in the western Piedmont and is not present in any of the other seven national parks in this study. There were no significant environmental variables separating the associations in analysis.

Classification results for the mesic acidic forests 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. Of the

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 Fredericksburg and Spotsylvania National Military Park. Two-dimensional ordinations have "n/a" listed in Axis 3 column.

Vegetation Group	Increment			Cumulative
	Axis 1	Axis 2	Axis 3	
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
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	0.166	0.592	n/a	0.758

two mesic acidic forests, only Mesic Mixed Hardwood Forest occurs at Fredericksburg and Spotsylvania National Military Park. A compositional summary for this association is presented in Appendix H, Table H4. Mesic Mixed Hardwood Forest was documented in five of the seven national parks included in this study. It is a common and wide-ranging community known from the Piedmont and Coastal Plain of Virginia and Maryland and ranging northward to southern New England.

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 in 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 Fredericksburg and Spotsylvania National Military Park. Acidic Oak-Hickory Forest is found on acidic soils that are common throughout the Piedmont and the association is a common matrix forest type in the Carolinas, Virginia, and south-central Maryland. However, since most of the rolling upland landscape of the Piedmont has been logged more than once since European settlement, stands older than 80 years are uncommon. 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, is not present at Fredericksburg and Spotsylvania National Military 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.

Classification results for the seepage wetland group are presented in Figures G11–G13 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 G11 and G12). Axis 1 of the joint plot (Appendix G, Figure G13) is highly correlated with the joint plot vectors representing pH, calcium / magnesium ratio, base saturation and fertility index, while axis 2 is significantly correlated with high percentage cover of boulders. Together these axes represent 86% of the variance in the data (Table 10). The only seepage wetland present in Fredericksburg and Spotsylvania National Military Park is Coastal Plain / Piedmont Acidic Seepage Swamp (CEGL006238). Plots classified as this association have the lowest average soil pH value in the group and low levels of base cations (Appendix F). A compositional summary of the association is presented in Table H6 of Appendix H. This association is found in four of the seven national parks included in this study (Appendix D). The remaining two seepage wetland associations represent basic seepage swamps and occur on high base status soils with high cation levels (Appendix F and Appendix G, Figure G13). 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 G14–G16 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 G16) 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. Two of the three associations in this analysis group are in Fredericksburg and Spotsylvania National Military Park, Coastal Plain / Piedmont Small-Stream Floodplain Forest (CEGL004418) and Piedmont / Mountain Floodplain Forest (CEGL006217). The 48 plot samples representing Coastal Plain / Piedmont Small-Stream Floodplain Forest are at the lowest end of the soil fertility gradient (Appendix G, Figure G16) and have the lowest averages in the group for soil variables indicative of fertility (Appendix F, Table F2). The 38 plot samples of Piedmont / Mountain Floodplain Forest are at the highest end of the soil fertility gradient (Appendix G, Figure G16) and have the highest 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 Floodplain Forest is found on the large floodplains of major mid-Atlantic rivers over the most fertile alluvium. Compositional summaries of both associations are presented in Appendix H. Coastal Plain / Piedmont Small-Stream Floodplain Forest occurs in four of the seven national parks in this study, and Piedmont / Mountain Floodplain Forest only occurs in Fredericksburg and Spotsylvania National Military Park (Appendix D).

The classification of 70 swamp forest sample plots is illustrated in Figures G17–G19 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 G17 and G18). 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 G19). Plot samples classed as the swamp forest association present at Fredericksburg and Spotsylvania National Military Park, Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type) (CEGL006605), are at the lowest 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). These forests also tend to have shorter hydroperiods and shallower flooding than forests classed as Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash – Red Maple Type) (CEGL006606), although these variables were not measured directly. A compositional summary of Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type) is presented in Table H9 of Appendix H. This association was also found at Petersburg National Battlefield (Appendix D).

The nonriverine forest group is presented in Appendix G, Figures G20–G21. Plot samples from 62 nonriverine forest plots cluster into four compositionally distinct groupings in the dendrogram and the two-dimensional ordination. (Appendix G, Figures G20–G21). The associations show the most separation in terms of species composition along axis 2 of the ordination (Table 10; Appendix G, Figure G21). 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). Two of the four associations occur in Fredericksburg and Spotsylvania National Military Park, Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type) (CEGL006110) and Non-Riverine Saturated Forest (CEGL004644). Compositional summaries for both of these associations are presented in Appendix H. Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type) only occurs in two parks in this study; Fredericksburg and Spotsylvania National Military Park and 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).

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. A total of 19 associations and 12 nonstandard park-specific vegetation classes representing disturbed or cultural vegetation were recognized from the seven parks. Fredericksburg and Spotsylvania National Military Park had eight of these cultural, disturbed, or exotic vegetation classes. Six of these vegetation classes were crosswalked to the association level of the USNVC and two represented vegetation that had no defined classification in the USNVC. These two vegetation classes were given nonstandard, park-specific names to describe the vegetation in Fredericksburg and Spotsylvania National Military 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.

Accuracy Assessment

Positional Accuracy

The final horizontal positional accuracies of the leaf-on and leaf-off mosaics are 1.099 meters and 0.815 meters, respectively, both of which meet the Class 1 National Map Accuracy Standard (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 data archive.

Thematic Accuracy

The results of thematic accuracy assessment for the original vegetation map were calculated with a contingency matrix (Table 11). The Kappa Index for the original vegetation map was 65.4% $\pm$ 5.5%, with an overall accuracy of 69.6%. This accuracy falls below the USGS-NPS VMP requirement of 80%. The error of commission for eight of the 14 map classes, and error of omission for seven of the 14 map classes also fell below the USGS-NPS VMP requirement of 80%. The error of omission for Eastern White - Pine Hardwood Forest is 0% since it is mapped as only one polygon and the polygon was incorrectly identified as Acidic Oak - Hickory Forest during accuracy assessment. The error of commission could not be calculated for Coastal Plain Depression Wetland since it was not included in the accuracy assessment, but is present in the contingency matrix since one polygon of Successional Tuliptree Forest was incorrectly identified as Coastal Plain Depression Wetland (Red Maple –Sweetgum – Willow Oak Type).

Since the overall thematic accuracy did not meet the 80% USGS-NPS VMP standard, all accuracy assessment data were reviewed to determine the main type of error present in the vegetation map. The majority of the errors occurred with the Acidic Oak - Hickory map class, either due to misuse of the dichotomous key or because of misclassification of polygons during initial aerial photo interpretation. The dichotomous key was edited to improve its usefulness in the field and the following revisions were made to the original vegetation map in order to produce a more accurate map:

- Acidic Oak - Hickory Forest polygons labeled incorrectly as Mesic Mixed Hardwood Forest or Successional Tuliptree Forest were attributed to Acidic Oak - Hickory Forest.
- Oak / Heath Forest polygons labeled incorrectly as Acidic Oak - Hickory Forest were attributed to Oak / Heath Forest.
- Loblolly Pine Plantation was added to the vegetation map as a new type identified during accuracy assessment.

The final contingency matrix based on the revised vegetation map is presented in Table 12. The Kappa Index for the final vegetation map was 78.3% $\pm$ 4.8%, with an overall accuracy of 81.1%. The errors of commission and omission improved for the four edited map classes. The error of commission increased to 80% or more for Oak / Heath Forest and Mesic Mixed Hardwood Forest and the error of omission increased to over 80% for Acidic Oak - Hickory Forest and Oak / Heath Forest. Overall, the error of commission and error of omission is at or above 80% for eight of the 14 map classes.

Table 11. Contingency matrix and calculated errors for the thematic accuracy assessment of the original vegetation map for Fredericksburg and Spotsylvania National Military Park. Cells highlighted in gray show the number of sampling points that were correct.

Accuracy Assessment Observation	Vegetation Map Class															
	Acidic Oak - Hickory Forest	Beaver Wetland Complex	Coastal Plain / Piedmont Acidic Seepage Swamp	Coastal Plain / Piedmont Floodplain Forest	Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type)	Eastern White Pine - Hardwood Forest	Mesic Mixed Hardwood Forest	Non-Riverine Saturated Forest	Oak / Heath Forest	Piedmont / Mountain Floodplain Forest	Successional Mixed Scrub	Successional Red-cedar Forest	Successional Tuliptree Forest	Successional Virginia Pine Forest	Grand Total	Error of Commission (Percent Correct)
Acidic Oak - Hickory Forest	21			1	1	1	11	2	3				12		52	40.4%
Beaver Wetland Complex		2		2											4	50.0%
Coastal Plain / Piedmont Acidic Seepage Swamp			4	2											6	66.7%
Coastal Plain / Piedmont Floodplain Forest				25									2		27	92.6%
Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type)					2										2	100.0%
Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type)													1		1	N/A
Eastern White Pine Hardwood Forest						0									0	N/A
Mesic Mixed Hardwood Forest				1			7							1	9	77.8%
Non-Riverine Saturated Forest	1							13					1		15	86.7%
Oak / Heath Forest	8		1	1					26					1	37	70.3%
Piedmont / Mountain Floodplain Forest										1					1	100.0%
Successional Mixed Scrub											9		1		10	90.0%
Successional Red-cedar Forest											1	3			4	75.0%
Successional Tuliptree Forest				2			1		1				10		14	71.4%
Successional Virginia Pine Forest				1			1					2	3	28	35	80.0%
Grand Total	30	2	5	35	3	1	20	15	30	1	10	5	30	30	217	
Error of Omission (Percent Correct)	70.0%	100.0%	80.0%	71.4%	66.7%	0.0%	35.0%	86.7%	86.7%	100.0%	90.0%	60.0%	33.3%	93.3%		
Total points correct															151	
Overall Accuracy															69.6%	
Kappa Index															65.4%	
90%Confidence Interval															5.5%	

Table 12. Contingency matrix and calculated errors for the thematic accuracy assessment of the final edited vegetation map for Fredericksburg and Spotsylvania National Military Park. Cells highlighted in gray show the number of sampling points that were correct.

Accuracy Assessment Observation	Vegetation Map Class														Grand Total	Error of Commission (Percent Correct)
	Acidic Oak - Hickory Forest	Beaver Wetland Complex	Coastal Plain / Piedmont Acidic Seepage Swamp	Coastal Plain / Piedmont Floodplain Forest	Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type)	Eastern White Pine - Hardwood Forest	Mesic Mixed Hardwood Forest	Non-Riverine Saturated Forest	Oak / Heath Forest	Piedmont / Mountain Floodplain Forest	Successional Mixed Scrub	Successional Red-cedar Forest	Successional Tuliptree Forest	Successional Virginia Pine Forest		
Acidic Oak - Hickory Forest	39			1	1	1	2	2	3				4		53	73.6%
Beaver Wetland Complex		2		2											4	50.0%
Coastal Plain / Piedmont Acidic Seepage Swamp			4	2											6	66.7%
Coastal Plain / Piedmont Floodplain Forest				25									2		27	92.6%
Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type)					2										2	100.0%
Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type)													1		1	N/A
Eastern White Pine – Hardwood Forest						0									0	N/A
Mesic Mixed Hardwood Forest				1			8							1	10	80.0%
Non-Riverine Saturated Forest	1							13					1		15	86.7%
Oak / Heath Forest			1	1					30					1	33	90.9%
Piedmont / Mountain Floodplain Forest										1					1	100.0%
Successional Mixed Scrub											9		1		10	90.0%
Successional Red-cedar Forest											1	3			4	75.0%
Successional Tuliptree Forest				2			1		1				12		16	75.0%
Successional Virginia Pine Forest				1			1					2	3	28	35	80.0%
Grand Total	40	2	5	35	3	1	12	15	34	1	10	5	24	30	217	
Error of Omission (Percent Correct)	97.5%	100.0%	80.0%	71.4%	66.7%	0.0%	66.7%	86.7%	88.2%	100.0%	90.0%	60.0%	50.0%	93.3%		

Total points correct 176
Overall Accuracy 81.1%
Kappa Index 78.3%
90% Confidence Interval 4.8%

Vegetation Community Descriptions and Map Classes

Twenty-one map classes were used in the vegetation map for Fredericksburg and Spotsylvania National Military 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 13 lists the 21 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. Sixteen of the 21 map classes were crosswalked to the finest level of the USNVC (association). Two of the 21 map classes were described as nonstandard, park-specific vegetation classes and three 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 Fredericksburg and Spotsylvania National Military Park were written based on information collected within the park boundary. Two map classes, Oak / Heath Forest and Coastal Plain / Piedmont Floodplain Forest represent more than one USNVC association. Polygons mapped as Oak / Heath Forest may be either one of two USNVC associations, and polygons mapped as Coastal Plain / Piedmont Floodplain Forest may be one of three associations. A detailed local description was written for each association within these two 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 April 17, 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 vegetation classes and land-use classes) are also provided. The descriptions are indexed by the regional vegetation class name or land-use class name. Representative photographs of the vegetation types are provided after the descriptions, if available. 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 Fredericksburg and Spotsylvania National Military Park is presented in Appendix K. The dichotomous key should be used in conjunction with the detailed descriptions.

Vegetation Map Production

The final vegetation map for Fredericksburg and Spotsylvania National Military Park is shown in Figures 9–11 and a summary of map class distribution and abundance is provided in Table 14. 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 below in the Accuracy Assessment results section. The mapping boundary was based on park boundary data obtained from Fredericksburg and Spotsylvania National Military Park in April

Table 13. Vegetation-map classes and corresponding USNVC associations or other classification for Fredericksburg and Spotsylvania National Military Park. Where a map class represents more than one vegetation class in the regional classification, a unique common name is listed for each vegetation class.

Map Class	USNVC Association (association code)	Regional Vegetation or Land-use Class* (name source)
Acidic Oak - Hickory Forest	<i>Quercus alba</i> - <i>Quercus rubra</i> - <i>Carya alba</i> / <i>Cornus florida</i> / <i>Vaccinium stamineum</i> / <i>Desmodium nudiflorum</i> Piedmont Forest (CEGL008475)	Acidic Oak - Hickory Forest (Fleming et al. 2006)
Beaver Wetland Complex	<i>Alnus serrulata</i> Swamp Shrubland (CEGL005082)	Beaver Wetland Complex (park-specific name)
Coastal Plain / Piedmont Acidic Seepage Swamp	<i>Acer rubrum</i> - <i>Nyssa sylvatica</i> - <i>Magnolia virginiana</i> / <i>Viburnum nudum</i> var. <i>nudum</i> / <i>Osmunda cinnamomea</i> - <i>Woodwardia areolata</i> Forest (CEGL006238)	Coastal Plain / Piedmont Acidic Seepage Swamp (Fleming et al 2006).
Coastal Plain / Piedmont Floodplain Forest	<i>Liquidambar styraciflua</i> - <i>Liriodendron tulipifera</i> / <i>Lindera benzoin</i> / <i>Arisaema triphyllum</i> Forest (CEGL004418) OR	Coastal Plain / Piedmont Small-Stream Floodplain Forest (park-specific name)
	<i>Liquidambar styraciflua</i> - (<i>Liriodendron tulipifera</i>) Temporarily Flooded Forest (CEGL007330) OR	Successional Tuliptree Floodplain Forest (park-specific name)
	<i>Betula nigra</i> - (<i>Platanus occidentalis</i>) Forest (CEGL006976)	Successional River Birch - Red Maple Floodplain Forest (park-specific name)
Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type)	<i>Quercus (phellos, palustris, michauxii)</i> - <i>Liquidambar styraciflua</i> / <i>Cinna arundinacea</i> Forest (CEGL006605)	Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type) (Fleming et al. 2006)
Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type)	<i>Liquidambar styraciflua</i> - <i>Acer rubrum</i> - <i>Quercus phellos</i> / <i>Leucothoe racemosa</i> Forest (CEGL006110)	Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type) (Fleming et al. 2006)
Cultural Meadow	<i>Dactylis glomerata</i> - <i>Phleum pratense</i> - <i>Festuca</i> spp. - <i>Solidago</i> spp. Herbaceous Vegetation (CEGL006107)	Cultural Meadow (park-specific name)
Eastern White Pine - Hardwood Forest	<i>Pinus strobus</i> - <i>Quercus alba</i> - <i>Quercus prinus</i> / <i>Vaccinium stamineum</i> Forest (CEGL008539)	Eastern White Pine - Hardwood Forest (Fleming et al. 2006)
Loblolly Pine Plantation	<i>Pinus taeda</i> Planted Forest (CEGL007179)	Loblolly Pine Plantation (NatureServe 2007)
Mesic Mixed Hardwood Forest	<i>Fagus grandifolia</i> - <i>Quercus (alba, rubra)</i> - <i>Liriodendron tulipifera</i> / (<i>Ilex opaca</i> var. <i>opaca</i>) / <i>Polystichum acrostichoides</i> Forest (CEGL006075)	Mesic Mixed Hardwood Forest (Fleming et al. 2006)
Non-Riverine Saturated Forest	<i>Quercus (phellos, pagoda, michauxii)</i> / <i>Ilex opaca</i> var. <i>opaca</i> / <i>Clethra alnifolia</i> / <i>Woodwardia areolata</i> Forest (CEGL004644)	Non-Riverine Saturated Forest (Fleming et al. 2006)

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Map Class	USNVC Association (association code)	Regional Vegetation or Land-use Class* (name source)
Oak / Heath Forest	<i>Quercus alba</i> - <i>Quercus (coccinea, velutina, prinus)</i> / <i>Gaylussacia baccata</i> Forest (CEGL008521) OR	Piedmont / Low Elevation Mixed Oak / Heath Forest (Fleming et al. 2006)
	<i>Quercus alba</i> - <i>Quercus falcata</i> - (<i>Carya pallida</i>) / <i>Gaylussacia frondosa</i> Forest (CEGL006269)	Coastal Plain Mixed Oak / Heath Forest (Fleming et al. 2006)
Other Urban or Built-up Land	Not defined - Anderson land-use class	Other Urban or Built-up Land (17) (Anderson et al. 1976)
Piedmont / Mountain Floodplain Forest	<i>Acer saccharinum</i> - <i>Acer negundo</i> / <i>Ageratina altissima</i> - <i>Laportea canadensis</i> - (<i>Elymus virginicus</i>) Forest (CEGL006217)	Piedmont / Mountain Floodplain Forest (Fleming et al. 2006)
Semipermanent Impoundment	Not defined - nonstandard, park-specific vegetation class	Semipermanent Impoundment (park-specific name)
Successional Mixed Scrub	Not defined - nonstandard, park-specific vegetation class	Successional Mixed Scrub (park-specific name)
Successional Red-cedar Forest	<i>Juniperus virginiana</i> Forest (CEGL006024)	Successional Red-cedar Forest (park-specific name)
Successional Tuliptree Forest	<i>Liriodendron tulipifera</i> - <i>Quercus</i> spp. Forest (CEGL007221)	Successional Tuliptree Forest (park-specific name)
Successional Virginia Pine Forest	<i>Pinus virginiana</i> Successional Forest (CEGL002591)	Successional Virginia Pine Forest (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 (53) (Anderson et al. 1976)

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

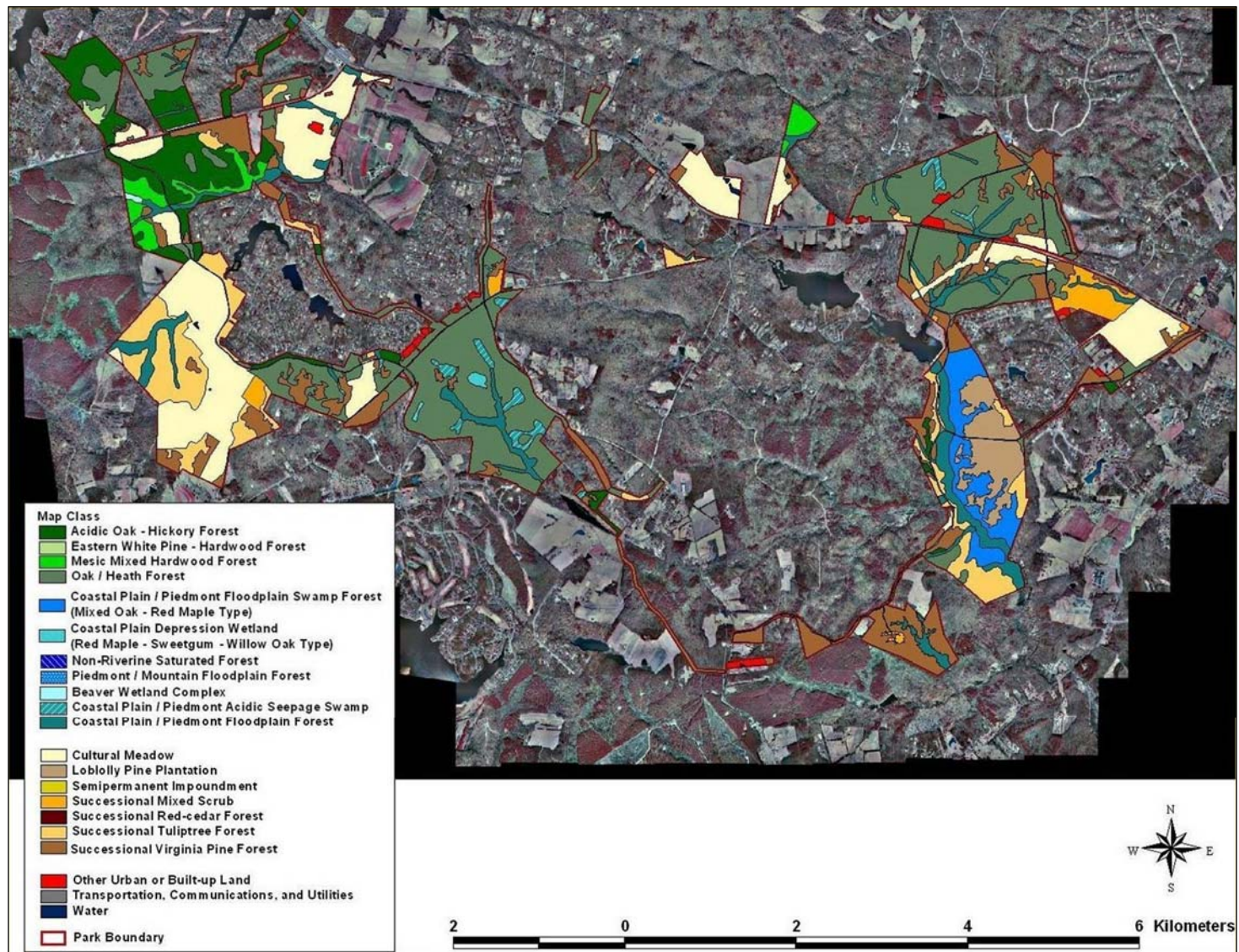


Figure 9. Vegetation and Anderson Level II map classes for Wilderness Battlefield and Chancellorsville Battlefield in Fredericksburg and Spotsylvania National Military Park.

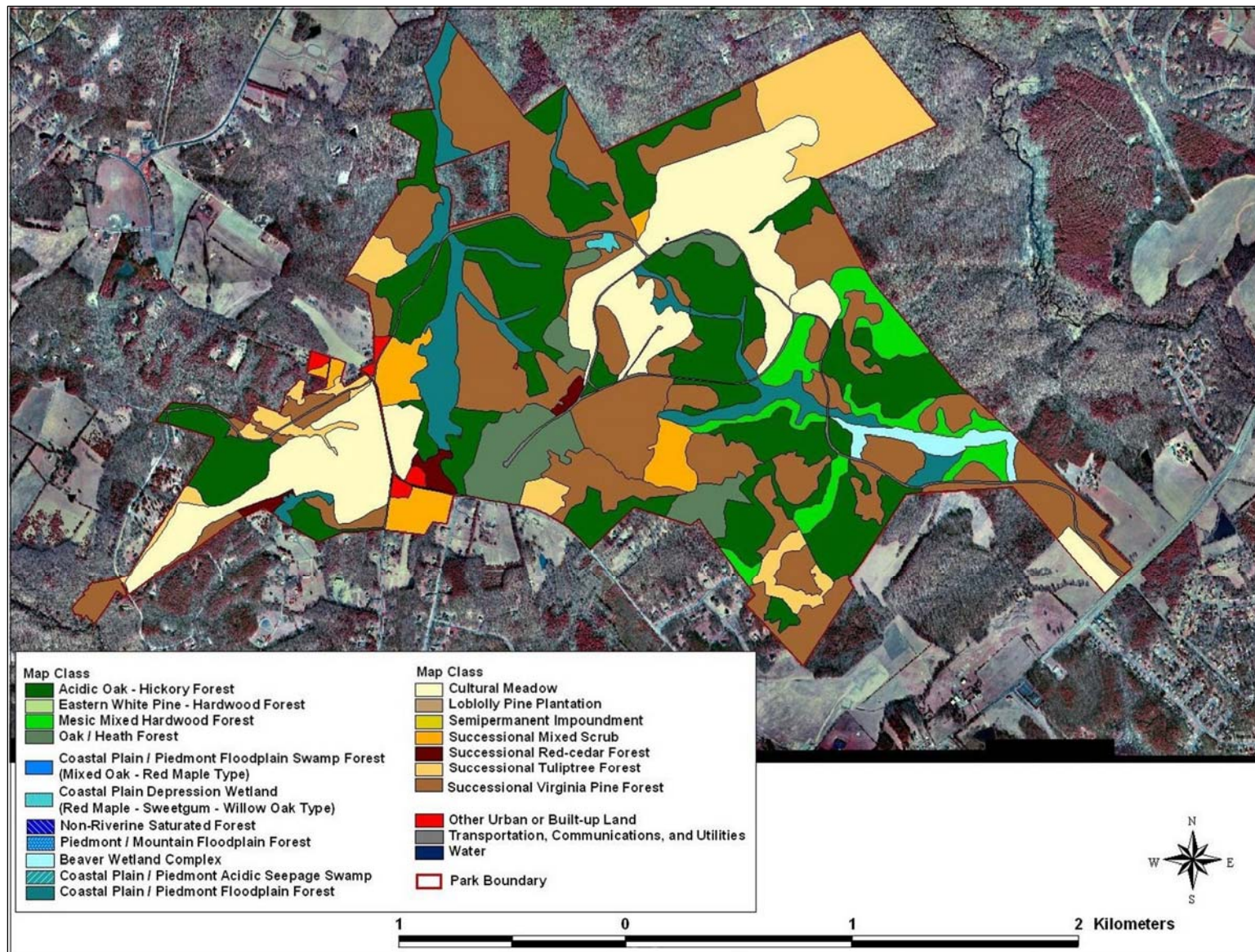


Figure 10. Vegetation and Anderson Level II map classes for Spotsylvania Court House Battlefield in Fredericksburg and Spotsylvania National Military Park.

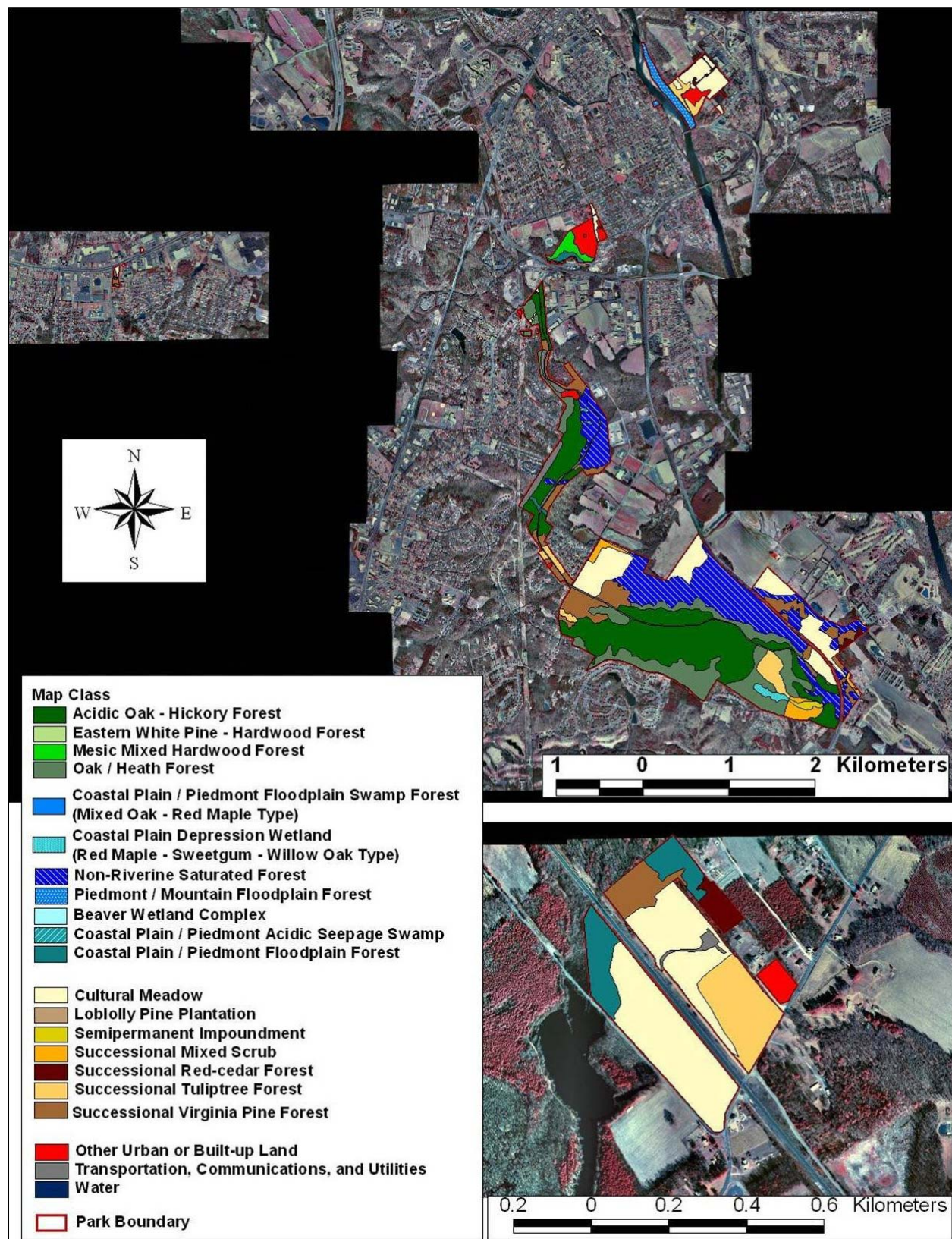


Figure 11. Vegetation and Anderson Level II map classes for Fredericksburg Battlefield and Stonewall Jackson Shrine in Fredericksburg and Spotsylvania National Military Park.

Table 14. Number of polygons, total mapped hectares, and number of quantitative plots sampled for the 21 vegetation-map classes at Fredericksburg and Spotsylvania National Military Park.

Map Class	Number of polygons	Total mapped hectares	Number of plots sampled
Acidic Oak - Hickory Forest	60	463.9	6
Beaver Wetland Complex	2	7.1	0
Coastal Plain / Piedmont Acidic Seepage Swamp	15	27.3	5
Coastal Plain / Piedmont Floodplain Forest	56	188.1	1
Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type)	3	72.6	2
Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type)	4	7.8	3
Cultural Meadow	50	516.7	0
Eastern White Pine - Hardwood Forest	1	4.0	1
Loblolly Pine Plantation	3	71.3	0
Mesic Mixed Hardwood Forest	14	72.1	3
Non-Riverine Saturated Forest	12	125.3	2
Oak / Heath Forest	67	678.6	5
Other Urban or Built-up Land	27	36.3	0
Piedmont / Mountain Floodplain Forest	2	8.9	0
Semipermanent Impoundment	1	2.3	0
Successional Mixed Scrub	16	72.2	0
Successional Red-cedar Forest	7	8.3	0
Successional Tuliptree Forest	44	238.0	0
Successional Virginia Pine Forest	140	502.3	0
Transportation, Communications, and Utilities	13	51.8	0
Water	7	2.0	0
TOTAL	544	3156.8	28

2004. The final vegetation map was clipped at the park boundary because areas outside the park were not surveyed or assessed for accuracy.

In the final map, two of the 21 map classes represent multiple USNVC associations since clear boundaries between the associations could not always be delineated on aerial photos or in the field. These map classes are Oak / Heath Forest and Coastal Plain / Piedmont Floodplain Forest. The Oak / Heath Forest map class includes two associations; Coastal Plain Mixed Oak / Heath Forest and Piedmont / Low Elevation Mixed Oak / Heath Forest. The Coastal Plain / Piedmont Floodplain Forest map class includes three associations; Coastal Plain / Piedmont Small-Stream Floodplain Forest, Successional Tuliptree Floodplain Forest, and Successional River Birch - Red Maple Floodplain Forest. The map class Coastal Plain / Piedmont Floodplain Forest includes stands that were significantly disturbed with high cover by nonnative invasive plants, and without the characteristic structure and species of less disturbed examples of floodplain forests. For the proper management of these natural communities it is important to distinguish between high quality stands and disturbed stands. The most disturbed stands of Coastal Plain / Piedmont Floodplain Forest are indicated in the Comment field of the map attribute table.

Polygons that were attributed with Anderson Level II class 14 (Transportation, Communication, and Utilities) are further attributed in the Comment field in the map attribute table to identify the finer feature they represent (road, utility line, etc). 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 hydrologic modifiers of temporarily flooded, seasonally flooded, saturated, semipermanently flooded, or tidally flooded in the formation name) 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. The map of polygons representing wetland map classes is shown in Figure 12. This is not a map of jurisdiction wetlands, but rather a map of the distribution of wetland map classes with the USNVC formation of temporarily flooded cold-deciduous forest, seasonally flooded cold-deciduous forest, seasonally flooded cold-deciduous shrubland, or saturated cold-deciduous forest. All wetland map classes for Fredericksburg and Spotsylvania National Military Park fall into the Palustrine System of the USFWS wetland classification.

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

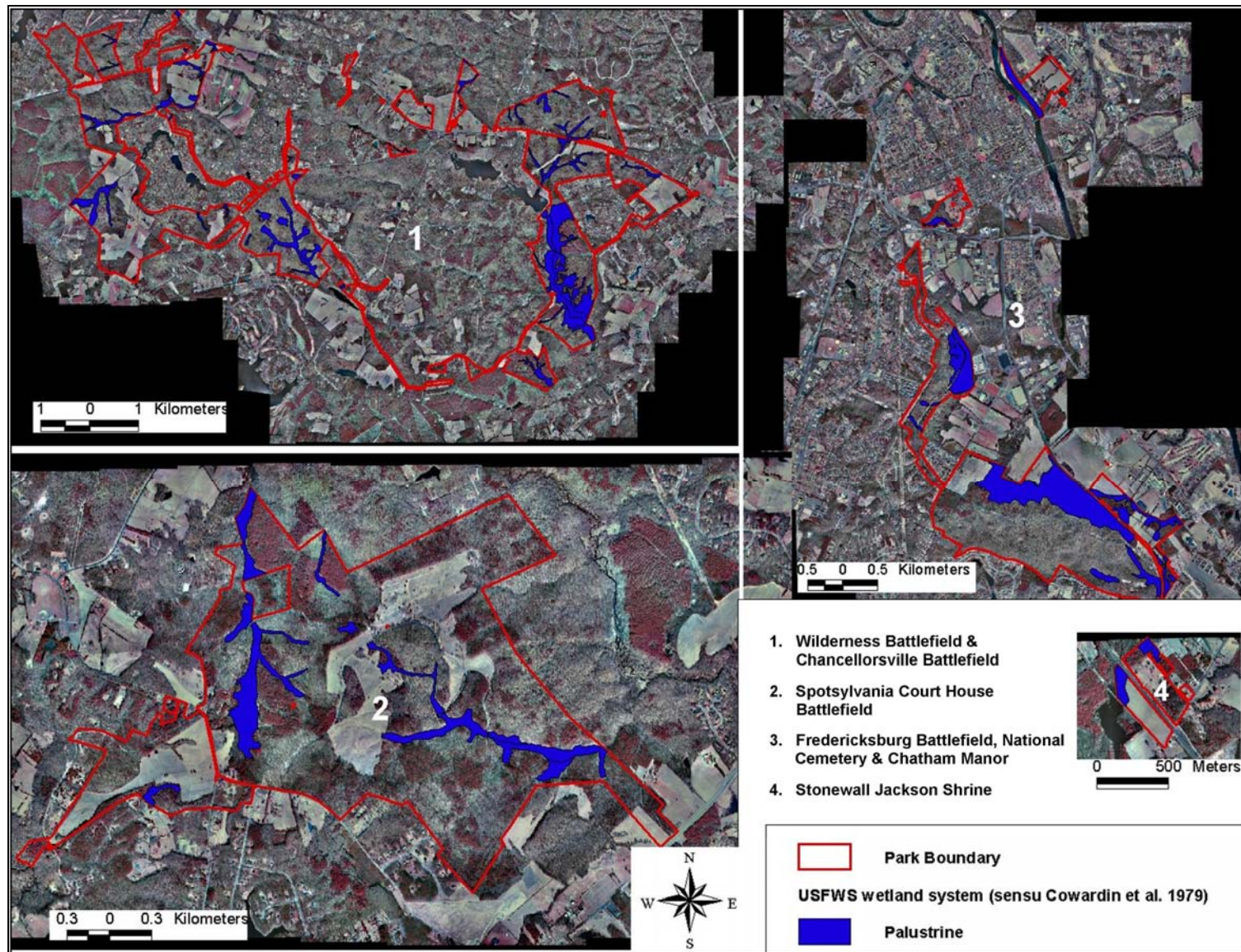


Figure 12. Distribution of wetland vegetation-map classes in Fredericksburg and Spotsylvania National Military Park.

Table 15. Summary of products resulting from the classification and mapping of vegetation in Fredericksburg and Spotsylvania National Military 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

The 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 Fredericksburg and Spotsylvania National Military Park identified and characterized 21 map classes, representing 19 associations, three Anderson Level II land-use classes (Anderson et al. 1976), and two nonstandard, park-specific, disturbed or cultural vegetation classes (Table 13). The diversity of vegetation represented by the map classes is a result of several factors, including bedrock geology and soils, park topography, hydrology, land use history, and cultural management of the park.

Geology, topography, and hydrology have the most influence on vegetation composition and structure in the later successional forests of the park. In the context of this study, late successional forests are mature forests found in the least disturbed areas in the park. These native vegetation associations or “natural communities” have the most stable species composition, with a greater diversity of native flora than other map classes representing disturbed or cultural vegetation. Ten map classes represent late-successional vegetation, and together they cover 52% of the land in the park (1648 ha [4073 ac]). The ten map classes can be broadly characterized based on different environmental settings as upland forests (four map classes) and forested wetlands (six map classes).

The upland forest map classes are Oak / Heath Forest, Acidic Oak - Hickory Forest, Mesic Mixed Hardwood Forest, and Eastern White Pine - Hardwood Forest. These upland forest types are associated with the well-drained, low fertility, acidic soils found throughout the park. Except for the Eastern White Pine - Hardwood Forest, these types are common on uplands throughout the mid-Atlantic region and are found in most of the seven national parks in this study.

The most common upland forest map class is Oak / Heath Forest which covers 679 ha (1,677 ac) of the park land. Polygons attributed to the map class Oak – Heath Forest may be one of two associations; Piedmont / Low Elevation Mixed Oak / Heath Forest or Coastal Plain Mixed Oak / Heath Forest. The associations were combined into a single map class due to the difficulty of distinguishing them on photography and in the field. Piedmont / Low Elevation Mixed Oak / Heath Forest is the matrix forest along the upper elevations and local crests in the park. It covers significantly more area than Coastal Plain Mixed Oak / Heath Forest, which is found only on park land within the Coastal Plain physiographic province. It is primarily located in Fredericksburg Battlefield along the lower slopes north of Lee Drive. See Appendix I for detailed descriptions of the two associations.

Eastern White Pine - Hardwood Forest is found in only one isolated patch in the northwestern portion of Wilderness Battlefield. This association is more common in the western Piedmont and Ridge and Valley physiographic provinces and does not occur in any of the other national

parks in this study. It tends to occur in similar environmental settings as Piedmont / Low Elevation Mixed Oak / Heath Forest. The two forest types can have a number of species in common and often the dominance of eastern white pine (*Pinus strobus*) is the main distinguishing feature between the two types. It is unclear as to why Eastern White Pine - Hardwood Forest occurs with such a limited extent in the park, although the location is near the eastern distributional limit of white pine in Virginia (Wieboldt et al. 2005).

Acidic Oak - Hickory Forest is the matrix forest on middle to lower slopes of the park. This dry hardwood forest is typically composed of various species of oaks (*Quercus* spp.) and hickories (*Carya* spp.), but disturbed stands may have a significant component of early successional pines (*Pinus* spp.) or tuliptree (*Liriodendron tulipifera*) in the canopy. Mesic Mixed Hardwood Forest occurs in scattered patches on lower slopes of the park, covering two percent of the park area (72 ha [178 ac]). This association is typically dominated by American beech (*Fagus grandifolia*), but can be co-dominated by white oak (*Quercus alba*) and/or tuliptree.

In recent decades, drier oak / heath and oak - hickory forests throughout the eastern United States have progressively exhibited compositional changes characterized by a lack of oak recruitment and the abundant establishment in understories of shade-tolerant, later-successional trees (Lorimer 1984; Abrams 1992, 1996). The principal reasons for these changes are believed to be the widespread exclusion of fire during the twentieth century, as well as the cessation of other disturbances (e.g., repeated cutting on short rotations) that favor oaks. In the mid-Atlantic region, red maple (*Acer rubrum*) and American beech are two of the most abundant, shade-tolerant invaders of oak forests, and this trend is evident over parts of Fredericksburg and Spotsylvania National Historical Park. As a result, stands of Acidic Oak - Hickory Forest and Mesic Mixed Hardwood Forest in the park may be intergradational and difficult to distinguish, given the spread of American beech throughout oak-hickory understories. For example, plot FRSP.10 was classified as Mesic Mixed Hardwood Forest in the regional analysis, largely due to the abundance of American beech in the understory. Yet this area of Spotsylvania Court House Battlefield is dominated by oaks and was, therefore, mapped as Acidic Oak - Hickory Forest. However, Orwig and Abrams (1994) found less evidence of successional change in the upland oak forests of the Wilderness and Chancellorsville battlefields, which is consistent with data collected during the present study. American beech is scarce in this part of the study area, possibly because of unfavorable Nason, Tatum, and Catharpin soils with somewhat impermeable, clayey subsoils with moderate shrink-swell potential (Elder 1985). Even the more adaptable red maple is less abundant here than in most other parts of the region.

The Wilderness and Chancellorsville battlefields also have a land use history that varies from many other areas of the Piedmont. While the majority of Piedmont uplands were cleared at some point in the post-settlement era, the Wilderness and Chancellorsville forests were utilized almost immediately in the early 1700s to fuel several iron furnaces in Spotsylvania County (Orwig and Abrams 1994). During much of the 18th and early 19th centuries, these forests were repeatedly logged, resulting in the very dense, oak-dominated coppice forests that hosted the two battles fought here in 1863 and 1864. Although some additional logging occurred through the early 1900s, the Wilderness and Chancellorsville forests today are physically mature and have a physiognomic character far different from that of the Civil War-era stands.

Forested wetlands cover 13.6% (430 ha, 1062 ac) of the park area and include six map classes. These map classes include alluvial floodplain forests, found in drainage swales and on floodplains, and non-alluvial wetlands that occur away from active floodplains in various environmental settings in the park.

Polygons attributed to the map class Coastal Plain / Piedmont Floodplain Forest may be one of three associations. The associations were combined into a single map class due to the difficulty of distinguishing them on photography and in the field. The three vegetation associations are Coastal Plain / Piedmont Small-Stream Floodplain Forest, Successional River Birch - Red Maple Floodplain Forest, and Successional Tuliptree Floodplain Forest. Coastal Plain / Piedmont Small-Stream Floodplain Forest is the only forest type of the three that represents later successional vegetation. It is a common floodplain forest throughout the region and in the park it occurs on well-drained floodplains of perennial streams with relatively acidic soil, such as Wilderness Run in Wilderness Battlefield. The well-drained mesic conditions of this forest association make it highly susceptible to exotic species invasion; therefore, it is important for park staff to site trails and roads to avoid high quality stands and work to mitigate impacts from surrounding developments. The successional alluvial forests occur in well-drained floodplain areas that have had recent disturbance or are undergoing succession from open wetland to forest.

Piedmont / Mountain Floodplain Forest is a common association on floodplains of major mid-Atlantic rivers dominated by silver maple (*Acer saccharinum*). The only river in the park large enough to support this type is the Rappahannock River, and the association covers about 9 ha (22 ac) on the floodplain near Chatham Manor. The association does not occur in any of the other national parks in this study. The soils are quite nutrient-rich, especially in comparison to the relatively acidic soils of the Coastal Plain / Piedmont Small-Stream Floodplain Forest. Nutrient levels are enhanced through flood deposition of base rich alluvium washed from more fertile areas upstream.

Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type) is a poorly drained floodplain swamp forest that often occurs in the backswamps of broad alluvial floodplains. It is found in the Coastal Plain and eastern Piedmont, where it is uncommon. The association has a conservation rank of G3G4 due to its relatively restricted range and threats to intact stands. In the park, Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type) only occurs along the upper reaches of the Ni River in Chancellorsville where soil drainage is impeded and the floodplain is wide enough to support the association. Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type) occurs adjacent to and grades into Successional River Birch - Red Maple Floodplain Forest, which is an early-successional temporary flooded forest with little to no oaks in the canopy. Small inclusions of Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type) can occur in the adjacent successional forest, and plot FRSP.9 is an example of this occurrence. This plot was collected because it is representative of Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type), but the inclusion is below the minimum mapping unit (0.5 ha) and not representative of the general area. The area is largely disturbed forest and was therefore mapped as Successional River Birch - Red Maple Floodplain Forest. Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type) should be an important conservation priority for the park, both because of its conservation status and because swamps can support diverse animal populations due to an abundance of food and habitat resources.

Non-alluvial forested wetlands include the map classes Coastal Plain / Piedmont Acidic Seepage Swamp, Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type), and Non-Riverine Saturated Forest. All three associations represented by these map classes are uncommon to rare in Virginia or the mid-Atlantic region and are vulnerable to alteration or destruction, such as by hydrologic modifications. Stands typically have standing water due to impermeable soils with poor drainage and high clay content. These isolated wetlands are important as amphibian breeding areas and provide habitat for many at-risk plant and animal species (Comer et al. 2005).

Coastal Plain / Piedmont Acidic Seepage Swamp is an uncommon (G3?) wetland habitat, scattered in the Coastal Plain from southeastern New York and New Jersey to southeastern Virginia. Several uncommon odonates (dragonflies and damselflies) depend on forested seeps for breeding habitat. Throughout the range of the association, Coastal Plain / Piedmont Acidic Seepage Swamp is 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 non-native species invasions. In Fredericksburg and Spotsylvania National Military Park, 15 stands of Coastal Plain / Piedmont Acidic Seepage Swamp are mapped in Wilderness, Chancellorsville, and Fredericksburg battlefields, with an average size of about two ha (5 ac).

Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type) occupies poorly-drained basins and occurs in the park as isolated wetlands in upland settings. Similar wetlands are scattered throughout the Mid-Atlantic Coastal Plain and occasionally occur in gentle, highly acidic terrain of the eastern Piedmont. It is an uncommon association in the park, only documented at four sites and covering a total of 7.8 ha (19.3 ac). The vegetation and habitats vary from closed forests in saturated soils to more open woodland occupying standing water (water levels fluctuate with the seasons). Because these isolated wetlands are typically free of fish that eat the eggs of frogs and salamanders, they provide important breeding habitats for amphibians.

Non-Riverine Saturated Forest is a globally rare (G2?) community restricted to flat terraces and very wide, ancient floodplains that are no longer subject to alluvial processes. Its hydrology varies from seasonally to permanently saturated, and is maintained by a high water table rather than by overland flooding. Shallow surface water ponding is common during periods when the water table is perched, and groundwater emanating from adjacent toe slopes may produce localized sheet flows. These specialized wetland habitats were probably never common on the landscape and are only known from about 25 sites in 13 counties in Virginia and 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. This association is particularly vulnerable to changes in hydrology that can alter the species composition and can encourage invasion by nonnative invasive plants. The natural hydrology of this association has been impacted by historic anthropogenic activities and historic berms and ditches are often evident. Within the study area, this community occurs only in Fredericksburg Battlefield and one particularly mature and extensive stand is found just north of Lee Drive. The stand is mapped as 78 ha (193 ac), which is over half of the total acreage of Non-Riverine Saturated

Forest in the park (125 ha [303 ac]). Younger and smaller stands of this association occur along roadways and near the railroad in Fredericksburg Battlefield and tend to have higher cover of red maple in the understory and canopy.

The remaining 11 map classes in the park represent early successional/transitional vegetation or cultural map classes which together cover 47.8% of the park. Land use history and ongoing management to maintain the historic and cultural landscape of the Civil War era are the most influential factors determining the current composition of these map classes.

Early successional or transitional vegetation covers 26.2% of the land in the park (828 ha [2,046 ac]). Map classes representing early successional or transitional vegetation are Successional Virginia Pine Forest, Successional Tuliptree Forest, Successional Red-cedar Forest, Successional Mixed Scrub, and Beaver Wetland Complex. This vegetation is the result of relatively recent (20–60 yrs) abandonment of fields or tree canopy removal by disturbances such as wind disturbance, beaver activity, or silvicultural practices. The upland stands are dominated by early successional, weedy tree species in the canopy and subcanopy, and have high cover of nonnative invasive plants in the shrub and herbaceous layers. Beaver-disturbed areas typically occur as semipermanently flooded habitat variously dominated by trees, shrubs, herbs, or open water. All of these map classes are rapidly changing in species composition and vegetation structure, and if invasive species and beaver activity can be kept in check or eliminated, the stands will eventually succeed into one of the later successional forest types mapped in the park. The most prevalent nonnative invasive species documented in the park during this study are Japanese honeysuckle (*Lonicera japonica*), Nepalese browntop (*Microstegium vimineum*), multiflora rose (*Rosa multiflora*), and Chinese privet (*Ligustrum sinense*).

Cultural map classes represent 21.6% of the park's acreage (680 ha [1,681 ac]). Cultural Meadow is the most common cultural map class, covering 517 ha (1,277 ac). Cultural Meadow includes all mowed or maintained fields in the park, such as fields under agricultural lease. Most Cultural Meadow areas are managed to maintain the open fields characteristic of Civil War battlefields. Other cultural map classes include Loblolly Pine Plantation, Semipermanent Impoundment, Other Urban or Built-Up Land, Transportation, Communications, and Utilities, and Water. The water map class largely represents small man-made ponds or reservoirs scattered throughout the park.

Of the 21 map classes used to map the vegetation at Fredericksburg and Spotsylvania National Military Park, 10 are natural communities as defined in the Natural Communities of Virginia (http://www.dcr.virginia.gov/natural_heritage/nctoc.shtml): Acidic Oak - Hickory Forest, Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type), Coastal Plain / Piedmont Acidic Seepage Swamp, Coastal Plain / Piedmont Floodplain Forest, Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type), Eastern White Pine - Hardwood Forest, Mesic Mixed Hardwood Forest, Non-Riverine Saturated Forest, Oak / Heath Forest, and Piedmont / Mountain Floodplain Forest. 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. All globally rare (G1 or G2) or state rare (S1 or S2) communities are tracked, regardless of their size, condition, and landscape context. Examples of three forested wetland communities, Coastal Plain / Piedmont Acidic

Seepage Swamp, Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type), and Non-Riverine Saturated Forest meet the criteria to be considered Natural Heritage exemplary natural community occurrences. Exemplary occurrences of Coastal Plain / Piedmont Acidic Seepage Swamp are found in the Wilderness Battlefield, in the vicinity of Hamilton's Thicket, where it covers about 8 ha (20 ac) in three patches, and in the Fredericksburg Battlefield area where two smaller examples are mapped. The example at Hamilton's Thicket is large compared to other known examples of this community. It also has an excellent landscape context, surrounded by intact, undisturbed forest, with few exotic species. The examples of Coastal Plain / Piedmont Acidic Seepage Swamp in Fredericksburg Battlefield have intact hydrology and representative species composition, but are smaller, surrounded by development, and near roads. A large, particularly mature example of Non-Riverine Saturated Forest in Fredericksburg Battlefield is found just north of Lee Drive and meets the criteria to be considered a Natural Heritage exemplary occurrence. Compared to other known occurrences of Non-Riverine Saturated Forest, it is a very large example with mature hydrophytic oaks and is representative of the association in terms of species composition. However, it has some evidence of hydrologic alterations and is bisected by a railroad and bounded by a park road and areas converted to agriculture. One example of Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type) meets type-specific criteria of size, condition, and landscape context to be considered an exemplary occurrence by the Virginia Division of Natural Heritage. This example is in the Wilderness Battlefield, in the vicinity of Hamilton's Thicket, and covers 3.6 ha (9 ac) in two patches. The other seven natural communities occurring in Fredericksburg and Spotsylvania National Military Park do not meet the criteria to be considered Natural Heritage exemplary community occurrences. However, all native plant associations are an important part of the park's natural resources and should be targets for conservation and management.

Vegetation Map Production

The final vegetation map for Fredericksburg and Spotsylvania National Military Park depicts 21 map classes. The map classes represent 19 vegetation associations defined in the USNVC (five associations are part of two map classes), two nonstandard park-specific vegetation classes in disturbed or cultural areas, and three Anderson Level II land-use classes.

The Kappa index for the final vegetation map and errors of commission and omission reported for six map classes falls slightly below the USGS-NPS VMP protocol requirement of 80% (Table 12). Errors in the vegetation map were caused by several factors. The largest source of error was the difficulty in distinguishing certain species of deciduous hardwood trees on the aerial photography. Although the photography included both leaf-on and leaf-off conditions, none of the hardwood species were in spring anthesis at the time; therefore, hardwood species could only be distinguished by crown architecture and assumptions about correlated edaphic factors.

The greatest error occurred in distinguishing Acidic Oak - Hickory Forest from Mesic Mixed Hardwood Forest and Successional Tuliptree Forest. Often the amount of American beech (*Fagus grandifolia*) and/or tuliptree (*Liriodendron tulipifera*) within a given stand was difficult to distinguish in the aerial photography. The results of accuracy assessment showed that Mesic Mixed Hardwood Forest and Successional Tuliptree Forest are not as widespread as initially

mapped and that Acidic Oak - Hickory Forest is more common on lower slopes. Overall, the leaf-on photography was quite informative for mapping, but photography that captured either spring anthesis or fall senescence would have been more informative and would have likely led to a more accurate map.

Difficulty in distinguishing deciduous hardwood tree species on the aerial photography also contributed to error in the mapping of wetland types such as Coastal Plain / Piedmont Floodplain Forest. The non-tidal wetland forests typically occur in the park as narrow linear patches or other small areas adjacent to upland vegetation. Uncertainty in identifying the signature of canopy tree species led to some over mapping of wetland forest boundaries and an increase in map error.

Another possible source of error is that the base map for the final vegetation map is aerial photography flown in 2002. The vegetation in the park has likely changed since that time due to various park management projects and processes such as natural succession. For example, unmanaged Cultural Meadow areas could have succeeded into Successional Mixed Scrub. The vegetation in the park continues to change and could result in errors in the map since the vegetation polygons were based on 2002 aerial photography signatures. Despite these possible changes, the vegetation map produced by this project provides important baseline data for park resource managers.

Recommendations for Future Projects

Further study of the vegetation associations at Fredericksburg and Spotsylvania National Military Park should concentrate on the non-alluvial wetlands throughout the park. This includes the map classes Non-Riverine Saturated Forest, Coastal Plain Depression Wetland (Red Maple Sweetgum – Willow Oak Type), and Coastal Plain / Piedmont Acidic Seepage Swamp, all of which are classified as state or globally rare, and all of which have exemplary occurrences in the park. More information is needed on the full extent of each wetland type in the park, as well as on possible threats from invasive exotic species and nearby development. This type of study would provide park staff with the information needed to develop a long-term management plan for the rare wetland communities in the park and help ensure their protection into the future.

Additional work on specific threats to the natural communities in the park would also greatly contribute to natural resource management and protection. The most prevalent disturbances seen in the park during this study were exotic species invasion and reduced growth of ground layer vegetation from deer browse. As mentioned above, the most prevalent exotic species documented during this study are Japanese honeysuckle (*Lonicera japonica*), Nepalese browntop (*Microstegium vimineum*), multiflora rose (*Rosa multiflora*), and Chinese privet (*Ligustrum sinense*), but a number of other exotic species also occur in the park. Exotic species were found throughout the park, and are often more prevalent along mesic floodplains and other wetland forest stands and in disturbed/successional areas. Future work should focus on exotic species removal from later successional forests, such as Coastal Plain / Piedmont Floodplain Forest, to help maintain the integrity of more mature forest stands. Many typical herbaceous species were absent from stands of Acidic Oak – Hickory Forest. Deer browse can be a factor, reducing the vigor and reproduction of many woodland herbs. Future work should first focus on monitoring the impact of deer over time through controlled studies, such as with deer exclosures. This type

of study would provide important data on the extent of the deer impact on understory flora, which the park staff can then use to develop effective management plans.

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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

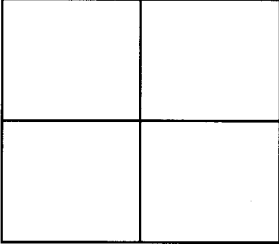
P.1

GENERAL INFORMATION PLOT: _____ Project: <u>Mid atlantic Veg mapping</u> Date: _____ Surveyors: _____		PLOT LOCATION Managed Area (Park): _____ Survey Site: _____ Quad: _____ County: _____ GPS unit: Garmin GPSMAP76 UTM zone: _____ Datum: <u>WGS 84</u> GPS pointname or file: _____ est accuracy: _____ m/ft # of sats fixed: _____ Reciever status: 2D / 3D / 2D WAAS / 3D WAAS																					
PLOT DOCUMENTATION Source Code: _____ Film Roll: _____ Frames: _____ Description of pic(s): _____		Field UTM X _____ E Y _____ N LAT _____ Long _____ Marked est. location on toposheet ____ yes																					
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																							
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																					
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 - interfluvie 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																					
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 nealq. 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 - hvygric (wet for most of growing season: permanent seepage/mottling) H - subhydic (water table at or near surface for most of the year) I - hydic (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		% Cover <table border="1" style="width:100%; border-collapse: collapse;"> <tr><td>bedrock</td><td></td></tr> <tr><td>boulders and stones</td><td></td></tr> <tr><td>gravel and cobbles</td><td></td></tr> <tr><td>litter / organic matter</td><td></td></tr> <tr><td>decaying wood</td><td></td></tr> <tr><td>water</td><td></td></tr> <tr><td>mineral soil / sand</td><td></td></tr> <tr><td>other</td><td></td></tr> <tr><td>(bryophytes and lichens)</td><td></td></tr> <tr><td>TOTAL</td><td>100%</td></tr> </table>		bedrock		boulders and stones		gravel and cobbles		litter / organic matter		decaying wood		water		mineral soil / sand		other		(bryophytes and lichens)		TOTAL	100%
bedrock																							
boulders and stones																							
gravel and cobbles																							
litter / organic matter																							
decaying wood																							
water																							
mineral soil / sand																							
other																							
(bryophytes and lichens)																							
TOTAL	100%																						
Cowardin System _____ Unland _____ 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	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; width: 50px;"></td> <td>GPS position</td> </tr> <tr> <td style="text-align: center;"></td> <td>centerline with bearing</td> </tr> <tr> <td style="text-align: center;"></td> <td></td> </tr> </table>		GPS position		centerline with bearing		
	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 Comments:

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 distribution 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.																	maximum CANOPY HEIGHT				m	
Stratum	T35+		T20-35		T10-20		T6-10		S1		S2		H		N		COLUMN VALUES:					
COVER CLASS																	T>35 = tree canopy > 35m (T1)					
Max Height m																	H = field layer (0-0.5 m)					
Phenology/ Growth form																	T20 = tree canopy 20-35m (T2)					
	D	ME	D	ME	D	ME	D	ME	D	ME	D	ME	Pt	F	B	LIC	N = nonvascular					
	MD	E	MD	E	MD	E	MD	E	MD	E	MD	E	G	W	MIXED		T10 = tree canopy 10-20m (T2)					
																	T6 = tree canopy 6-10m (T3)					
																	V = vines					
																	E = epiphytes					

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

[illegible]

*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

[illegible]

Appendix B. Accuracy assessment data form for the vegetation map of Fredericksburg and Spotsylvania National Military Park.

I. IDENTIFIERS AND LOCATION DATA

1. AA Point Code _AA_____ 2. Park Code: FRSP 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*)

FRSP 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

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 FREDERICKSBURG and SPOTSYLVANIA NATIONAL MILITARY 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 Fredericksburg and Spotsylvania National Military Park in 2002–2006.

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	<i>Ruellia caroliniensis</i>	Carolina wild petunia
Aceraceae	<i>Acer negundo</i>	boxelder
	<i>Acer platanoides</i>	Norway maple ^{c#}
	<i>Acer rubrum</i>	red maple
	<i>Acer saccharinum</i>	silver maple
	<i>Rhus copallinum</i>	flameleaf sumac
Anacardiaceae	<i>Toxicodendron radicans</i>	eastern poison ivy
	<i>Toxicodendron vernix</i>	poison sumac
Annonaceae	<i>Asimina triloba</i>	pawpaw
Apiaceae	<i>Cicuta maculata</i> var. <i>maculata</i>	spotted water hemlock
	<i>Oxypolis rigidior</i>	stiff cowbane
	<i>Sanicula canadensis</i>	Canadian blacksnakeroot
Apocynaceae	<i>Apocynum cannabinum</i>	Indianhemp
Aquifoliaceae	<i>Ilex opaca</i> var. <i>opaca</i>	American holly
	<i>Ilex verticillata</i>	common winterberry
Araceae	<i>Arisaema triphyllum</i>	Jack in the pulpit
	<i>Peltandra virginica</i>	green arrow arum
	<i>Symplocarpus foetidus</i>	skunk cabbage
Araliaceae	<i>Aralia spinosa</i>	devil's walkingstick
	<i>Hedera helix</i>	English ivy ^{c#}
Aristolochiaceae	<i>Aristolochia serpentaria</i>	Virginia snakeroot
Asclepiadaceae	<i>Asclepias variegata</i>	redring milkweed
Aspleniaceae	<i>Asplenium platyneuron</i>	ebony spleenwort
Asteraceae	<i>Achillea millefolium</i>	common yarrow
	<i>Ageratina altissima</i>	white snakeroot
	<i>Bidens aristosa</i>	bearded beggarticks
	<i>Doellingeria umbellata</i>	parasol whitetop
	<i>Elephantopus carolinianus</i>	Carolina elephantsfoot
	<i>Erechtites hieraciifolia</i> var. <i>hieraciifolia</i>	American burnweed
	<i>Eupatorium fistulosum</i>	trumpetweed
	<i>Eupatorium perfoliatum</i> var. <i>perfoliatum</i>	common boneset
	<i>Eurybia divaricata</i>	white wood aster
	<i>Hieracium venosum</i>	rattlesnakeweed
	<i>Lactuca biennis</i>	tall blue lettuce
	<i>Lactuca floridana</i>	woodland lettuce
	<i>Packera aurea</i>	golden ragwort
	<i>Prenanthes serpentaria</i>	cankerweed
	<i>Prenanthes trifoliolata</i>	gall of the earth
	<i>Rudbeckia laciniata</i>	cutleaf coneflower
	<i>Solidago caesia</i>	wreath goldenrod
	<i>Solidago juncea</i>	early goldenrod
	<i>Solidago rugosa</i>	wrinkleleaf goldenrod

Family	Scientific Name	Common Name
Asteraceae (cont.)	<i>Symphyotrichum dumosum</i> var. <i>dumosum</i>	rice button aster
	<i>Symphyotrichum lateriflorum</i>	calico aster
	<i>Verbesina alternifolia</i>	wingstem
	<i>Vernonia noveboracensis</i>	New York ironweed
Balsaminaceae	<i>Impatiens capensis</i>	jewelweed
Berberidaceae	<i>Podophyllum peltatum</i>	mayapple
Betulaceae	<i>Alnus serrulata</i>	hazel alder
	<i>Betula lenta</i>	sweet birch
	<i>Betula nigra</i>	river birch
	<i>Carpinus caroliniana</i>	American hornbeam
	<i>Corylus americana</i>	American hazelnut
	<i>Ostrya virginiana</i>	hophornbeam
	<i>Woodwardia areolata</i>	netted chainfern
	<i>Woodwardia virginica</i>	Virginia chainfern
Brassicaceae	<i>Alliaria petiolata</i>	garlic mustard ^{e#}
Campanulaceae	<i>Lobelia amoena</i> var. <i>glandulifera</i>	southern lobelia
	<i>Lobelia cardinalis</i>	cardinalflower
	<i>Lobelia spicata</i>	palespike lobelia
Caprifoliaceae	<i>Lonicera japonica</i>	Japanese honeysuckle ^{e#}
	<i>Sambucus nigra</i> ssp. <i>canadensis</i>	common elderberry
	<i>Symphoricarpos orbiculatus</i>	coralberry
	<i>Viburnum acerifolium</i>	mapleleaf viburnum
	<i>Viburnum dentatum</i>	southern arrowwood
	<i>Viburnum nudum</i>	possumhaw
	<i>Viburnum prunifolium</i>	blackhaw
	<i>Stellaria media</i>	common chickweed
Caryophyllaceae	<i>Euonymus americana</i>	strawberry bush
Celastraceae	<i>Clethra alnifolia</i>	coastal sweetpepperbush
Clusiaceae	<i>Hypericum hypericoides</i> ssp. <i>multicaule</i>	St. Andrew's cross
	<i>Hypericum punctatum</i>	spotted St. Johnswort
	<i>Triadenum virginicum</i>	Virginia marsh St. Johnswort
	<i>Triadenum walteri</i>	greater marsh St. Johnswort
Cornaceae	<i>Cornus amomum</i>	silky dogwood
	<i>Cornus florida</i>	flowering dogwood
	<i>Cornus foemina</i>	stiff dogwood
	<i>Juniperus virginiana</i> var. <i>virginiana</i>	eastern redcedar
Cyperaceae	<i>Carex abscondita</i>	thicket sedge
	<i>Carex albicans</i>	whitetinge sedge
	<i>Carex albicans</i> var. <i>albicans</i>	whitetinge sedge
	<i>Carex albolutescens</i>	greenwhite sedge
	<i>Carex amphibola</i>	eastern narrowleaf sedge
	<i>Carex atlantica</i> ssp. <i>atlantica</i>	prickly bog sedge
	<i>Carex blanda</i>	eastern woodland sedge
	<i>Carex comosa</i>	longhair sedge
	<i>Carex complanata</i>	hirsute sedge
	<i>Carex crinita</i>	fringed sedge
	<i>Carex debilis</i>	white edge sedge
	<i>Carex digitalis</i>	slender woodland sedge
	<i>Carex festucacea</i>	fescue sedge
	<i>Carex glaucoidea</i>	blue sedge

Family	Scientific Name	Common Name
Cyperaceae (cont.)	<i>Carex gracilescens</i>	slender looseflower sedge
	<i>Carex gracillima</i>	graceful sedge
	<i>Carex hirsutella</i>	fuzzy wuzzy sedge
	<i>Carex intumescens</i>	greater bladder sedge
	<i>Carex laevivaginata</i>	smoothsheath sedge
	<i>Carex laxiculmis</i> var. <i>laxiculmis</i>	spreading sedge
	<i>Carex laxiflora</i> var. <i>laxiflora</i>	broad looseflower sedge
	<i>Carex leptalea</i>	bristlystalked sedge
	<i>Carex lonchocarpa</i>	southern long sedge
	<i>Carex lupulina</i>	hop sedge
	<i>Carex lurida</i>	shallow sedge
	<i>Carex nigromarginata</i>	black edge sedge
	<i>Carex normalis</i>	greater straw sedge
	<i>Carex platyphylla</i>	broadleaf sedge
	<i>Carex prasina</i>	drooping sedge
	<i>Carex radiata</i>	eastern star sedge
	<i>Carex rosea</i>	rosy sedge
	<i>Carex seorsa</i>	weak stellate sedge
	<i>Carex squarrosa</i>	squarrose sedge
	<i>Carex stipata</i> var. <i>stipata</i>	owlfruit sedge
	<i>Carex styloflexa</i>	bent sedge
	<i>Carex swanii</i>	Swan's sedge
	<i>Carex tribuloides</i>	blunt broom sedge
	<i>Carex typhina</i>	cattail sedge
	<i>Carex virescens</i>	ribbed sedge
	<i>Carex willdenowii</i>	Willdenow's sedge
	<i>Eleocharis</i>	spikerush
Dennstaedtiaceae	<i>Dennstaedtia punctilobula</i>	eastern hayscented fern
	<i>Pteridium aquilinum</i>	western brackenfern
Dioscoreaceae	<i>Dioscorea oppositifolia</i>	Chinese yam ^{e#}
	<i>Dioscorea quaternata</i>	fourleaf yam
	<i>Dioscorea villosa</i>	wild yam
Dryopteridaceae	<i>Athyrium filix-femina</i>	common ladyfern
	<i>Onoclea sensibilis</i>	sensitive fern
	<i>Polystichum acrostichoides</i>	Christmas fern
Ebenaceae	<i>Diospyros virginiana</i>	common persimmon
Elaeagnaceae	<i>Elaeagnus umbellata</i> var. <i>parvifolia</i>	autumn olive ^{e#}
Ericaceae	<i>Gaylussacia baccata</i>	black huckleberry
	<i>Gaylussacia dumosa</i>	dwarf huckleberry*
	<i>Gaylussacia frondosa</i>	blue huckleberry
	<i>Kalmia latifolia</i>	mountain laurel
	<i>Leucothoe racemosa</i>	swamp doghobble
	<i>Lyonia ligustrina</i>	maleberry
	<i>Lyonia mariana</i>	piedmont staggerbush
	<i>Rhododendron periclymenoides</i>	pink azalea
	<i>Rhododendron viscosum</i>	swamp azalea
	<i>Vaccinium corymbosum</i>	highbush blueberry
	<i>Vaccinium formosum</i>	southern blueberry
	<i>Vaccinium fuscatum</i>	black highbush blueberry
	<i>Vaccinium pallidum</i>	Blue Ridge blueberry

Family	Scientific Name	Common Name
Ericaceae (cont.)	<i>Vaccinium stamineum</i>	deerberry
Euphorbiaceae	<i>Euphorbia corollata</i>	flowering spurge
Fabaceae	<i>Amphicarpaea bracteata</i>	American hogpeanut
	<i>Apios americana</i>	groundnut
	<i>Cercis canadensis</i> var. <i>canadensis</i>	eastern redbud
	<i>Desmodium nudiflorum</i>	nakedflower ticktrefoil
	<i>Lespedeza cuneata</i>	Chinese lespedeza ^{e#}
	<i>Robinia pseudoacacia</i>	black locust
Fagaceae	<i>Castanea dentata</i>	American chestnut
	<i>Castanea pumila</i> var. <i>pumila</i>	chinkapin
	<i>Fagus grandifolia</i>	American beech
	<i>Quercus alba</i>	white oak
	<i>Quercus coccinea</i>	scarlet oak
	<i>Quercus falcata</i>	southern red oak
	<i>Quercus marilandica</i>	blackjack oak
	<i>Quercus michauxii</i>	swamp chestnut oak
	<i>Quercus palustris</i>	pin oak
	<i>Quercus phellos</i>	willow oak
	<i>Quercus prinus</i>	chestnut oak
	<i>Quercus rubra</i>	northern red oak
	<i>Quercus shumardii</i>	Shumard's oak
	<i>Quercus stellata</i>	post oak
	<i>Quercus velutina</i>	black oak
Gentianaceae	<i>Bartonia virginica</i>	yellow screwstem
Hamamelidaceae	<i>Liquidambar styraciflua</i>	sweetgum
Iridaceae	<i>Hypoxis hirsuta</i>	common goldstar
	<i>Iris verna</i>	dwarf violet iris
	<i>Sisyrinchium angustifolium</i>	narrowleaf blue-eyed grass
Juglandaceae	<i>Carya alba</i>	mockernut hickory
	<i>Carya cordiformis</i>	bitternut hickory
	<i>Carya glabra</i>	pignut hickory
	<i>Carya ovalis</i>	red hickory
	<i>Juglans nigra</i>	black walnut
Juncaceae	<i>Juncus effusus</i>	common rush
	<i>Luzula acuminata</i>	hairy woodrush
	<i>Luzula bulbosa</i>	bulbous woodrush
	<i>Luzula echinata</i>	hedgehog woodrush
Lamiaceae	<i>Collinsonia canadensis</i>	richweed
	<i>Cunila origanoides</i>	common dittany
	<i>Lycopus virginicus</i>	Virginia water horehound
	<i>Pycnanthemum tenuifolium</i>	narrowleaf mountainmint
	<i>Salvia lyrata</i>	lyreleaf sage
	<i>Scutellaria elliptica</i>	hairy skullcap
	<i>Scutellaria integrifolia</i>	helmet flower
Lauraceae	<i>Lindera benzoin</i>	northern spicebush
	<i>Sassafras albidum</i>	sassafras
Liliaceae	<i>Allium vineale</i>	wild garlic ^{e#}
	<i>Maianthemum racemosum</i> ssp. <i>racemosum</i>	feathery false lily of the valley
	<i>Medeola virginiana</i>	Indian cucumber
	<i>Narcissus</i>	daffodil

Family	Scientific Name	Common Name
Liliaceae (cont.)	<i>Polygonatum biflorum</i>	smooth Solomon's seal
	<i>Uvularia perfoliata</i>	perfoliate bellwort
	<i>Uvularia sessilifolia</i>	sessileleaf bellwort
Lycopodiaceae	<i>Lycopodium digitatum</i>	fan clubmoss
	<i>Lycopodium obscurum</i>	rare clubmoss
Lythraceae	<i>Decodon verticillatus</i>	swamp loosestrife
Magnoliaceae	<i>Liriodendron tulipifera</i>	tuliptree
	<i>Magnolia virginiana</i>	sweetbay
Malvaceae	<i>Hibiscus</i>	rosemallow
Moraceae	<i>Morus rubra</i>	red mulberry
Nyssaceae	<i>Nyssa sylvatica</i>	blackgum
Oleaceae	<i>Chionanthus virginicus</i>	white fringetree
	<i>Fraxinus americana</i>	white ash
	<i>Fraxinus pennsylvanica</i>	green ash
	<i>Ligustrum sinense</i>	Chinese privet ^{ch}
Onagraceae	<i>Circaea lutetiana</i> ssp. <i>canadensis</i>	broadleaf enchanter's nightshade
Ophioglossaceae	<i>Botrychium dissectum</i>	cutleaf grapefern
	<i>Botrychium virginianum</i>	rattlesnake fern
	<i>Ophioglossum vulgatum</i>	southern adderstongue
Orchidaceae	<i>Cypripedium acaule</i>	moccasin flower
	<i>Galearis spectabilis</i>	showy orchid
	<i>Goodyera pubescens</i>	downy rattlesnake plantain
	<i>Isotria medeoloides</i>	green fiveleaf orchid*
	<i>Isotria verticillata</i>	purple fiveleaf orchid
	<i>Liparis liliifolia</i>	brown widelip orchid
	<i>Platanthera clavellata</i>	small green wood orchid
	<i>Tipularia discolor</i>	crippled crane-fly
Osmundaceae	<i>Osmunda cinnamomea</i> var. <i>cinnamomea</i>	cinnamon fern
	<i>Osmunda claytoniana</i>	interrupted fern
	<i>Osmunda regalis</i> var. <i>spectabilis</i>	royal fern
Oxalidaceae	<i>Oxalis stricta</i>	common yellow oxalis
	<i>Oxalis violacea</i>	violet woodsorrel
Papaveraceae	<i>Sanguinaria canadensis</i>	bloodroot
Phytolaccaceae	<i>Phytolacca americana</i>	American pokeweed
Pinaceae	<i>Pinus strobus</i>	eastern white pine
	<i>Pinus taeda</i>	loblolly pine
	<i>Pinus virginiana</i>	Virginia pine
Platanaceae	<i>Platanus occidentalis</i>	American sycamore
Poaceae	<i>Agrostis perennans</i>	upland bentgrass
	<i>Andropogon gerardii</i>	big bluestem*
	<i>Andropogon gyrans</i>	Elliott's bluestem
	<i>Andropogon virginicus</i>	broomsedge bluestem
	<i>Anthoxanthum odoratum</i>	sweet vernalgrass ^c
	<i>Brachyelytrum erectum</i>	bearded shorthusk
	<i>Bromus pubescens</i>	hairy woodland brome
	<i>Chasmanthium latifolium</i>	Indian woodoats
	<i>Chasmanthium laxum</i>	slender woodoats
	<i>Cinna arundinacea</i>	sweet woodreed
	<i>Dactylis glomerata</i>	orchardgrass ^{ch*}
	<i>Danthonia spicata</i>	poverty oatgrass

Family	Scientific Name	Common Name
Poaceae (cont.)	<i>Dichanthelium acuminatum</i>	tapered rosette grass
	<i>Dichanthelium boscii</i>	Bosc's panicgrass
	<i>Dichanthelium clandestinum</i>	deertongue
	<i>Dichanthelium commutatum</i>	variable panicgrass
	<i>Dichanthelium dichotomum</i>	cypress panicgrass
	<i>Elymus hystrix</i> var. <i>hystrix</i>	eastern bottlebrush grass
	<i>Elymus virginicus</i> var. <i>virginicus</i>	Virginia wildrye
	<i>Festuca subverticillata</i>	nodding fescue
	<i>Glyceria striata</i>	fowl mannagrass
	<i>Leersia oryzoides</i>	rice cutgrass
	<i>Leersia virginica</i>	whitegrass
	<i>Microstegium vimineum</i>	Nepalese browntop ^{e#}
	<i>Panicum</i>	panicgrass
	<i>Panicum anceps</i>	beaked panicgrass [*]
	<i>Panicum virgatum</i>	switchgrass [*]
	<i>Poa autumnalis</i>	autumn bluegrass
	<i>Poa cuspidata</i>	early bluegrass
	<i>Sorghastrum nutans</i>	Indiangrass [*]
	<i>Tridens flavus</i>	purpletop tridens [*]
Polygalaceae	<i>Polygala</i>	polygala
	<i>Polygonum arifolium</i>	halberdleaf tearthumb
	<i>Polygonum caespitosum</i> var. <i>longisetum</i>	oriental ladythumb ^{e#}
	<i>Polygonum sagittatum</i>	arrowleaf tearthumb
	<i>Polygonum virginianum</i>	jumpseed
Primulaceae	<i>Claytonia virginica</i>	Virginia springbeauty
	<i>Lysimachia ciliata</i>	fringed loosestrife
Pteridaceae	<i>Lysimachia quadrifolia</i>	whorled yellow loosestrife
	<i>Adiantum pedatum</i>	northern maidenhair
Pyrolaceae	<i>Chimaphila maculata</i>	striped prince's pine
	<i>Chimaphila umbellata</i> ssp. <i>cisatlantica</i>	pipsissewa
	<i>Pyrola americana</i>	American wintergreen
Ranunculaceae	<i>Aconitum uncinatum</i>	southern blue monkshood
	<i>Clematis virginiana</i>	devil's darning needles
	<i>Ranunculus abortivus</i>	littleleaf buttercup
	<i>Ranunculus recurvatus</i>	blisterwort
	<i>Thalictrum pubescens</i>	king of the meadow
Rosaceae	<i>Thalictrum thalictroides</i>	rue anemone
	<i>Agrimonia rostellata</i>	beaked agrimony
	<i>Amelanchier arborea</i>	common serviceberry
	<i>Geum canadense</i>	white avens
	<i>Malus angustifolia</i> var. <i>angustifolia</i>	southern crabapple
	<i>Photinia melanocarpa</i>	black chokeberry
	<i>Photinia pyrifolia</i>	red chokeberry
	<i>Potentilla simplex</i>	common cinquefoil
	<i>Prunus serotina</i> var. <i>serotina</i>	black cherry
	<i>Rosa carolina</i> var. <i>carolina</i>	Carolina rose
	<i>Rosa multiflora</i>	multiflora rose ^{e#}
	<i>Rosa palustris</i>	swamp rose
	<i>Rubus allegheniensis</i> var. <i>allegheniensis</i>	Allegheny blackberry
	<i>Rubus argutus</i>	sawtooth blackberry

Family	Scientific Name	Common Name
Rosaceae (cont.)	<i>Rubus flagellaris</i>	northern dewberry
	<i>Rubus hispidus</i>	bristly dewberry
	<i>Rubus pensilvanicus</i>	Pennsylvania blackberry
Rubiaceae	<i>Galium circaezans</i>	licorice bedstraw
	<i>Galium obtusum</i> ssp. <i>obtusum</i>	bluntleaf bedstraw
	<i>Galium pilosum</i>	hairy bedstraw
	<i>Galium triflorum</i>	fragrant bedstraw
	<i>Houstonia caerulea</i>	azure bluet
Rubiaceae (cont.)	<i>Houstonia purpurea</i> var. <i>purpurea</i>	Venus' pride
	<i>Mitchella repens</i>	partridgeberry
Salicaceae	<i>Salix nigra</i>	black willow
Santalaceae	<i>Comandra umbellata</i> ssp. <i>umbellata</i>	bastard toadflax
Scrophulariaceae	<i>Aureolaria virginica</i>	downy yellow false foxglove
	<i>Chelone glabra</i>	white turtlehead
	<i>Mimulus alatus</i>	sharpwing monkeyflower
Simaroubaceae	<i>Ailanthus altissima</i>	tree of heaven ^{c#}
Smilacaceae	<i>Smilax bona-nox</i>	saw greenbrier
	<i>Smilax glauca</i>	cat greenbrier
	<i>Smilax herbacea</i>	smooth carrionflower
	<i>Smilax pulverulenta</i>	downy carrionflower
	<i>Smilax rotundifolia</i>	roundleaf greenbrier
Sparganiaceae	<i>Sparganium americanum</i>	American bur-reed
Sphagnaceae	<i>Sphagnum</i>	sphagnum
Thelypteridaceae	<i>Phegopteris hexagonoptera</i>	broad beechfern
	<i>Thelypteris noveboracensis</i>	New York fern
	<i>Thelypteris palustris</i> var. <i>pubescens</i>	eastern marsh fern
Ulmaceae	<i>Celtis laevigata</i>	sugarberry
	<i>Celtis occidentalis</i>	common hackberry
	<i>Ulmus americana</i>	American elm
	<i>Ulmus rubra</i>	slippery elm
Urticaceae	<i>Boehmeria cylindrica</i>	smallspike false nettle
Verbenaceae	<i>Phryma leptostachya</i>	American lopseed
Violaceae	<i>Viola</i> × <i>primulifolia</i>	primrose-leaf violet
	<i>Viola cucullata</i>	marsh blue violet
	<i>Viola hirsutula</i>	southern woodland violet
	<i>Viola palmata</i>	early blue violet
	<i>Viola sororia</i>	common blue violet
Vitaceae	<i>Parthenocissus quinquefolia</i>	Virginia creeper
	<i>Vitis aestivalis</i>	summer grape
	<i>Vitis cinerea</i>	graybark grape
	<i>Vitis labrusca</i>	fox grape
	<i>Vitis rotundifolia</i>	muscadine
	<i>Vitis vulpina</i>	frost grape

^c 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 Fredericksburg and Spotsylvania National Military Park can be found in Table 13 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

USGS-NPS Vegetation Mapping Program
Fredericksburg and Spotsylvania National Military Park

	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 Shrub Swamp	nonstandard					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
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 a 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 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 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 to 20 occurrences state-wide, and/or covering less than 250 ha (618 ac) in aggregate; or covering 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 to 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 Qualifiers

? - 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 Fredericksburg and Spotsylvania National Military Park are listed in bold font.

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

	USNVC code	Aspect	Slope Inclination	Topographic 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
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

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	USNVC code	Aspect	Slope Inclination	Topographic Position	TRMI	% Bedrock	% Large Rocks	% Small Rocks	% Min. Soil	% Litter & Duff	% Wood	% Water	% NonVasc
Tidal 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	Ca:Mg Ratio	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
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

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	USNVC code	pH	N	P	S	Ca	Mg	K	Na	B	Fe	Mn	Cu	Zn	Al	CEC	TBS	OM	Ca:Mg Ratio	Fertility
Tidal 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 eight major vegetation groups present at Fredericksburg and Spotsylvania National Military Park.

Groups without joint plots had no significant environmental variables separating the vegetation associations.

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)
Seepage Wetlands (Figures G11–G13)
Alluvial Forests (Figures G14–G16)
Swamp Forests (Figures G17–G19)
Nonriverine Forests (Figures G20–G21)

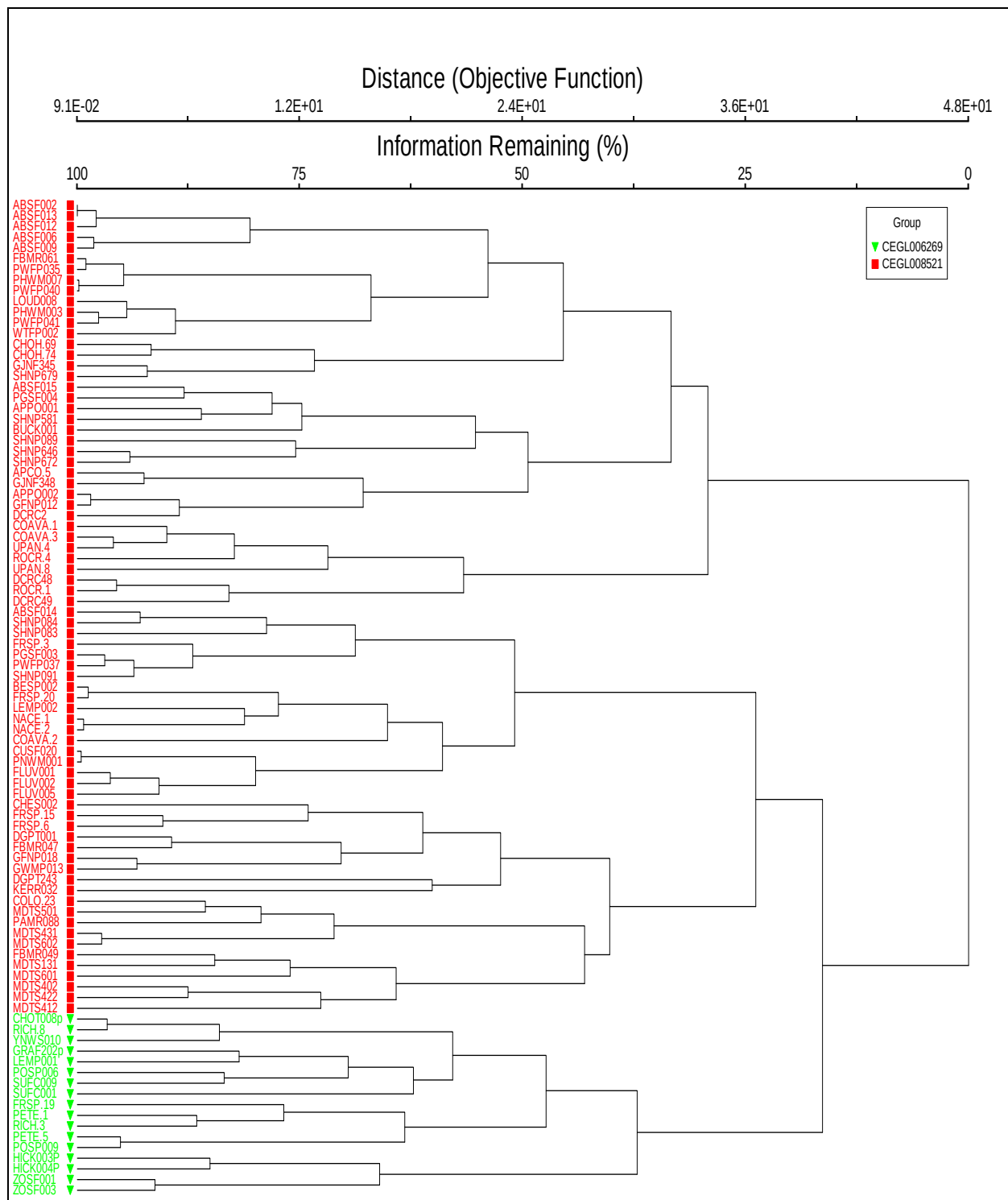


Figure G1. Dendrogram resulting from cluster analysis of species coverage data from 93 oak / heath forest plots. Plot membership in two oak / heath forest associations is shown. CEGL006269 = Coastal Plain Mixed Oak / Heath Forest; CEGL008521 = Piedmont / Low Elevation Mixed Oak / Heath Forest. Distance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

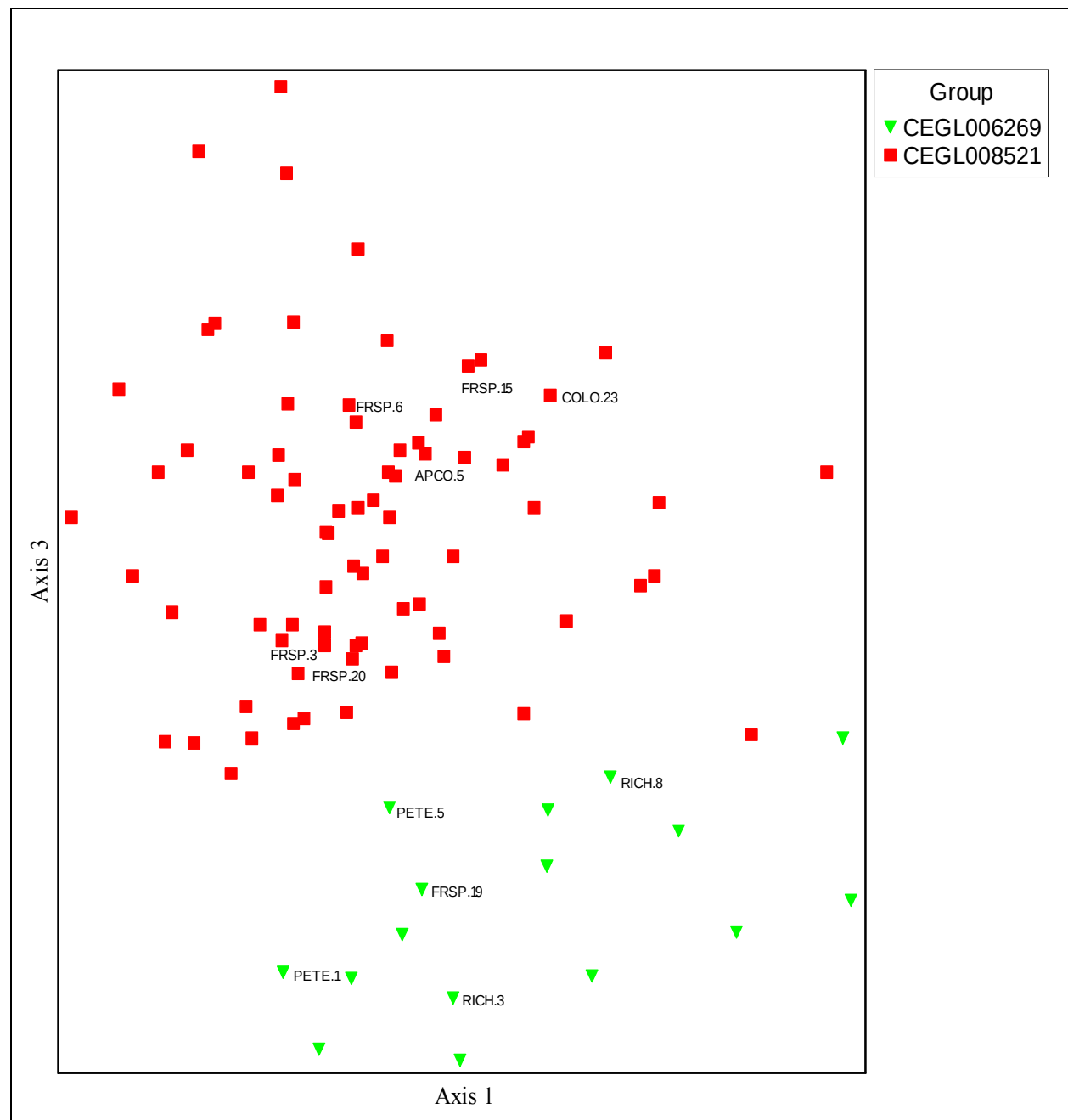


Figure G2. Scatterplot diagram for three-dimensional NMDS ordination of 92 oak/heath forest plots, showing Axis 1 and 3. Plot membership in two oak/heath forest associations is based on cluster analysis. CEGL006269 = Coastal Plain Mixed Oak / Heath Forest; CEGL008521 = Piedmont / Low Elevation Mixed 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.

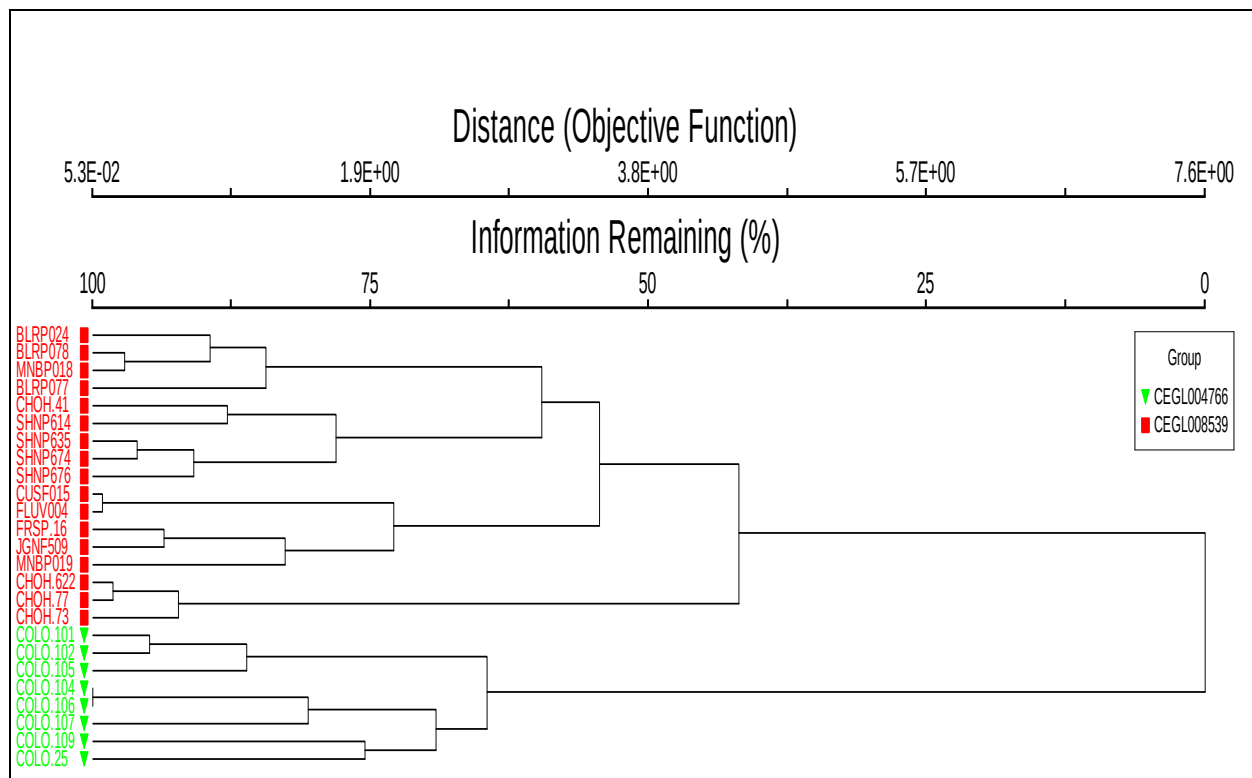


Figure G3. Dendrogram resulting from cluster analysis of species coverage data from 25 pine – oak forest plots. Plot membership in two pine – oak forest associations is shown. CEGL004766 = Coastal Plain Loblolly Pine - Oak Forest; CEGL008539 = Eastern White Pine - Hardwood Forest. Distance on the dendrogram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

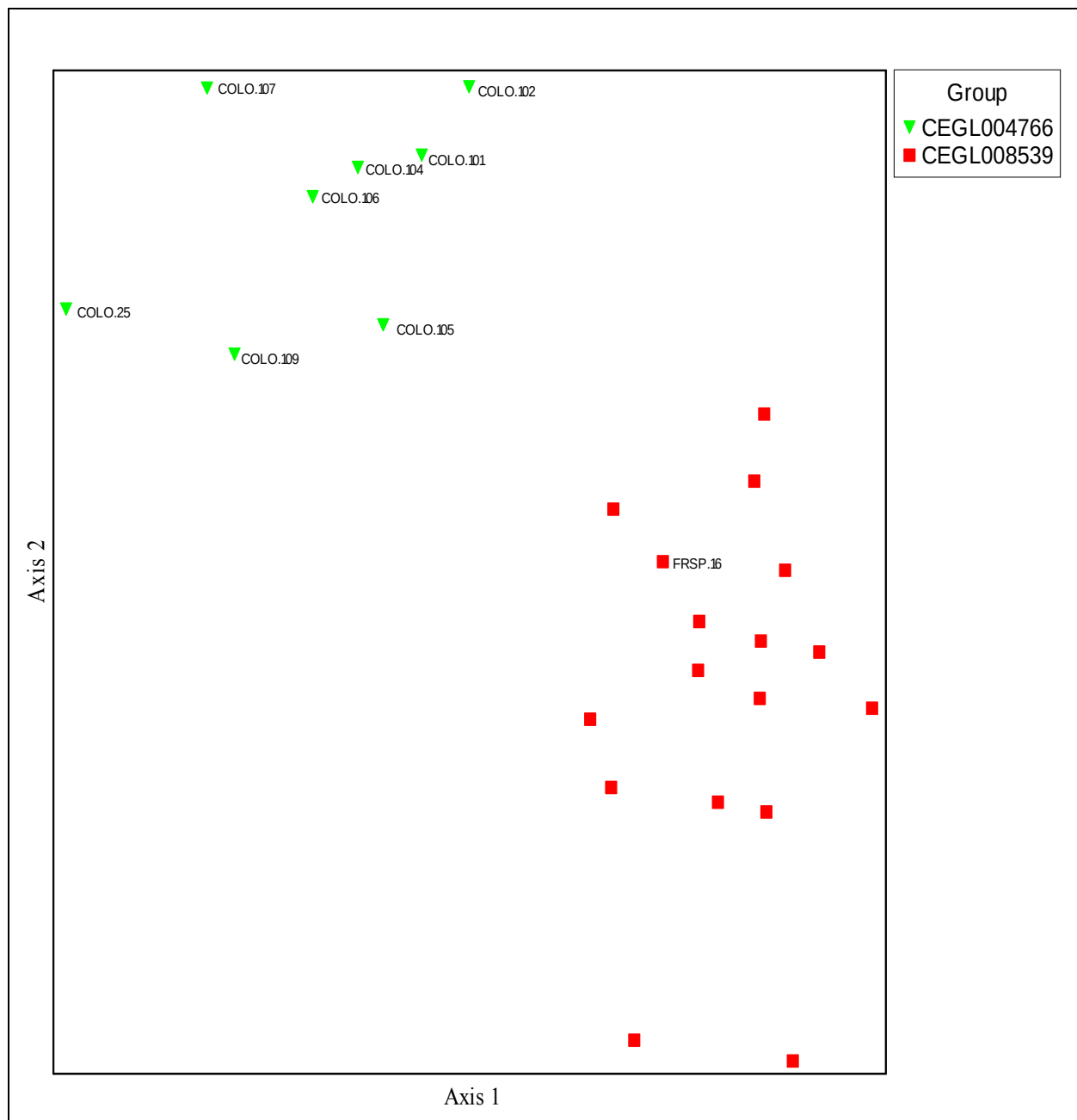


Figure G4. Scatterplot diagram for two-dimensional NMDS ordination of 25 pine – oak forest plots. Plot membership in two pine – oak forest associations is based on cluster analysis. CEGL004766 = Coastal Plain Loblolly Pine - Oak Forest; CEGL008539 = Eastern White Pine - Hardwood Forest. Plots from the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

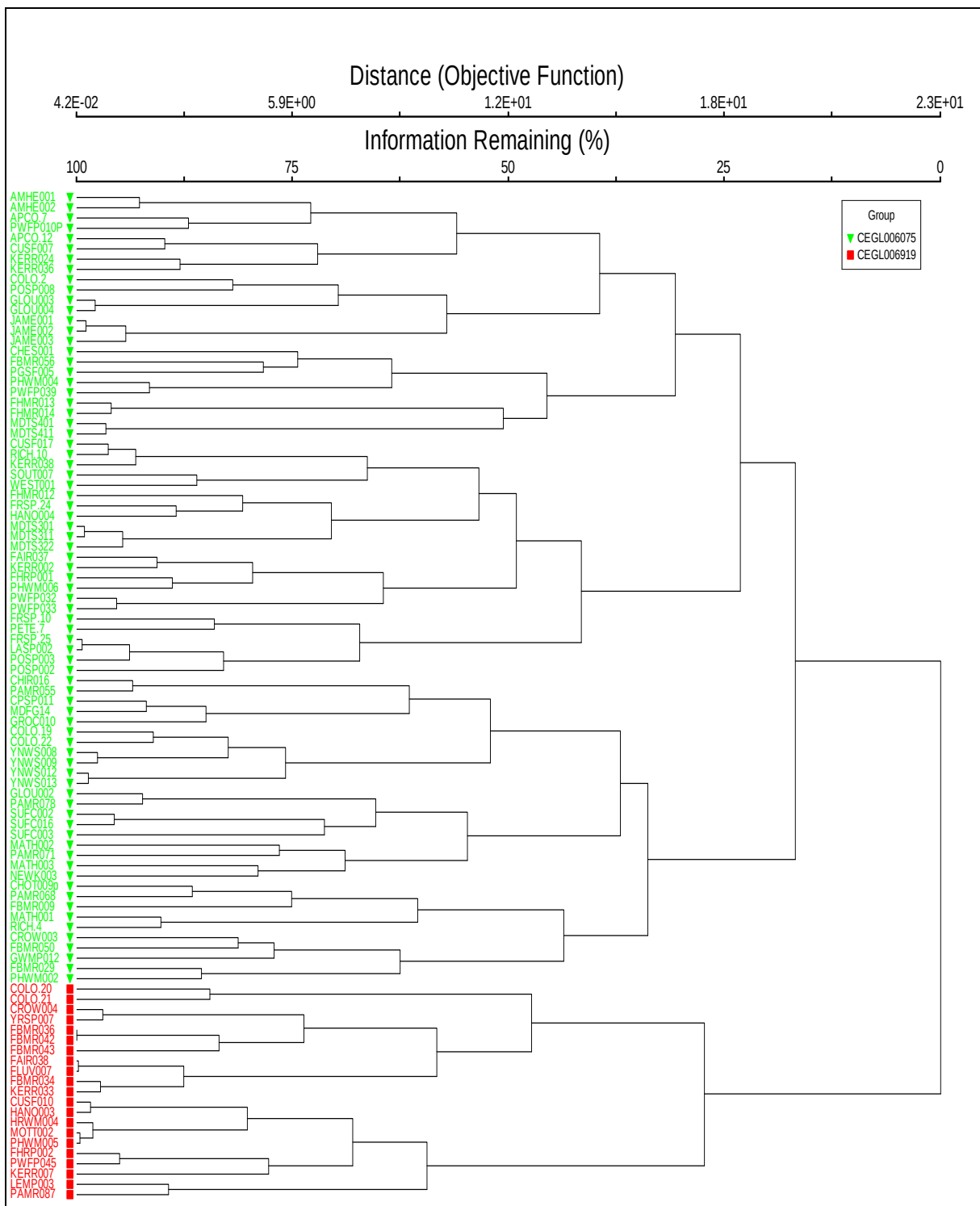


Figure G5. Dendrogram resulting from cluster analysis of species coverage data from 98 mesic acidic forest plots. Plot membership in two mesic acidic forest associations is shown. CEG006075 = Mesic Mixed Hardwood Forest; CEG006919 = Piedmont / Coastal Plain Oak – Beech / Heath Forest. Distance on the 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.

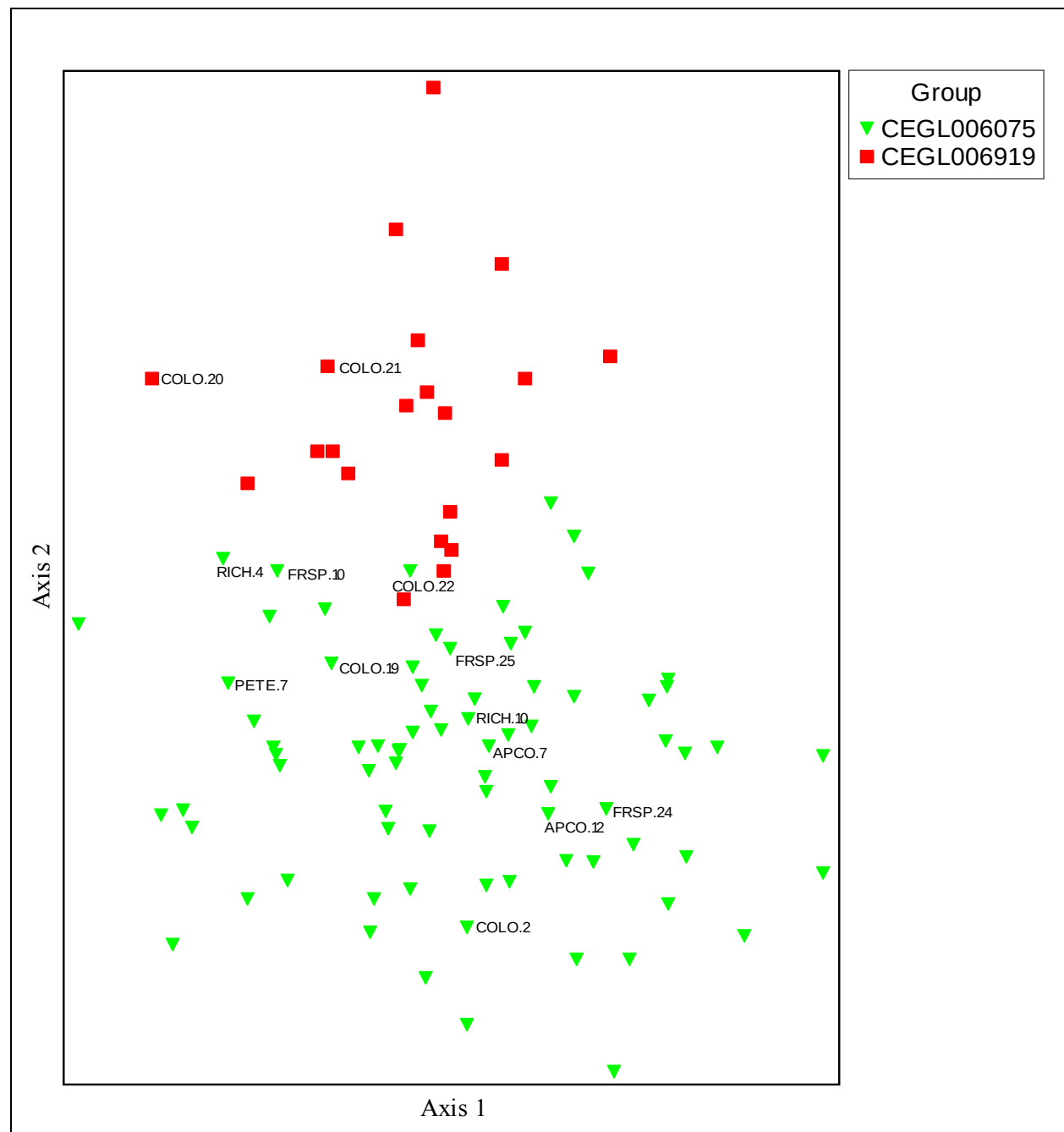


Figure G6. Scatterplot diagram for three-dimensional NMDS ordination of 98 mesic acidic forest plots, showing Axis 1 and 2. Plot membership in two mesic acidic forest associations is based on cluster analysis. CEGL006075 = Mesic Mixed Hardwood Forest; CEGL006919 = Piedmont / Coastal Plain Oak – Beech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

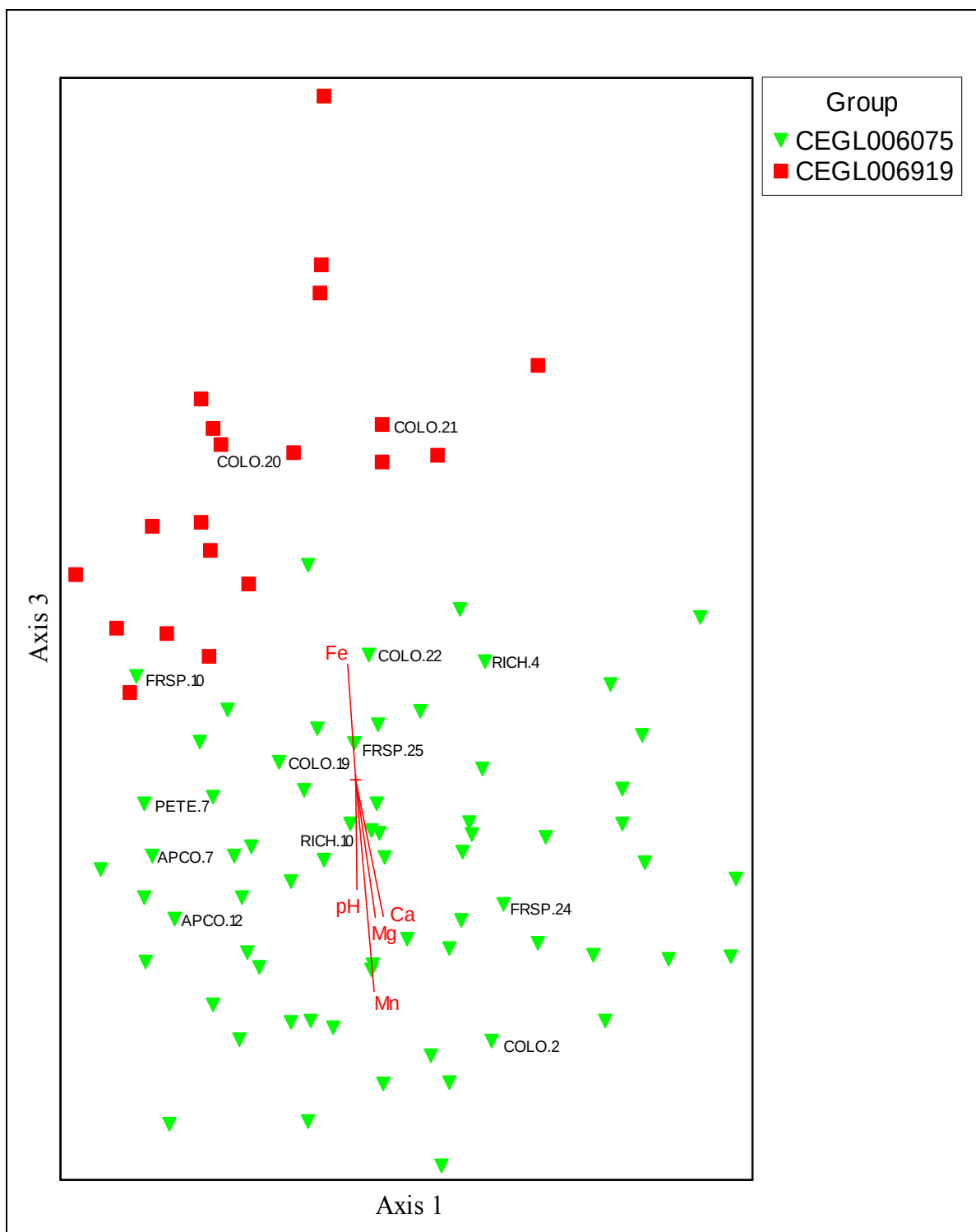


Figure G7. Joint plot showing significant correlations ($r^2 = 0.20$) of 19 soil variables with ordination scores for 87 mesic acidic forest plots on Axis 1 and Axis 3 of the NMDS ordination. The angles and lengths of the radiating lines indicate the direction and strength of the relationship. Environmental 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.

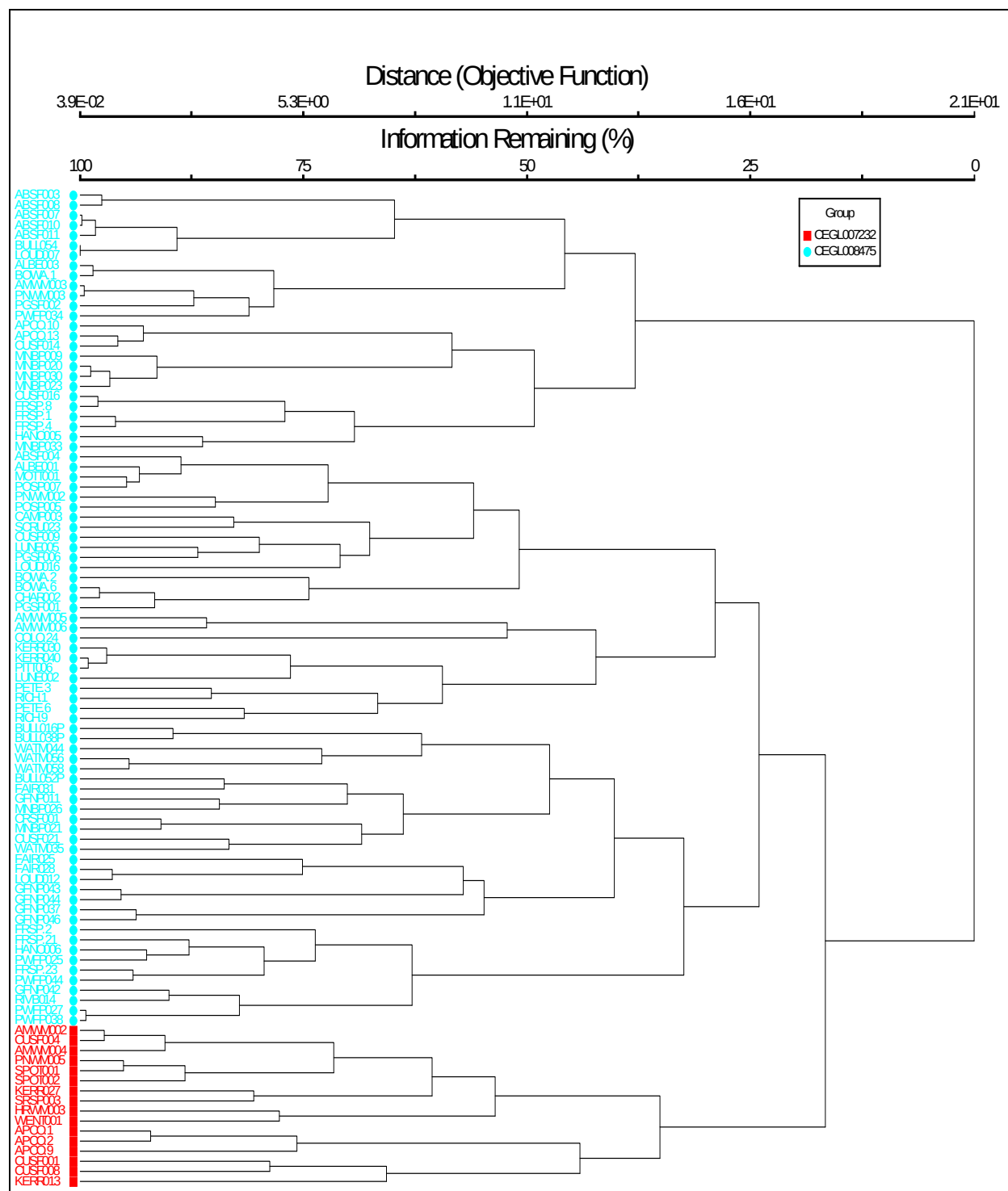


Figure G8. Dendrogram resulting from cluster analysis of species coverage data from 99 oak-hickory forest plots. Plot membership in two oak-hickory forest associations is shown. CEGL007232 = Basic Oak - Hickory Forest; CEGL008475 = Acidic Oak - Hickory Forest. Distance on the dendrogram scale is Wishart's 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.

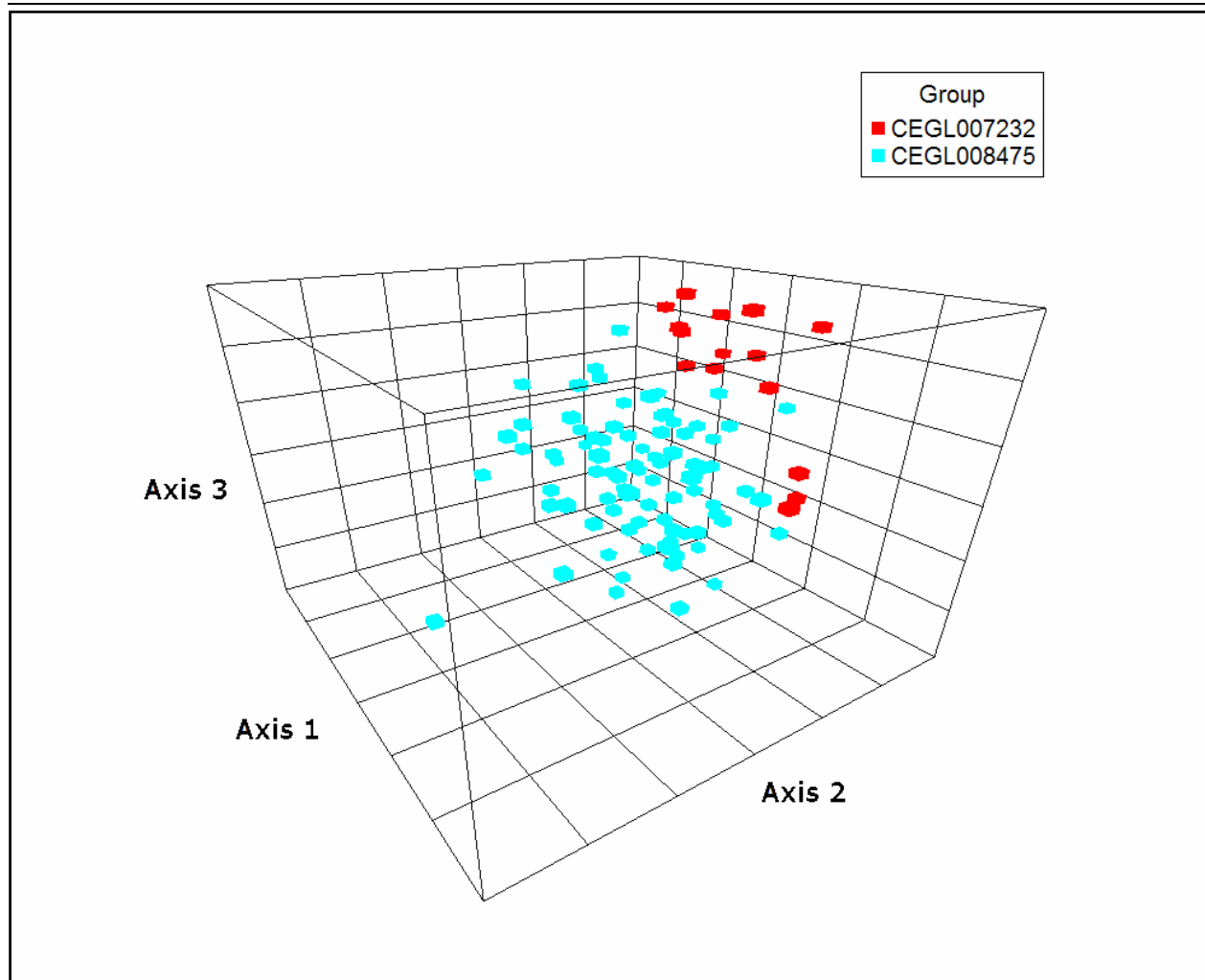


Figure G9. Scatterplot diagram for three-dimensional NMDS ordination of 98 oak-hickory forest plots. Plot membership in two oak-hickory forest associations is based on cluster analysis. CEGL007232 = Basic Oak - Hickory Forest; CEGL008475= Acidic Oak - Hickory Forest. One plot was determined to be an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

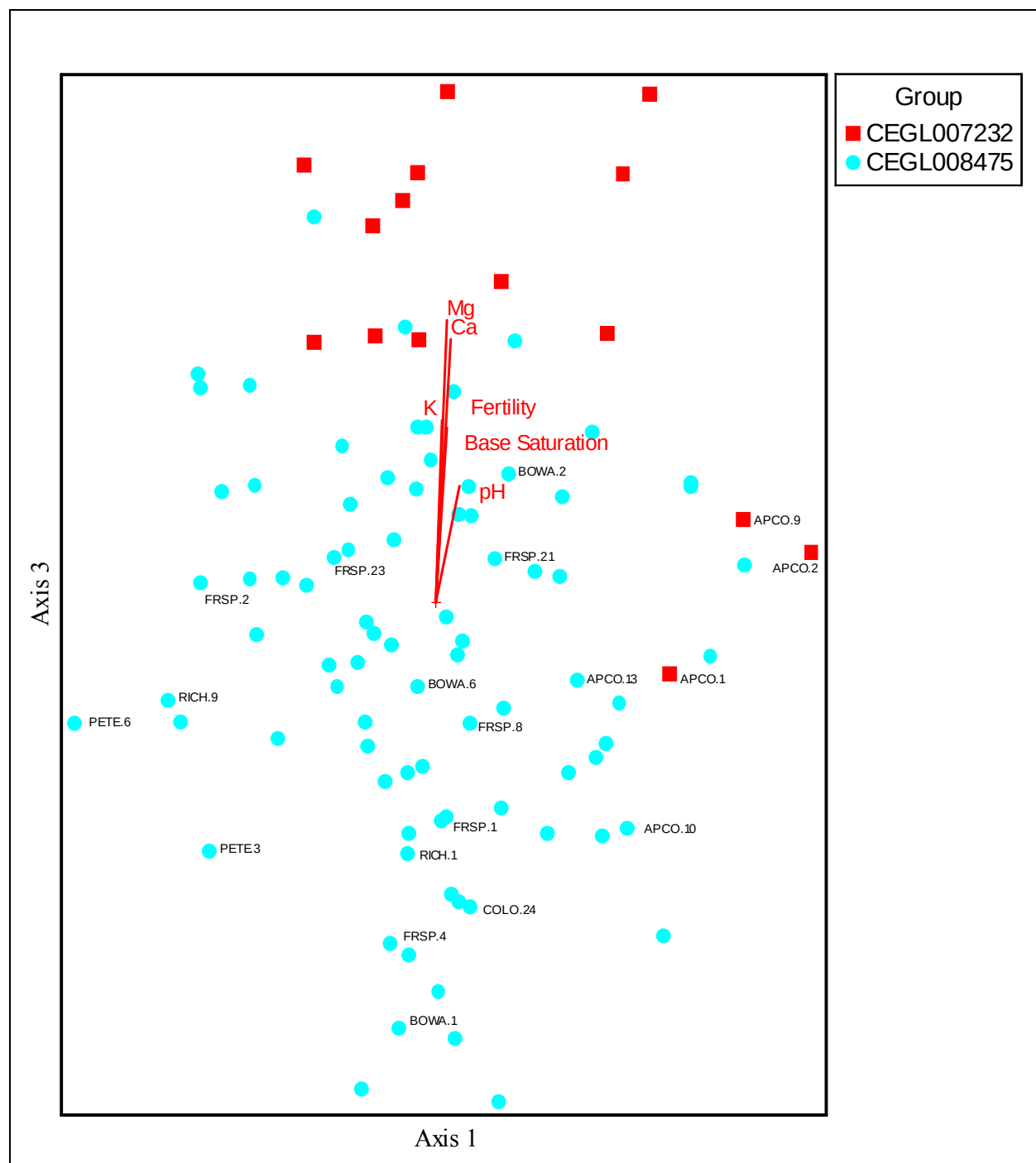


Figure G10. Joint plot showing significant correlations ($r^2 = 0.20$) of environmental variables with ordination scores for 98 oak-hickory forest plots on Axis 1 and Axis 3 of the NMDS ordination. The angles and lengths of the radiating lines indicate the direction and strength of the relationship. 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.

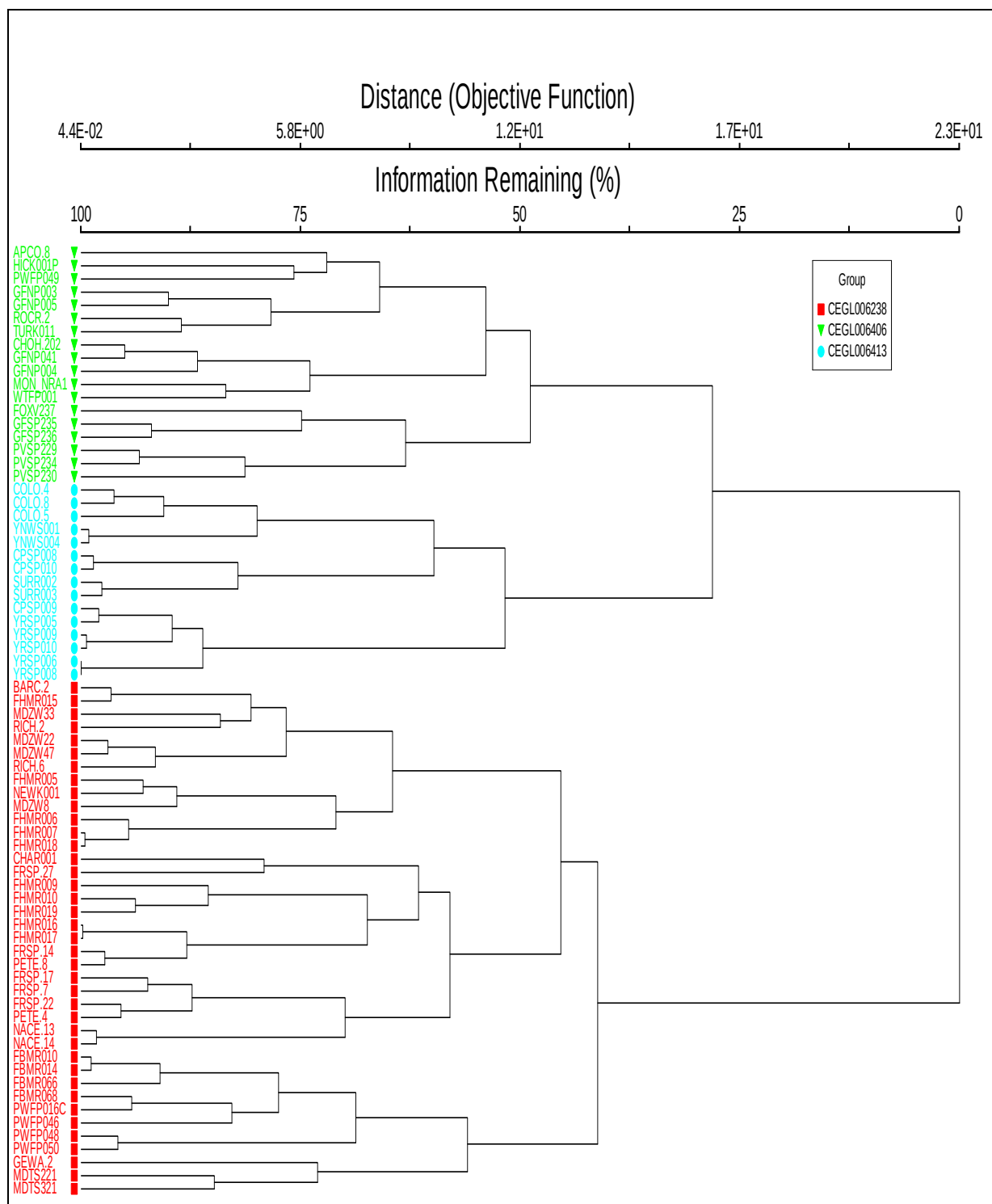


Figure G11. Dendrogram resulting from cluster analysis of species coverage data from 72 seepage wetland plots. Plot membership in three seepage wetland associations is shown. CEGLO06238 = Coastal Plain / Piedmont Acidic Seepage Swamp; CEGLO06406 = Northern Piedmont / Lower New England Basic Seepage Swamp; CEGLO06413 = Coastal Plain Calcareous Seepage Swamp. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

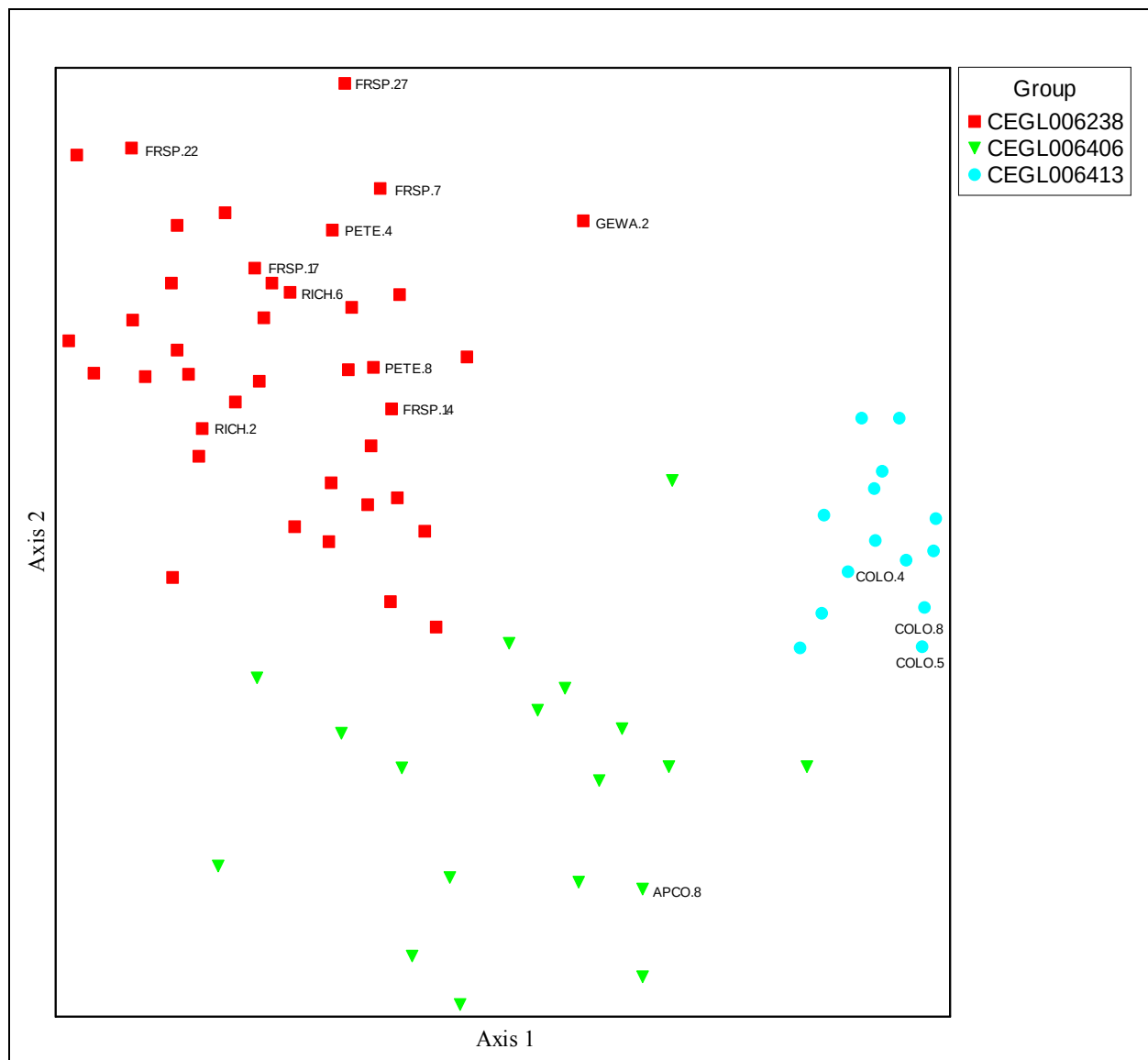


Figure G12. Scatterplot diagram for two-dimensional NMDS ordination of 71 seepage wetland plots. Plot membership in three seepage wetland associations is based on cluster analysis. CEGL006238 = Coastal Plain / Piedmont Acidic Seepage Swamp; CEGL006406 = Northern Piedmont / Lower New England Basic Seepage 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.

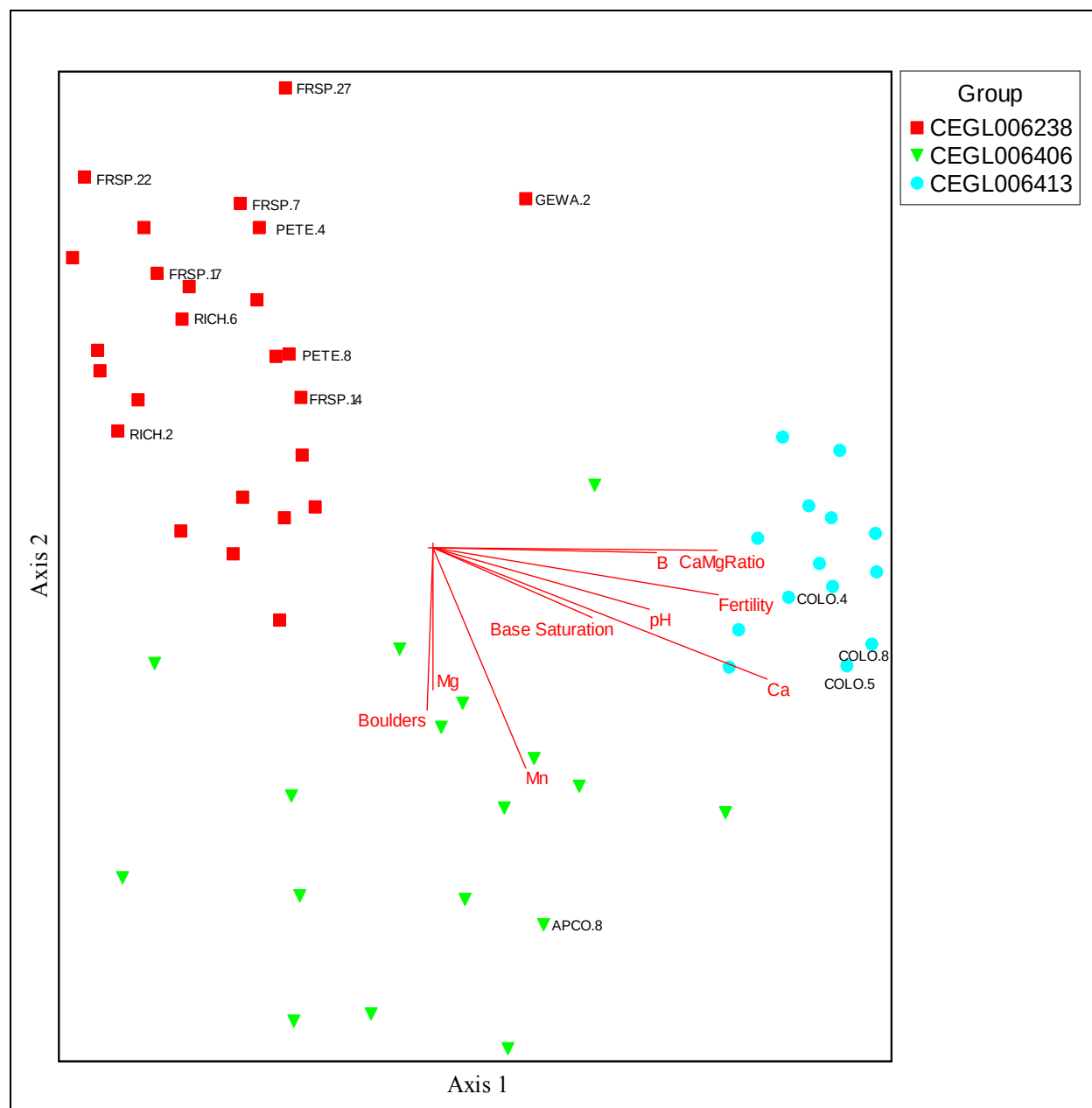


Figure G13. Joint plot showing significant correlations ($r^2 = 0.290$) of environmental variables with ordination scores for 56 seepage wetland plots on Axis 1 and Axis 2 of the NMDS ordination. The angles and lengths of the radiating lines indicate the direction and strength of the relationship. Environmental 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.

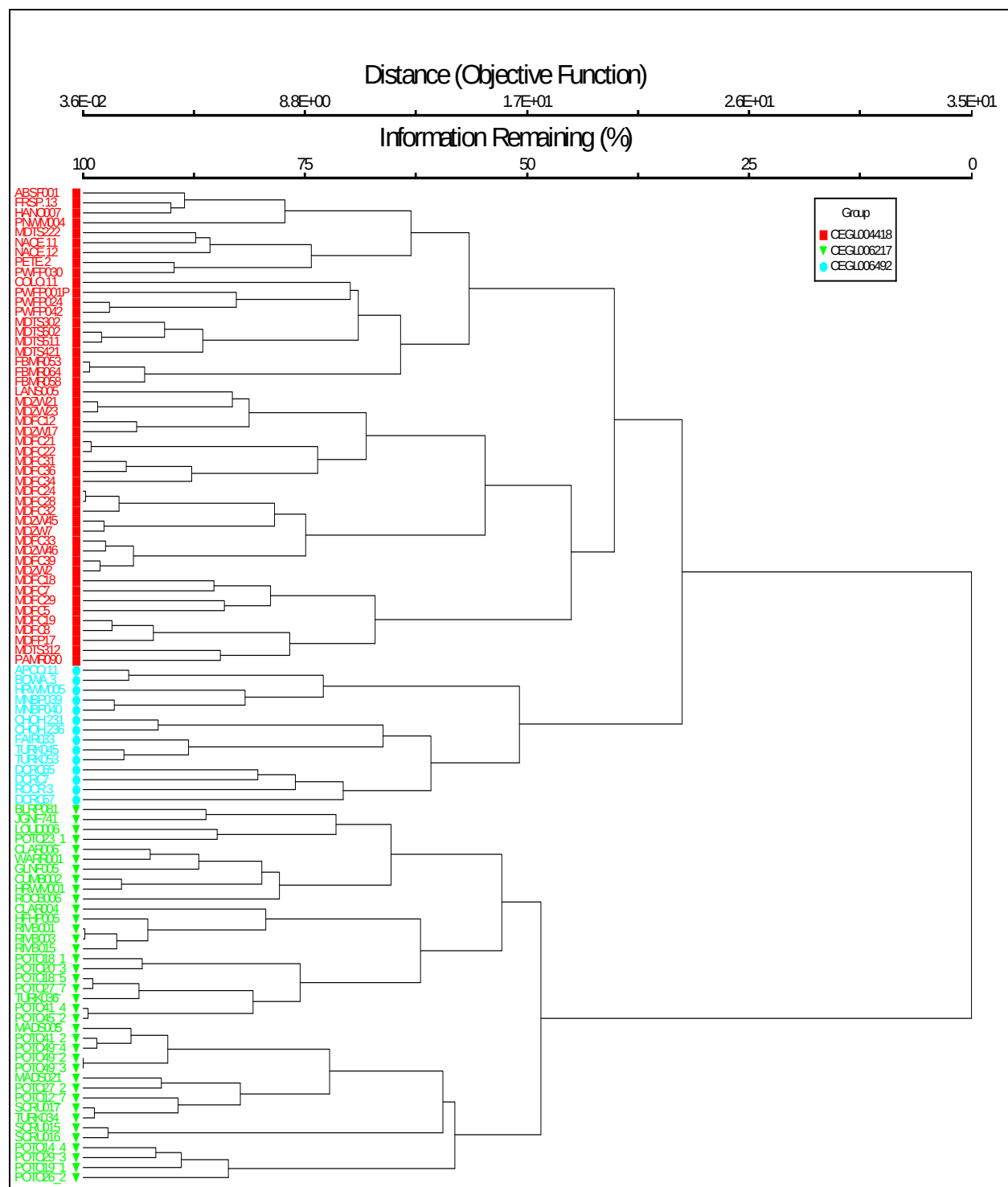


Figure G14. Dendrogram resulting from cluster analysis of species coverage data from 100 alluvial forest plots. Plot membership in three alluvial forest associations is shown. CEG004418 = Coastal Plain / Piedmont Small-Stream Floodplain Forest; CEG006217= Piedmont / Mountain Floodplain Forest; CEG006492= Piedmont / Mountain Alluvial Forest. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

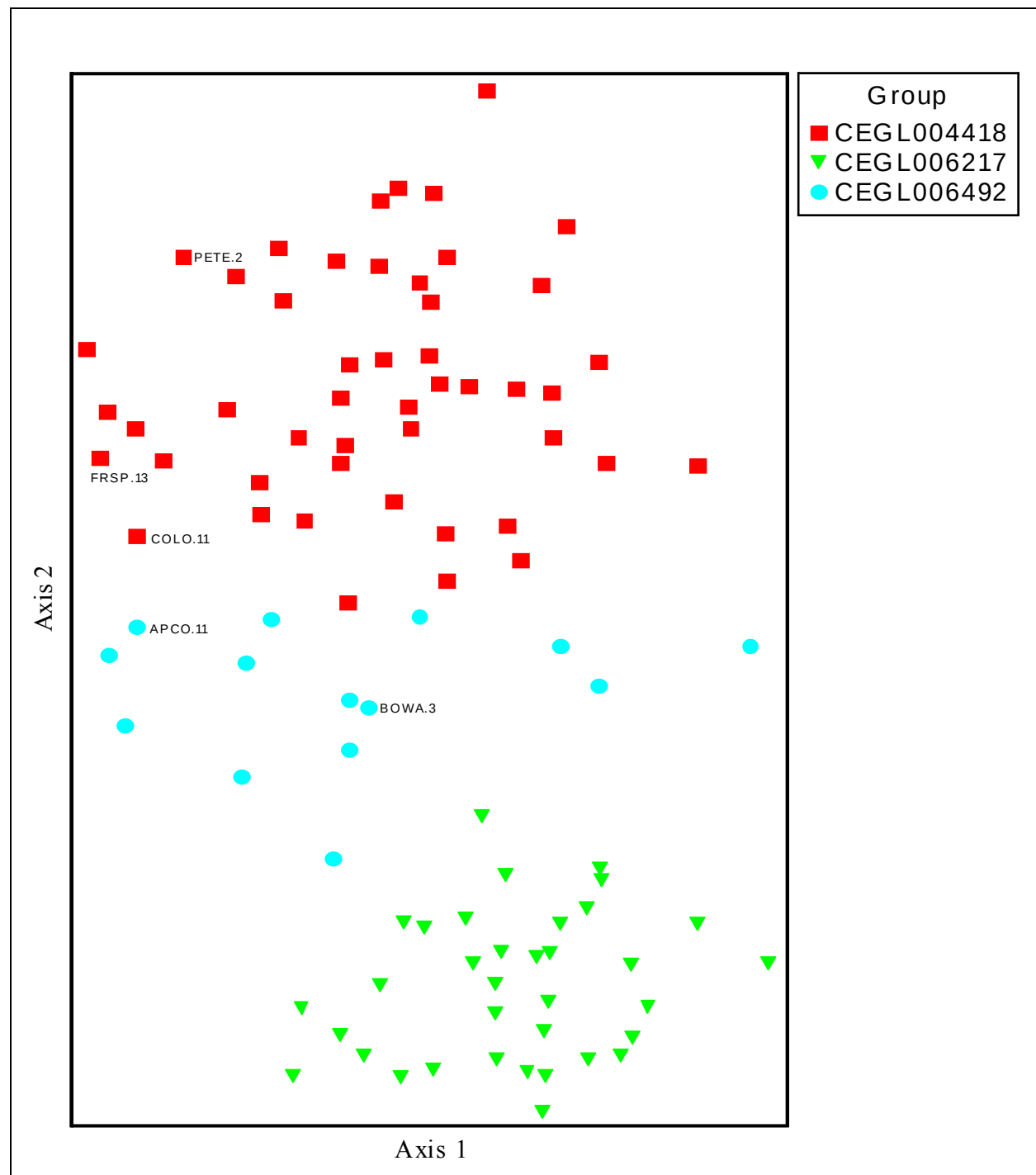


Figure G15. Scatterplot diagram for two-dimensional NMDS ordination of 97 alluvial forest plots. Plot membership in three alluvial forest associations is based on cluster analysis. CEGL004418 = Coastal Plain / Piedmont Small-Stream Floodplain Forest; CEGL006217= Piedmont / Mountain Floodplain Forest; 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.

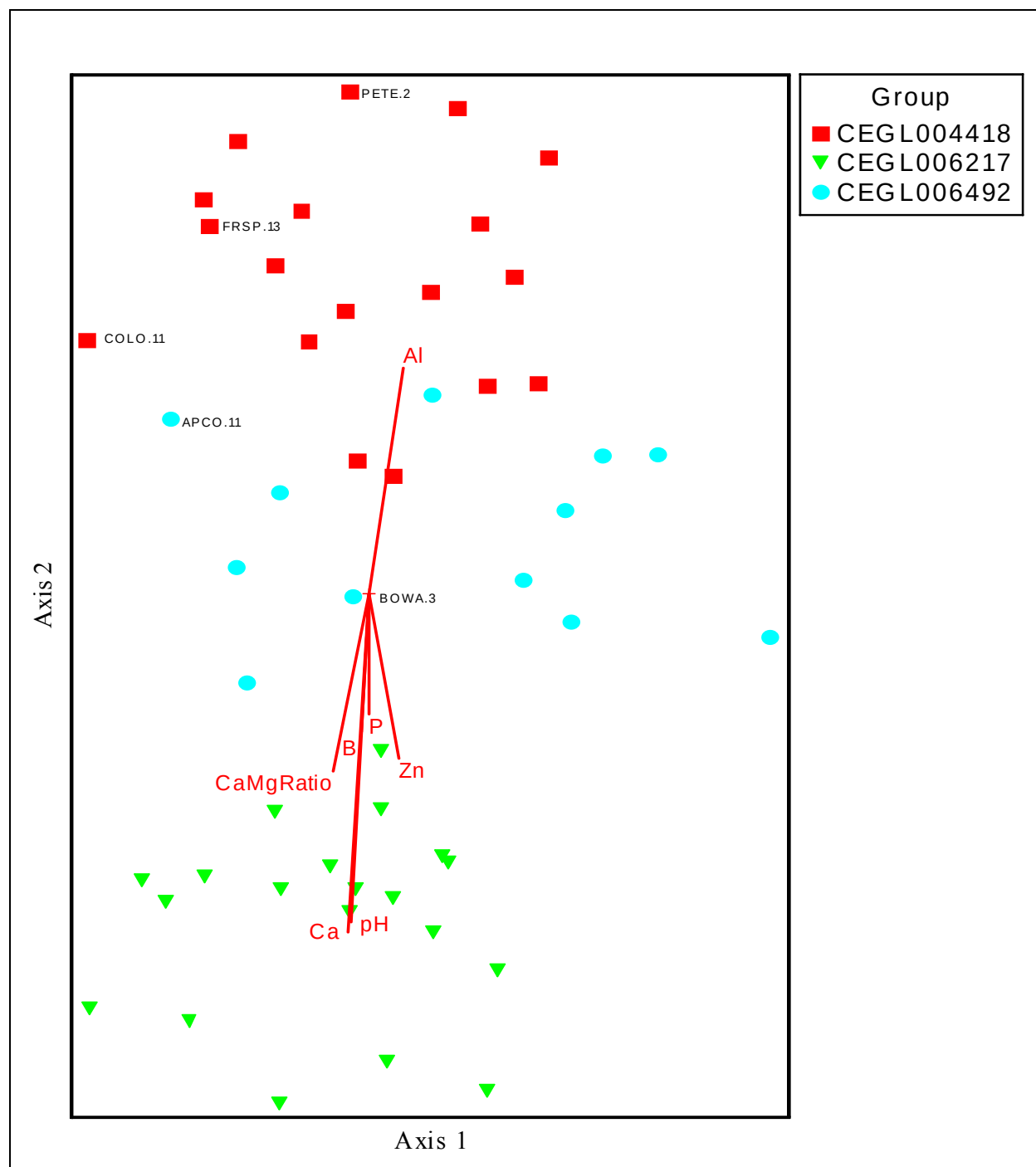


Figure G16. Joint plot showing significant correlations ($r^2 = 0.20$) of environmental variables with ordination scores for 50 alluvial forest plots on Axis 1 and Axis 2 of the NMDS ordination. The angles and lengths of the radiating lines indicate the direction and strength of the relationship. Environmental 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.

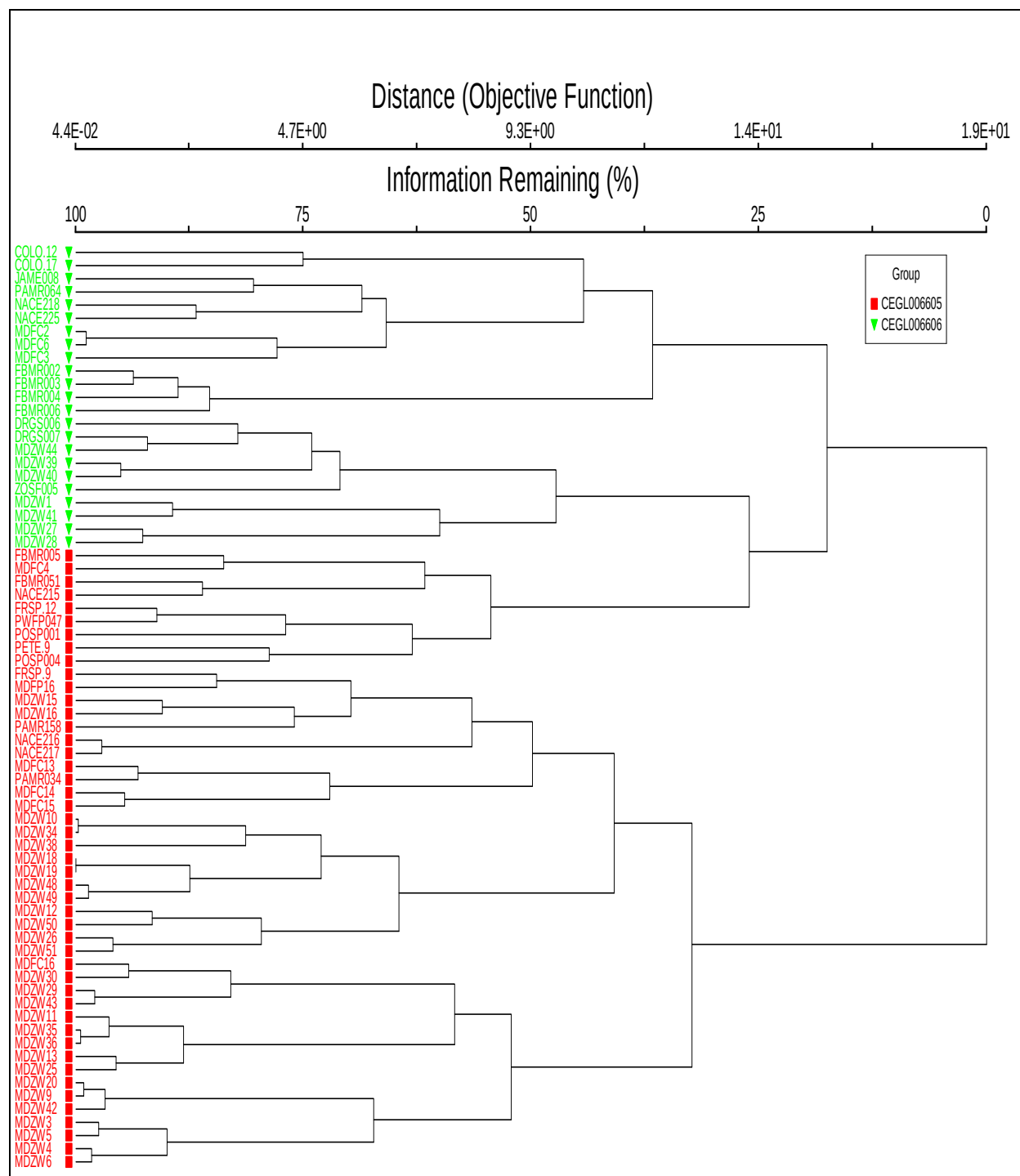


Figure G17. Dendrogram resulting from cluster analysis of species coverage data from 70 swamp forest plots. Plot membership in two swamp forest associations is shown. CEGL006605 = Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type); CEGL006606 = Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash – Red Maple Type). Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

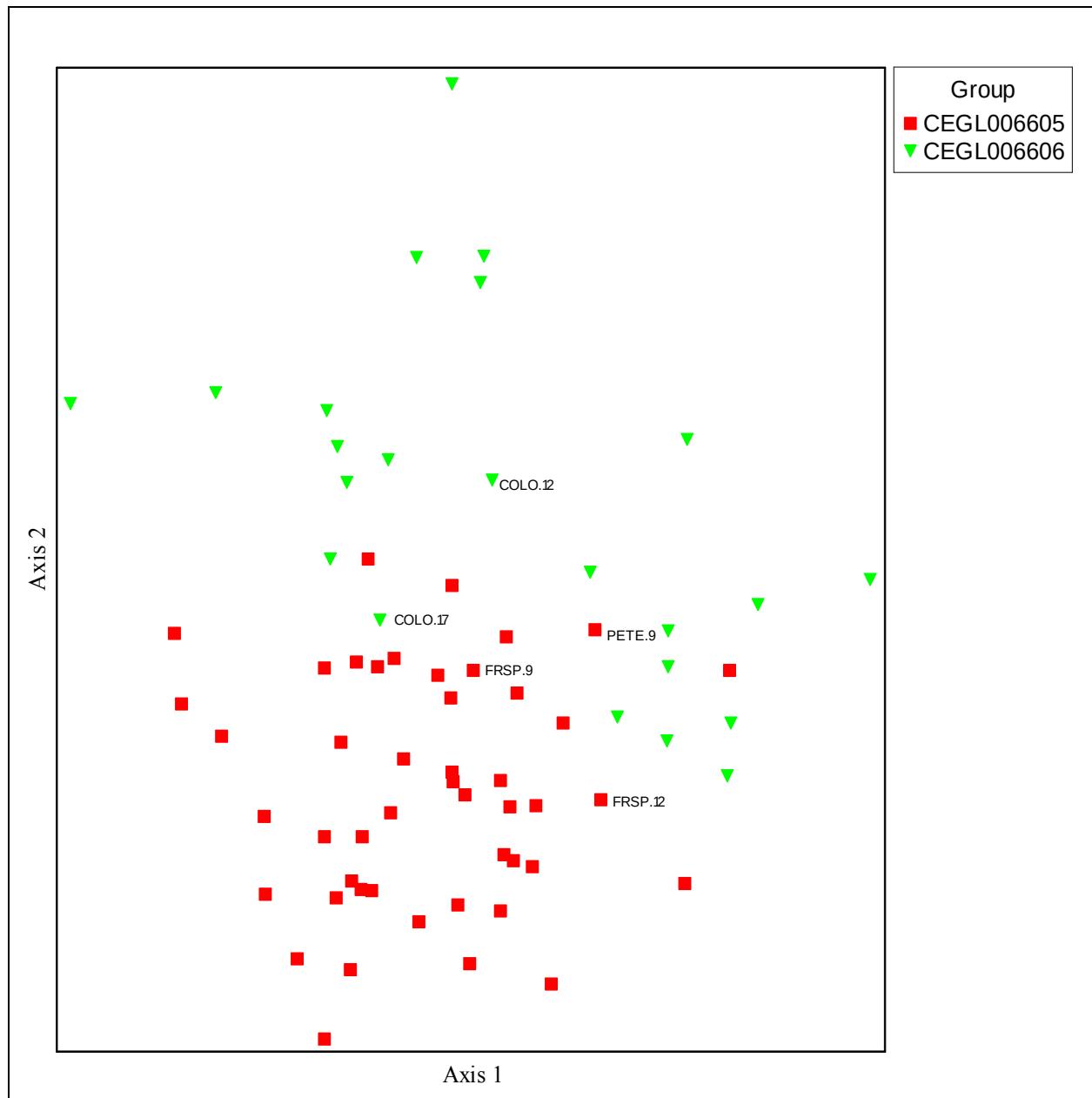


Figure G18. Scatterplot diagram for NMDS ordination of 70 swamp forest plots. Axis 1 and 2 are shown from a three-dimensional ordination. Plot membership in two swamp forest associations is based on cluster analysis. CEG006605 = Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type); CEG006606 = 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.

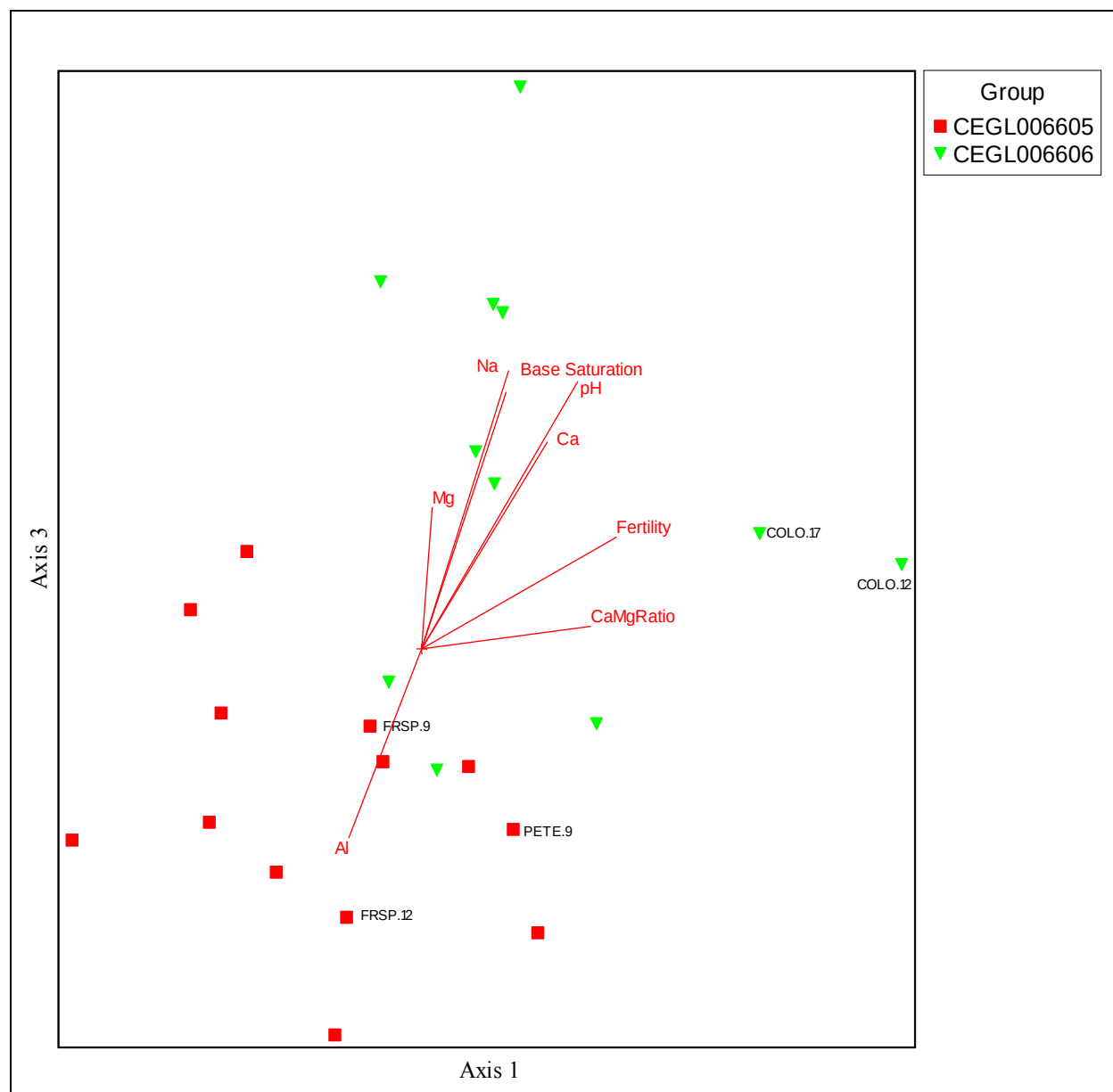


Figure G19. Joint plot showing significant correlations ($r^2 = 0.290$) of environmental variables with ordination scores for 70 swamp forest plots on Axis 1 and Axis 3 of the NMDS ordination. The angles and lengths of the radiating lines indicate the direction and strength of the relationship. Environmental 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.

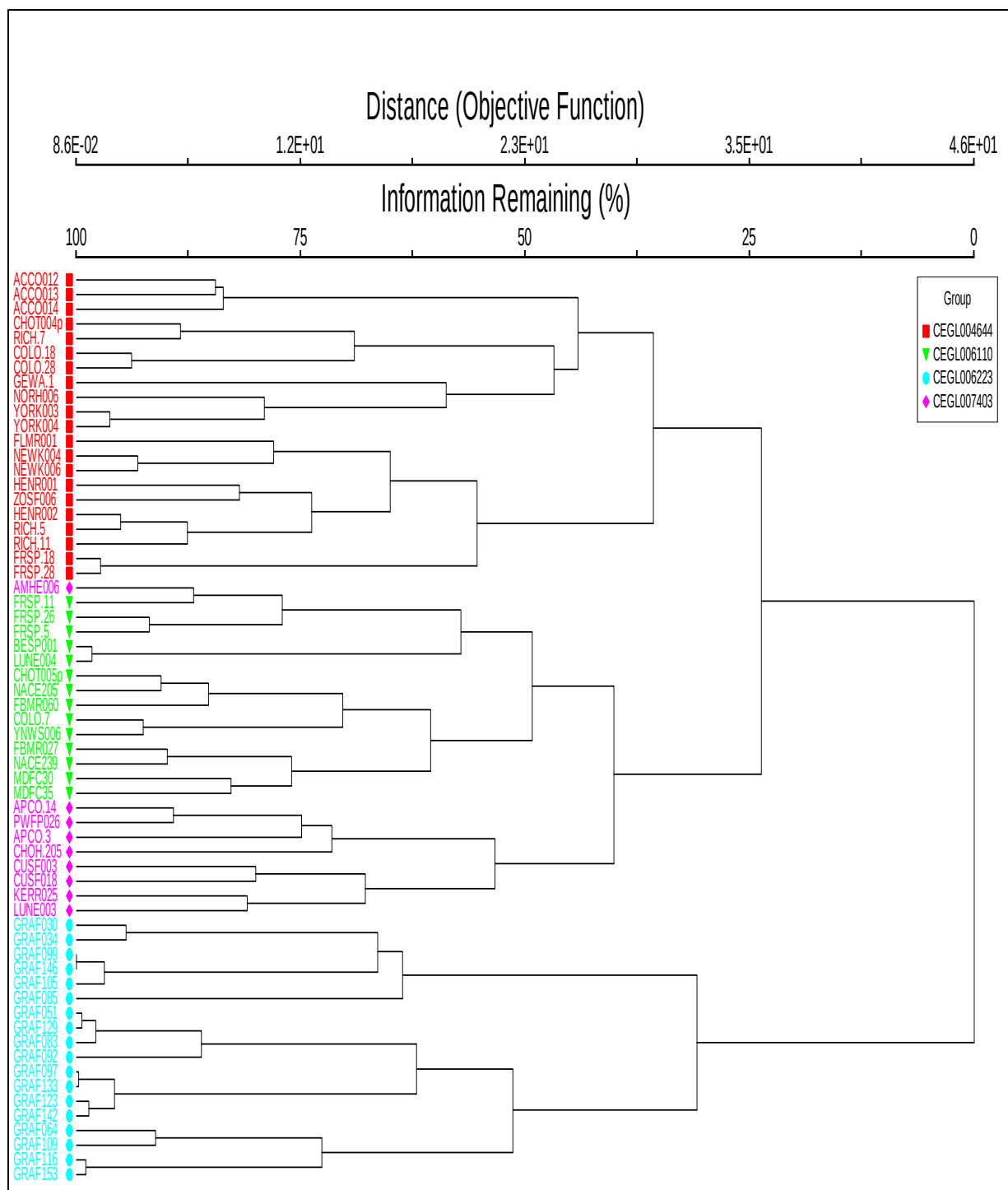


Figure G20. Dendrogram resulting from cluster analysis of species coverage data from 62 nonriverine forest plots. Plot membership in four nonriverine forest associations is shown. CEG004644 = Non-Riverine Saturated Forest; CEG006110 = Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type); CEG006223 = Coastal Plain Depression Wetland (Swamp Tupelo Type); CEG007403 = Upland Depression Swamp. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

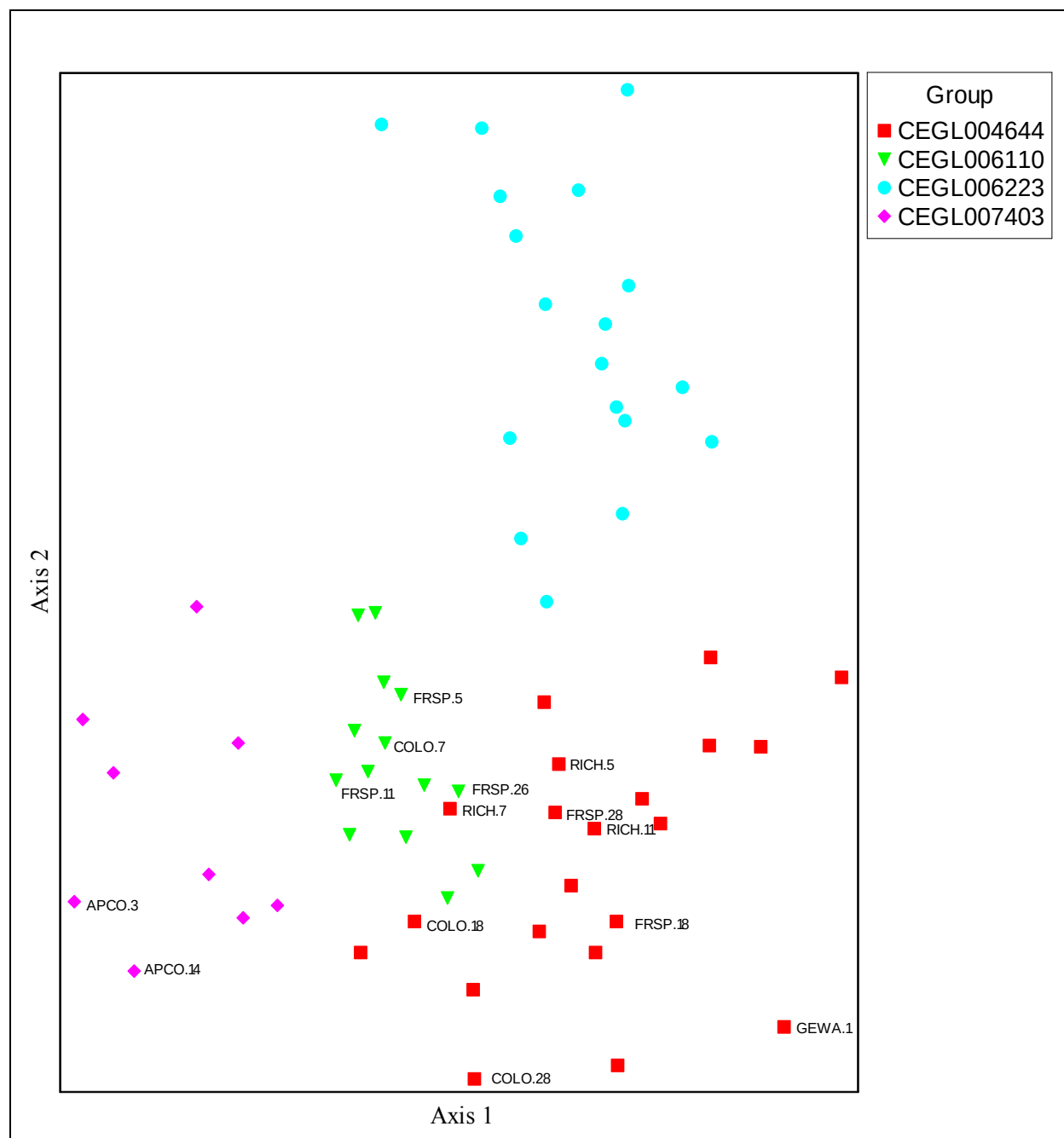


Figure G21. Scatterplot diagram for two-dimensional NMDS ordination of 62 nonriverine forest plots. Plot membership in four nonriverine forest associations is based on cluster analysis. CEGL004644 = Non-Riverine Saturated Forest; CEGL006110 = Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow 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.

Appendix H. Compositional summary statistics for vegetation associations within Fredericksburg and Spotsylvania National Military Park derived from the analysis of quantitative regional 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. 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 Acidic Seepage Swamp.....	Table H6
Coastal Plain / Piedmont Small-Stream Floodplain Forest	Table H7
Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type)....	Table H9
Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type)	Table H10
Coastal Plain Mixed Oak / Heath Forest	Table H1
Eastern White Pine-Hardwood Forest	Table H3
Mesic Mixed Hardwood Forest	Table H4
Non-Riverine Saturated Forest	Table H11
Piedmont / Low Elevation Mixed Oak / Heath Forest	Table H2
Piedmont / Mountain Floodplain Forest	Table H8

Table H1. Compositional summary statistics from the regional analysis of Coastal Plain Mixed Oak / Heath Forest (CEGL006269).

Mean Species Richness	27
Homogeneity	0.673
Number of Plots	18

Species	Total Freq	Total Mean Cover	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
<i>Gaylussacia frondosa</i>	63	2	7	+++++	100	29	29	22	914
<i>Quercus alba</i>	720	6	7	+	100	3	3	2	5
<i>Vaccinium pallidum</i>	527	4	5	+	100	3	3	2	7
<i>Acer rubrum</i>	1090	6	5	-	94	2	1	1	1
<i>Ilex opaca</i> var. <i>opaca</i>	575	4	6	++	89	3	2	2	10
<i>Vaccinium stamineum</i>	373	2	4	++	89	4	4	2	15
<i>Quercus falcata</i>	178	3	6	+++	83	8	7	5	56
<i>Quercus velutina</i>	428	4	6	++	83	4	3	2	12
<i>Nyssa sylvatica</i>	810	5	5	0	83	2	2	1	2
<i>Diospyros virginiana</i>	292	2	2	0	83	5	4	1	4
<i>Sassafras albidum</i>	520	3	2	-	78	3	2	0	1
<i>Vitis rotundifolia</i>	169	2	4	++	72	8	6	2	22
<i>Smilax glauca</i>	528	2	2	0	72	2	2	0	2
<i>Liquidambar styraciflua</i>	472	4	3	-	67	3	2	1	1
<i>Quercus coccinea</i>	212	4	5	+	61	5	3	2	6
<i>Cornus florida</i>	626	4	4	0	61	2	1	0	1
<i>Pinus taeda</i>	112	2	3	+	61	10	6	2	12
<i>Gaylussacia baccata</i>	224	4	4	0	56	4	2	1	2
<i>Amelanchier arborea</i>	387	2	2	0	56	3	1	0	1
<i>Carya pallida</i>	22	2	5	+++	44	36	16	9	129
<i>Fagus grandifolia</i>	630	6	5	-	44	1	1	0	0
<i>Carya alba</i>	410	4	3	-	44	2	1	0	0
<i>Juniperus virginiana</i> var. <i>virginiana</i>	353	2	3	+	39	2	1	0	2
<i>Castanea pumila</i> var. <i>pumila</i>	73	1	2	+	39	10	4	1	7
<i>Mitchella repens</i>	395	2	2	0	39	2	1	0	1
<i>Chimaphila maculata</i>	412	2	1	-	39	2	1	0	0
<i>Quercus phellos</i>	238	4	1	---	39	3	1	0	0

Table H2. 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)
<i>Nyssa sylvatica</i>	810	5	6	+	99	9	9	6	18
<i>Vaccinium pallidum</i>	528	4	6	++	97	14	13	9	53
<i>Acer rubrum</i>	1090	6	6	0	97	7	6	4	6
<i>Quercus alba</i>	721	6	7	+	93	10	9	7	18
<i>Gaylussacia baccata</i>	225	4	7	+++	89	29	26	20	209
<i>Sassafras albidum</i>	521	3	4	+	85	12	10	5	21
<i>Vaccinium stamineum</i>	373	2	5	+++	82	16	13	7	108
<i>Quercus velutina</i>	429	4	5	+	82	14	12	7	23
<i>Chimaphila maculata</i>	412	2	2	0	74	13	10	2	10
<i>Quercus coccinea</i>	212	4	6	++	70	25	17	11	69
<i>Quercus prinus</i>	396	5	7	++	69	13	9	7	36
<i>Smilax glauca</i>	528	2	2	0	66	9	6	1	6
<i>Amelanchier arborea</i>	388	2	4	++	61	12	7	3	28
<i>Pinus virginiana</i>	182	2	4	++	59	24	14	6	57
<i>Carya glabra</i>	437	4	4	0	58	10	6	3	6
<i>Smilax rotundifolia</i>	798	3	2	-	54	5	3	1	1
<i>Carya alba</i>	411	4	4	0	50	9	5	2	5
<i>Prunus serotina</i> var. <i>serotina</i>	620	2	2	0	50	6	3	1	3
<i>Ilex opaca</i> var. <i>opaca</i>	576	4	4	0	47	6	3	1	3
<i>Fagus grandifolia</i>	631	6	4	--	47	6	3	1	1
<i>Rhododendron periclymenoides</i>	275	2	3	+	46	12	6	2	11
<i>Cornus florida</i>	627	4	3	-	46	5	2	1	1
<i>Diospyros virginiana</i>	293	2	2	0	46	12	5	1	5
<i>Quercus falcata</i>	178	3	4	+	45	19	8	4	17
<i>Kalmia latifolia</i>	281	4	4	0	42	11	5	2	5

Table H3. Compositional summary statistics from the regional analysis of Eastern White Pine-Hardwood Forest (CEGL008539).

Mean Species Richness	36
Homoteneity	0.589
Number of Plots	17

Species	Total Freq	Total Mean Cover	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
<i>Pinus strobus</i>	159	3	7	++++	100	10	10	8	161
<i>Vaccinium stamineum</i>	233	2	4	++	100	7	7	3	27
<i>Acer rubrum</i>	564	5	6	+	88	2	2	1	4
<i>Vaccinium pallidum</i>	373	4	5	+	88	4	3	2	7
<i>Smilax rotundifolia</i>	370	2	3	+	88	4	3	1	7
<i>Quercus alba</i>	325	4	6	++	81	4	3	2	13
<i>Amelanchier arborea</i>	387	3	5	++	81	3	3	2	11
<i>Nyssa sylvatica</i>	378	4	5	+	81	3	3	2	6
<i>Carya glabra</i>	310	4	4	0	81	4	3	2	3
<i>Cornus florida</i>	360	4	4	0	81	4	3	1	3
<i>Quercus prinus</i>	533	6	6	0	75	2	2	1	2
<i>Quercus rubra</i>	612	5	6	+	75	2	1	1	3
<i>Chimaphila maculata</i>	264	2	2	0	69	4	3	1	3
<i>Polygonatum biflorum</i>	350	2	2	0	69	3	2	0	2
<i>Sassafras albidum</i>	430	3	4	+	63	2	1	1	3
<i>Prunus serotina</i> var. <i>serotina</i>	340	2	3	+	63	3	2	1	4
<i>Smilax glauca</i>	194	2	2	0	63	5	3	1	3
<i>Viburnum acerifolium</i>	312	2	3	+	56	3	2	1	3
<i>Maianthemum racemosum</i> ssp. <i>racemosum</i>	366	2	2	0	56	2	1	0	1
<i>Pinus virginiana</i>	152	2	5	+++	50	5	3	1	21
<i>Kalmia latifolia</i>	243	4	4	0	50	3	2	1	2
<i>Quercus velutina</i>	249	3	4	+	50	3	2	1	3
<i>Dioscorea quaternata</i>	329	2	2	0	50	2	1	0	1
<i>Carya alba</i>	194	3	4	+	44	4	2	1	3
<i>Rhododendron periclymenoides</i>	155	2	2	0	44	5	2	0	2
<i>Quercus coccinea</i>	110	3	4	+	38	5	2	1	4
<i>Dichanthelium dichotomum</i>	120	1	2	+	38	5	2	0	4
<i>Eurybia divaricata</i>	343	2	2	0	38	2	1	0	1
<i>Parthenocissus quinquefolia</i>	679	3	2	-	38	1	0	0	0
<i>Lysimachia quadrifolia</i>	71	1	1	0	38	8	3	0	3
<i>Hamamelis virginiana</i>	308	3	4	+	31	2	1	0	1
<i>Danthonia spicata</i>	195	2	2	0	31	3	1	0	1
<i>Juniperus virginiana</i> var. <i>virginiana</i>	120	2	2	0	31	4	1	0	1
<i>Mitchella repens</i>	91	1	2	+	31	5	2	0	3
<i>Potentilla canadensis</i>	163	2	2	0	31	3	1	0	1
<i>Vitis aestivalis</i>	257	2	2	0	31	2	1	0	1

Table H4. 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)
<i>Fagus grandifolia</i>	630	6	7	+	97	26	25	20	51
<i>Acer rubrum</i>	1090	6	6	0	92	14	13	9	13
<i>Liriodendron tulipifera</i>	753	5	6	+	92	21	19	13	38
<i>Parthenocissus quinquefolia</i>	899	2	2	0	89	17	15	3	15
<i>Quercus alba</i>	720	6	6	0	84	20	16	11	16
<i>Cornus florida</i>	626	4	5	+	82	22	18	10	37
<i>Quercus rubra</i>	668	5	6	+	77	20	15	10	30
<i>Nyssa sylvatica</i>	810	5	5	0	77	16	12	7	12
<i>Prunus serotina</i> var. <i>serotina</i>	619	2	2	0	75	21	15	3	15
<i>Toxicodendron radicans</i>	747	3	2	-	75	17	13	3	6
<i>Ilex opaca</i> var. <i>opaca</i>	575	4	5	+	73	22	16	9	31
<i>Polystichum acrostichoides</i>	414	3	4	+	71	29	20	9	41
<i>Maianthemum racemosum</i> ssp. <i>racemosum</i>	481	2	2	0	64	23	15	3	15
<i>Polygonatum biflorum</i>	462	2	2	0	63	23	15	3	15
<i>Smilax rotundifolia</i>	797	3	2	-	62	13	8	2	4
<i>Asimina triloba</i>	519	5	4	-	61	20	12	5	6
<i>Euonymus americanus</i>	433	2	2	0	61	24	15	3	15
<i>Smilax glauca</i>	528	2	2	0	60	19	12	3	12
<i>Carya alba</i>	410	4	4	0	58	24	14	6	14
<i>Carpinus caroliniana</i>	497	4	4	0	58	20	12	5	12
<i>Mitchella repens</i>	395	2	2	0	55	24	13	3	13
<i>Vaccinium pallidum</i>	527	4	2	--	52	17	9	2	2
<i>Carya glabra</i>	437	4	4	0	51	20	10	5	10
<i>Carex digitalis</i>	268	2	2	0	51	32	16	4	16
<i>Chimaphila maculata</i>	412	2	2	0	49	20	10	2	10
<i>Sassafras albidum</i>	520	3	2	-	49	16	8	2	4
<i>Desmodium nudiflorum</i>	307	2	2	0	48	27	13	3	13
<i>Viburnum acerifolium</i>	319	2	3	+	46	24	11	4	22
<i>Galium circaezans</i>	384	2	2	0	45	20	9	2	9
<i>Dioscorea quaternata</i>	339	2	2	0	45	22	10	2	10
<i>Fraxinus americana</i>	509	4	2	--	45	15	7	1	2
<i>Lonicera japonica</i>	516	2	2	0	44	14	6	1	6
<i>Liquidambar styraciflua</i>	472	4	4	0	42	15	6	3	6
<i>Quercus velutina</i>	428	4	4	0	42	17	7	3	7
<i>Vitis vulpina</i>	384	2	2	0	40	18	7	2	7
<i>Lindera benzoin</i>	456	4	3	-	39	14	6	2	3
<i>Amelanchier arborea</i>	387	2	2	0	36	16	6	1	6
<i>Quercus prinus</i>	396	5	5	0	34	15	5	3	5
<i>Epifagus virginiana</i>	107	1	2	+	34	54	18	4	37
<i>Carex albicans</i>	290	2	2	0	33	19	6	1	6
<i>Medeola virginiana</i>	175	1	2	+	29	28	8	2	16
<i>Eurybia divaricata</i>	236	2	2	0	28	20	6	1	6

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

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

Table H6. Compositional summary statistics from the regional analysis of Coastal Plain / Piedmont Acidic Seepage Swamp (CEGL006238).

Mean Species Richness	43
Homoteneity	0.589
Number of Plots	39

Species	Total Freq	Total Mean Cover	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
<i>Acer rubrum</i>	1090	6	7	+	97	3	3	3	7
<i>Nyssa sylvatica</i>	810	5	6	+	97	5	4	3	9
<i>Smilax rotundifolia</i>	797	3	3	0	95	5	4	1	4
<i>Mitchella repens</i>	395	2	2	0	95	9	9	2	9
<i>Osmunda cinnamomea</i>	129	2	5	+++	92	27	25	14	200
<i>Ilex opaca</i> var. <i>opaca</i>	575	4	5	+	92	6	6	3	11
<i>Viburnum nudum</i>	73	2	5	+++	89	47	42	23	333
<i>Magnolia virginiana</i>	87	2	6	++++	84	37	31	21	496
<i>Liriodendron tulipifera</i>	753	5	5	0	82	4	3	2	3
<i>Ilex verticillata</i>	194	2	4	++	74	14	11	5	43
<i>Lycopus virginicus</i>	179	1	2	+	68	15	10	2	20
<i>Woodwardia areolata</i>	73	2	4	++	66	34	23	10	90
<i>Leersia virginica</i>	201	2	3	+	66	12	8	3	16
<i>Lindera benzoin</i>	456	4	4	0	63	5	3	1	3
<i>Medeola virginiana</i>	175	1	2	+	63	14	9	2	17
<i>Vaccinium corymbosum</i>	136	2	5	+++	61	17	10	6	82
<i>Arisaema triphyllum</i>	405	2	2	0	61	6	3	1	3
<i>Liquidambar styraciflua</i>	472	4	5	+	58	5	3	1	5
<i>Symplocarpus foetidus</i>	80	3	6	+++	55	26	15	10	116
<i>Rhododendron viscosum</i>	49	2	4	++	53	41	21	10	86
<i>Quercus alba</i>	720	6	4	--	53	3	1	1	0
<i>Osmunda regalis</i> var. <i>spectabilis</i>	78	2	3	+	53	26	13	4	27
<i>Carex debilis</i>	130	2	3	+	53	15	8	3	16
<i>Parthenocissus quinquefolia</i>	899	2	2	0	53	2	1	0	1
<i>Viola primulifolia</i>	37	1	2	+	50	51	26	6	51
<i>Carex intumescens</i> var. <i>intumescens</i>	111	2	2	0	50	17	9	2	9
<i>Cinna arundinacea</i>	229	3	2	-	50	8	4	1	2
<i>Clethra alnifolia</i>	52	2	6	++++	47	35	16	11	262
<i>Leucothoe racemosa</i>	88	2	3	+	47	20	10	3	19
<i>Platanthera clavellata</i>	40	1	2	+	47	45	21	5	43
<i>Rubus hispidus</i>	88	2	2	0	47	20	10	2	10
<i>Chionanthus virginicus</i>	176	2	3	+	45	10	4	1	9
<i>Viburnum dentatum</i>	236	2	2	0	45	7	3	1	3
<i>Vaccinium fuscum</i>	134	2	4	++	42	12	5	2	20
<i>Viola cucullata</i>	89	2	2	0	42	18	8	2	8
<i>Dioscorea villosa</i>	58	1	2	+	39	26	10	2	20
<i>Glyceria striata</i>	152	2	2	0	39	10	4	1	4
<i>Carex atlantica</i> ssp. <i>atlantica</i>	41	2	4	++	37	34	13	6	50
<i>Thelypteris noveboracensis</i>	157	3	4	+	37	9	3	1	7
<i>Chasmanthium laxum</i>	76	2	3	+	37	18	7	2	14
<i>Carex seorsa</i>	38	2	2	0	37	37	14	3	14
<i>Chelone glabra</i>	81	1	2	+	37	17	6	1	13

Table H7. Compositional summary statistics from the regional analysis of Coastal Plain / Piedmont Small-Stream Floodplain Forest (CEGL004418).

Mean Species Richness	45
Homogeneity	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)
<i>Liriodendron tulipifera</i>	753	5	7	++	96	6	6	5	23
<i>Lindera benzoin</i>	456	4	6	++	94	10	9	6	37
<i>Toxicodendron radicans</i>	747	3	4	+	94	6	6	3	11
<i>Liquidambar styraciflua</i>	472	4	6	++	92	9	9	6	34
<i>Parthenocissus quinquefolia</i>	899	2	4	++	92	5	4	2	18
<i>Ilex opaca</i> var. <i>opaca</i>	575	4	5	+	90	7	7	4	13
<i>Smilax rotundifolia</i>	797	3	3	0	88	5	5	2	5
<i>Acer rubrum</i>	1090	6	6	0	85	4	3	2	3
<i>Arisaema triphyllum</i>	405	2	4	++	81	10	8	3	31
<i>Asimina triloba</i>	519	5	5	0	73	7	5	3	5
<i>Thelypteris noveboracensis</i>	157	3	6	+++	71	22	15	10	123
<i>Carpinus caroliniana</i>	497	4	5	+	71	7	5	3	10
<i>Euonymus americanus</i>	433	2	2	0	69	8	5	1	5
<i>Polystichum acrostichoides</i>	414	3	3	0	65	7	5	2	5
<i>Mitchella repens</i>	395	2	2	0	56	7	4	1	4
<i>Fagus grandifolia</i>	630	6	5	-	54	4	2	1	1
<i>Lonicera japonica</i>	516	2	3	+	54	5	3	1	5
<i>Boehmeria cylindrica</i>	226	2	3	+	52	11	6	2	12
<i>Carex debilis</i>	130	2	2	0	48	18	8	2	8
<i>Nyssa sylvatica</i>	810	5	5	0	46	3	1	1	1
<i>Athyrium filix-femina</i> var. <i>asplenioides</i>	157	2	4	++	46	14	6	3	26
<i>Cinna arundinacea</i>	229	3	3	0	46	10	4	1	4
<i>Platanus occidentalis</i>	85	2	4	++	44	25	11	5	43
<i>Cornus florida</i>	626	4	4	0	42	3	1	1	1
<i>Onoclea sensibilis</i>	95	1	2	+	42	21	9	2	18
<i>Polygonum virginianum</i>	203	2	2	0	42	10	4	1	4
<i>Circaea lutetiana</i> ssp. <i>canadensis</i>	247	2	2	0	42	8	3	1	3
<i>Carex intumescens</i> var. <i>intumescens</i>	111	2	2	0	40	17	7	2	7
<i>Carex radiata</i>	146	2	2	0	40	13	5	1	5
<i>Festuca subverticillata</i>	268	2	2	0	40	7	3	1	3
<i>Impatiens capensis</i>	203	2	2	0	38	9	3	1	3
<i>Viburnum dentatum</i>	236	2	2	0	38	8	3	1	3
<i>Smilax glauca</i>	528	2	2	0	38	3	1	0	1
<i>Carya cordiformis</i>	289	3	3	0	33	6	2	1	2
<i>Medeola virginiana</i>	175	1	2	+	33	9	3	1	6
<i>Amphicarpaea bracteata</i>	261	2	2	0	33	6	2	0	2
<i>Betula nigra</i>	60	2	5	+++	31	25	8	4	63
<i>Lycopus virginicus</i>	179	1	2	+	31	8	3	1	5
<i>Sanicula canadensis</i>	307	2	2	0	31	5	2	0	2
<i>Ulmus americana</i>	238	3	3	0	29	6	2	1	2
<i>Sambucus nigra</i> ssp. <i>canadensis</i>	94	1	2	+	29	15	4	1	9
<i>Carex swanii</i>	124	1	2	+	29	11	3	1	7
<i>Woodwardia areolata</i>	73	2	2	0	29	19	6	1	6
<i>Campsis radicans</i>	208	2	2	0	29	7	2	0	2
<i>Galium triflorum</i>	258	2	2	0	29	5	2	0	2

Table H8. Compositional summary statistics from the regional analysis of Piedmont / Mountain Floodplain Forest (CEGL006217).

Mean Species Richness	47
Homoteneity	0.594
Number of Plots	38

Species	Total Freq	Total Mean Cover	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
<i>Acer negundo</i>	269	4	7	+++	100	14	14	11	113
<i>Acer saccharinum</i>	181	4	8	++++	95	20	19	17	301
<i>Lindera benzoin</i>	364	4	6	++	92	10	9	6	35
<i>Verbesina alternifolia</i>	210	2	5	+++	92	17	15	9	123
<i>Leersia virginica</i>	183	2	2	0	87	18	16	3	16
<i>Alliaria petiolata</i>	368	3	5	++	84	9	7	4	29
<i>Asimina triloba</i>	330	5	6	+	82	9	8	5	15
<i>Platanus occidentalis</i>	260	4	6	++	82	12	10	6	39
<i>Urtica dioica</i>	98	2	6	++++	82	32	26	17	413
<i>Viola sororia</i>	300	2	3	+	79	10	8	3	16
<i>Glechoma hederacea</i>	125	3	6	+++	76	23	18	12	142
<i>Laportea canadensis</i>	129	2	5	+++	76	22	17	10	137
<i>Parthenocissus quinquefolia</i>	679	3	3	0	76	4	3	1	3
<i>Microstegium vimineum</i>	306	3	4	+	74	9	7	3	13
<i>Oxalis stricta</i>	220	2	2	0	74	13	9	2	9
<i>Fraxinus pennsylvanica</i>	175	3	5	++	71	15	11	6	44
<i>Ageratina altissima</i>	325	2	5	+++	68	8	5	3	44
<i>Toxicodendron radicans</i>	480	2	3	+	66	5	3	1	7
<i>Polygonum caespitosum longisetum</i>	254	2	2	0	66	10	6	1	6
<i>Ulmus americana</i>	215	3	5	++	63	11	7	4	28
<i>Rudbeckia laciniata</i>	64	2	4	++	63	38	24	11	95
<i>Pilea pumila</i>	196	2	3	+	63	12	8	3	15
<i>Boehmeria cylindrica</i>	164	2	3	+	61	14	8	3	17
<i>Polygonum virginianum</i>	161	2	3	+	55	13	7	2	14
<i>Cryptotaenia canadensis</i>	90	1	2	+	55	23	13	3	26
<i>Elymus virginicus</i> var. <i>virginicus</i>	97	2	5	+++	50	20	10	5	78
<i>Mertensia virginica</i>	102	3	4	+	47	18	8	4	17
<i>Stellaria media</i>	112	2	3	+	47	16	8	3	15
<i>Acalypha rhomboidea</i>	154	2	2	0	47	12	6	1	6
<i>Bidens frondosa</i>	110	1	2	+	47	16	8	2	16
<i>Carya cordiformis</i>	271	3	2	-	47	7	3	1	2
<i>Impatiens capensis</i>	115	2	2	0	47	16	7	2	7
<i>Celtis occidentalis</i>	266	3	3	0	45	6	3	1	3
<i>Teucrium canadense</i>	97	2	3	+	45	18	8	3	16
<i>Perilla frutescens</i>	99	1	2	+	45	17	8	2	15
<i>Artemisia annua</i>	145	2	2	0	42	11	5	1	5
<i>Geum canadense</i>	113	1	2	+	42	14	6	1	12
<i>Veronica hederifolia</i>	134	2	2	0	42	12	5	1	5
<i>Symphyotrichum lanceolatum</i> ssp. <i>lanceolatum</i>	70	1	2	+	39	21	8	2	17
<i>Festuca subverticillata</i>	270	2	2	0	37	5	2	0	2
<i>Polygonum punctatum</i>	116	2	2	0	37	12	4	1	4
<i>Juglans nigra</i>	146	3	4	+	34	9	3	1	6
<i>Hydrophyllum canadense</i>	97	2	3	+	34	13	5	2	9
<i>Scrophularia marilandica</i>	51	1	3	++	34	25	9	3	35
<i>Phlox divaricata</i>	79	1	2	+	34	16	6	1	11
<i>Sanicula odorata</i>	92	2	2	0	34	14	5	1	5
<i>Humulus japonicus</i>	57	1	2	+	32	21	7	1	13

Table H9. Compositional summary statistics from the regional analysis of Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type) (CEGL006605).

Mean Species Richness	38
Homogeneity	0.606
Number of Plots	47

Species	Total Freq	Total Mean Cover	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
<i>Acer rubrum</i>	1090	6	7	+	100	4	4	3	9
<i>Smilax rotundifolia</i>	798	3	4	+	98	6	6	3	11
<i>Liquidambar styraciflua</i>	473	4	6	++	96	10	9	6	36
<i>Parthenocissus quinquefolia</i>	900	2	2	0	94	5	5	1	5
<i>Toxicodendron radicans</i>	748	3	5	++	91	6	5	3	21
<i>Cinna arundinacea</i>	229	3	6	+++	85	17	15	10	119
<i>Carpinus caroliniana</i>	498	4	6	++	85	8	7	5	27
<i>Boehmeria cylindrica</i>	226	2	3	+	81	17	14	5	27
<i>Fraxinus pennsylvanica</i>	238	4	5	+	81	16	13	7	26
<i>Ilex opaca</i> var. <i>opaca</i>	576	4	5	+	77	6	5	3	10
<i>Asimina triloba</i>	519	5	5	0	72	7	5	3	5
<i>Nyssa sylvatica</i>	810	5	4	-	70	4	3	1	1
<i>Campsis radicans</i>	209	2	2	0	68	15	10	2	10
<i>Lonicera japonica</i>	517	2	4	++	66	6	4	2	16
<i>Ulmus americana</i>	238	3	5	++	66	13	9	5	34
<i>Euonymus americanus</i>	434	2	2	0	64	7	4	1	4
<i>Carex debilis</i>	130	2	4	++	64	23	15	7	59
<i>Arisaema triphyllum</i>	405	2	2	0	62	7	4	1	4
<i>Quercus palustris</i>	126	4	6	++	60	22	13	9	53
<i>Carex intumescens</i> var. <i>intumescens</i>	134	2	3	+	57	20	12	4	23
<i>Lycopus virginicus</i>	179	1	2	+	55	15	8	2	16
<i>Viburnum dentatum</i>	236	2	2	0	51	10	5	1	5
<i>Lindera benzoin</i>	456	4	4	0	49	5	2	1	2
<i>Quercus phellos</i>	238	4	5	+	49	10	5	3	9
<i>Ilex verticillata</i>	194	2	3	+	47	11	5	2	11
<i>Quercus michauxii</i>	91	2	5	+++	47	24	11	6	91
<i>Impatiens capensis</i>	203	2	2	0	45	10	5	1	5
<i>Dulichium arundinaceum</i>	31	1	2	+	45	68	30	7	61
<i>Athyrium filix-femina</i> var. <i>asplenioides</i>	157	2	2	0	45	13	6	1	6
<i>Leersia virginica</i>	201	2	2	0	43	10	4	1	4
<i>Symphotrichum lateriflorum</i>	309	2	2	0	40	6	2	1	2
<i>Juncus effusus</i>	121	1	2	+	40	16	6	1	13
<i>Rubus hispidus</i>	88	2	3	+	38	20	8	3	16
<i>Lobelia cardinalis</i>	55	1	2	+	36	31	11	2	22
<i>Polygonum virginianum</i>	203	2	2	0	34	8	3	1	3
<i>Onoclea sensibilis</i>	95	1	2	+	34	17	6	1	11
<i>Carex radiata</i>	146	2	2	0	34	11	4	1	4
<i>Glyceria striata</i>	152	2	3	+	34	11	4	1	7

Table H10. Compositional summary statistics from the regional analysis of Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type) (CEGL006110).

Mean Species Richness	28
Homogeneity	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)
<i>Quercus phellos</i>	238	4	7	+++	100	6	6	5	50
<i>Liquidambar styraciflua</i>	472	4	6	++	100	3	3	2	13
<i>Nyssa sylvatica</i>	810	5	6	+	100	2	2	1	4
<i>Acer rubrum</i>	1090	6	6	0	100	1	1	1	1
<i>Smilax rotundifolia</i>	797	3	5	++	100	2	2	1	8
<i>Toxicodendron radicans</i>	747	3	2	-	67	1	1	0	0
<i>Chasmanthium laxum</i>	76	2	5	+++	60	12	7	4	57
<i>Ilex opaca</i> var. <i>opaca</i>	575	4	3	-	60	2	1	0	0
<i>Mitchella repens</i>	395	2	2	0	60	2	1	0	1
<i>Juncus effusus</i>	121	1	2	+	53	7	4	1	7
<i>Leucothoe racemosa</i>	88	2	4	++	47	8	4	2	15
<i>Vaccinium corymbosum</i>	136	2	3	+	47	5	2	1	5
<i>Liriodendron tulipifera</i>	753	5	3	--	47	1	0	0	0
<i>Parthenocissus quinquefolia</i>	899	2	2	0	47	1	0	0	0
<i>Quercus palustris</i>	126	4	4	0	40	5	2	1	2
<i>Carex albolutescens</i>	31	1	2	+	40	19	8	2	15
<i>Euonymus americanus</i>	433	2	2	0	40	1	1	0	1
<i>Quercus alba</i>	720	6	2	----	40	1	0	0	0
<i>Carex debilis</i>	130	2	4	++	33	4	1	1	5
<i>Betula nigra</i>	60	2	3	+	33	8	3	1	6
<i>Pinus taeda</i>	112	2	3	+	33	4	1	0	3
<i>Cinna arundinacea</i>	229	3	3	0	33	2	1	0	1
<i>Osmunda regalis</i> var. <i>spectabilis</i>	78	2	2	0	33	6	2	0	2
<i>Magnolia virginiana</i>	87	2	2	0	33	6	2	0	2
<i>Carex intumescens</i> var. <i>intumescens</i>	111	2	2	0	33	5	2	0	2
<i>Dichanthelium dichotomum</i>	270	2	2	0	33	2	1	0	1
<i>Fraxinus pennsylvanica</i>	238	4	2	--	33	2	1	0	0
<i>Carex joorii</i>	5	1	4	+++	27	80	21	9	171

Table H11. Compositional summary statistics from the regional analysis of Non-Riverine Saturated Forest (CEGL004644).

Mean Species Richness	35
Homogeneity	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)
<i>Liquidambar styraciflua</i>	472	4	6	++	100	4	4	3	18
<i>Acer rubrum</i>	1090	6	6	0	100	2	2	1	2
<i>Nyssa sylvatica</i>	810	5	5	0	90	2	2	1	2
<i>Smilax rotundifolia</i>	797	3	4	+	90	2	2	1	4
<i>Quercus phellos</i>	238	4	6	++	86	8	6	4	26
<i>Ilex opaca</i> var. <i>opaca</i>	575	4	6	++	81	3	2	2	10
<i>Mitchella repens</i>	395	2	2	0	76	4	3	1	3
<i>Toxicodendron radicans</i>	747	3	2	-	76	2	2	0	1
<i>Woodwardia areolata</i>	73	2	5	+++	71	21	15	8	117
<i>Quercus michauxii</i>	91	2	6	++++	67	15	10	7	164
<i>Pinus taeda</i>	112	2	4	++	67	13	8	4	33
<i>Clethra alnifolia</i>	52	2	6	++++	62	25	15	10	248
<i>Quercus pagoda</i>	39	2	6	++++	57	31	18	12	281
<i>Carex debilis</i>	130	2	4	++	57	9	5	2	21
<i>Magnolia virginiana</i>	87	2	3	+	57	14	8	3	16
<i>Vitis rotundifolia</i>	169	2	2	0	57	7	4	1	4
<i>Viburnum nudum</i>	73	2	4	++	52	15	8	4	32
<i>Parthenocissus quinquefolia</i>	899	2	2	0	52	1	1	0	1
<i>Chasmanthium laxum</i>	76	2	4	++	48	13	6	3	25
<i>Leucothoe racemosa</i>	88	2	3	+	48	11	5	2	11
<i>Euonymus americanus</i>	433	2	2	0	48	2	1	0	1
<i>Quercus alba</i>	720	6	5	-	43	1	1	0	0
<i>Osmunda regalis</i> var. <i>spectabilis</i>	78	2	4	++	43	12	5	2	20
<i>Osmunda cinnamomea</i>	129	2	4	++	43	7	3	1	12
<i>Vaccinium corymbosum</i>	136	2	4	++	43	7	3	1	11
<i>Carex intumescens</i> var. <i>intumescens</i>	111	2	3	+	43	8	3	1	7
<i>Ilex verticillata</i>	194	2	2	0	43	5	2	0	2
<i>Liriodendron tulipifera</i>	753	5	2	---	43	1	1	0	0
<i>Carex seorsa</i>	38	2	5	+++	38	21	8	4	64
<i>Carpinus caroliniana</i>	497	4	5	+	38	2	1	0	1
<i>Fraxinus pennsylvanica</i>	238	4	4	0	38	3	1	1	1
<i>Vaccinium fuscum</i>	134	2	3	+	38	6	2	1	5
<i>Campsis radicans</i>	208	2	2	0	38	4	1	0	1
<i>Viburnum dentatum</i>	236	2	2	0	38	3	1	0	1
<i>Fagus grandifolia</i>	630	6	2	----	38	1	0	0	0

Appendix I. Local and global descriptions of vegetation associations and other vegetation-map classes for Fredericksburg and Spotsylvania National Military Park

This appendix contains detailed local descriptions for the map classes present at Fredericksburg and Spotsylvania National Military Park, written based on information collected within the park boundary. Of the 21 map classes used to map Fredericksburg and Spotsylvania National Military Park, 16 were crosswalked to the finest level of the USNVC (association), two were described as nonstandard, park-specific vegetation classes, and three 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 April 17, 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, and 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. Acceptable photos were not available for Piedmont / Mountain Floodplain Forest, Semipermanent Impoundment, and Successional Tuliptree Floodplain Forest.

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 IVC 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 Fredericksburg and Spotsylvania National Military 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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EVERGREEN AND MIXED EVERGREEN FORESTS

Eastern White Pine - Hardwood Forest	165
Loblolly Pine Plantation	150
Mesic Mixed Hardwood Forest	170
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Non-Riverine Saturated Forest	225
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CULTURAL AND NONSTANDARD MAP CLASSES

Cultural Meadow	240
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ANDERSON LEVEL II MAP CLASSES

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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: CEG007179

LOCAL INFORMATION

Environmental Description: Loblolly Pine Plantation occurs on areas where *Pinus taeda* (loblolly pine) has been recently planted or on areas where *Pinus taeda* (loblolly pine) was planted in the past and has since been abandoned and allowed to regenerate, leaving a dense mixture of *Pinus taeda* (loblolly pine) with a subcanopy of young hardwood species.

Vegetation Description: Loblolly Pine Plantation includes planted evergreen forests with canopies dominated by *Pinus taeda* (loblolly pine). The association can be dominated by *Pinus taeda* (loblolly pine) planted in discernable rows with little or no other tree or shrub species. This association also includes abandoned plantations which, after a time with no active management, can develop an understory of hardwood species. Hardwood species that can occur in the understory as small trees or shrubs or (rarely) break into the canopy include *Liquidambar styraciflua* (sweetgum), *Quercus falcata* (southern red oak), *Quercus alba* (white oak), *Juniperus virginiana* var. *virginiana* (eastern redcedar), and *Diospyros virginiana* (common persimmon). Shrub species can include *Vaccinium pallidum* (Blue Ridge blueberry) and *Vaccinium stamineum* (deerberry). Needle litter typically dominates the ground layer with no or very sparse herbaceous cover.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Pinus taeda</i> (loblolly pine)

Characteristic Species: *Pinus taeda* (loblolly pine).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	plant	invasive nonnative

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNA	.	.	[not crosswalked]	.

Local Range: Loblolly Pine Plantation is not well-documented in Fredericksburg & Spotsylvania National Military Park. It is currently mapped as 3 polygons, covering a total of 71 hectares, but is likely present in additional areas throughout the park.

Classification Comments: Loblolly Pine Plantation is distinguished from other vegetation in Fredericksburg & Spotsylvania National Military Park by having a canopy dominated by *Pinus taeda* (loblolly pine), often planted in discernable rows or appearing to have been planted in rows in the past, but now with no active management. Deciduous trees may be in the understory/shrub layers but do not break into the canopy.

Other Comments: Loblolly Pine Plantation varies in structure and composition. Stands mapped as this unit can range from obvious plantations with trees in straight rows to stands of small-diameter *Pinus taeda* (loblolly pine) with a subcanopy of young hardwood trees.

Local Description Authors: K. D. Patterson and K. Taverna.

Plots: None.

Fredericksburg & Spotsylvania National Military 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	<i>Pinus taeda</i> Planted Forest Alliance (A.99)
Alliance (English name)	Loblolly Pine Planted Forest Alliance
Association	<i>Pinus taeda</i> 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: Information not available.

Vegetation Description: 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), *Vitis* spp. (grapes), *Smilax* spp. (greenbriars), 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. (lespedeza species), *Symphotrichum 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 (Chickamauga-Chattanooga?, Fredericksburg-Spotsylvania, Natchez Trace, Obed, 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 NF, 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., CEG007109) 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., CEG007364). 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.

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 1998a.



Figure I1. Loblolly Pine Plantation photographed at George Washington Birthplace National Monument. May 2004.

COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL VIRGINIA PINE FOREST

SYNONYMS

USNVC English Name: Virginia Pine Successional Forest
USNVC Scientific Name: *Pinus virginiana* Successional Forest
USNVC Identifier: CEGLO02591

LOCAL INFORMATION

Environmental Description: Stands of Successional Virginia Pine Forest occur on gentle slopes in Fredericksburg & Spotsylvania National Military Park and develop after field abandonment. They are short-lived, generally persisting less than 75 years. In many stands, *Pinus virginiana* (Virginia pine) is dead or dying and there are often many fallen trees and snags.

Vegetation Description: Successional Virginia Pine Forest includes stands of pure *Pinus virginiana* (Virginia pine), as well as older stands where the *Pinus virginiana* (Virginia pine) is decadent and the evergreen canopy is breaking up with hardwood succession. Stands of Successional Virginia Pine Forest develop after field abandonment and are short-lived, generally less than 75 years. This forest typically has a dense canopy of *Pinus virginiana* (Virginia pine) often with a mix of successional deciduous trees. Deciduous species can comprise up to 75% of the canopy composition and can be almost any species from the surrounding forests. Some common canopy associates include *Liriodendron tulipifera* (tuliptree), *Quercus alba* (white oak), and *Carya* spp. (hickories). Common subcanopy/tall-shrub associates include *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), *Cornus florida* (flowering dogwood), *Ilex opaca* var. *opaca* (American holly), *Sassafras albidum* (sassafras), and *Juniperus virginiana* var. *virginiana* (eastern redcedar). Woody shrubs and vines can have high cover and often include *Viburnum acerifolium* (mapleleaf viburnum), *Gaylussacia baccata* (black huckleberry), *Parthenocissus quinquefolia* (Virginia creeper), *Lonicera japonica* (Japanese honeysuckle), *Vaccinium stamineum* (deerberry), *Vaccinium pallidum* (Blue Ridge blueberry), and *Toxicodendron radicans* (eastern poison ivy). The ground layer is usually covered by pine litter with few herbs or dominated by the clubmoss *Lycopodium digitatum* (fan clubmoss). Other common herbs are *Mitchella repens* (partridgeberry), *Polystichum acrostichoides* (Christmas fern), and *Galium circaezans* (licorice bedstraw).

The structure of Successional Virginia Pine Forest varies greatly within the park, depending mostly on stand age. Typically this association occurs with decadent *Pinus virginiana* (Virginia pine) forming a patchy emergent canopy over mixed hardwood regeneration. It can also occur as a dense, pure evergreen forest with no understory or herb layer. It often occurs scattered along the uplands, near field edges, or as narrow zones along roadsides.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	<i>Liriodendron tulipifera</i> (tuliptree)
Tree canopy	Needle-leaved tree	<i>Pinus virginiana</i> (Virginia pine)

Characteristic Species: *Liquidambar styraciflua* (sweetgum), *Liriodendron tulipifera* (tuliptree), *Lycopodium digitatum* (fan clubmoss), *Pinus virginiana* (Virginia pine).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	plant	invasive nonnative

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNA	.	.	[not crosswalked]	.

Local Range: Successional Virginia Pine Forest is common in the park and is mapped as 140 polygons occurring throughout the park, ranging in size from 0.5 to 51.1 hectares. It covers a total of 502 hectares in the park.

Classification Comments: Information not available.

Other Comments: Successional Virginia Pine Forest could be confused with the associations Successional Tuliptree Forest and Successional Mixed Scrub. Successional Virginia Pine Forest can be distinguished by having a canopy comprised of 25-100% *Pinus virginiana* (Virginia pine).

Local Description Authors: K. Taverna and K. D. Patterson.

Plots: None.

Fredericksburg & Spotsylvania National Military 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	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
Formation	Rounded-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.b.)
Alliance	<i>Pinus virginiana</i> Forest Alliance (A.131)
Alliance (English name)	Virginia Pine Forest Alliance
Association	<i>Pinus virginiana</i> Successional Forest
Association (English name)	Virginia Pine Successional Forest
Ecological System(s):	Central Appalachian Dry Oak-Pine Forest (CES202.591) Northeastern Interior Dry-Mesic Oak Forest (CES202.592) Southern Appalachian Low-Elevation Pine Forest (CES202.332)

GLOBAL DESCRIPTION

Concept Summary: This community occurs in areas where canopy removal has created dry, open conditions and bare mineral soil, allowing for the establishment of *Pinus virginiana* (Virginia pine). These habitats include old fields, old pastures, clearcuts, and burned or eroded areas. This forest typically has a very dense canopy of *Pinus virginiana* (Virginia pine) and little understory vegetation. The dense canopy may also include admixtures of other *Pinus* (pine) species (e.g., *Pinus taeda* (loblolly pine), *Pinus echinata* (shortleaf pine)) or other early-successional deciduous trees (e.g., *Acer rubrum* (red maple), *Liquidambar styraciflua* (sweetgum), *Prunus serotina* var. *serotina* (black cherry), *Liriodendron tulipifera* (tuliptree)). Associated woody and herbaceous species vary with geography but are typically ruderal or exotic species. Shrub and herb layers are frequently very sparse. Stands are short-lived, generally less than 75 years.

Environmental Description: This community occurs in areas where canopy removal has created open conditions and bare mineral soil, allowing for the establishment of *Pinus virginiana* (Virginia pine). These conditions can include old fields, old pastures, clearcuts, and burned or eroded areas. In the Ridge and Valley of Tennessee, northeastern Monroe County, early

successional forests with *Pinus virginiana* (Virginia pine) dominance were found on low slopes in areas that were cleared for agriculture prior to the 1970s, when Tellico Lake was created (Andreu and Tukman 1995). In the Central Appalachians, this vegetation occurs where soft shales have been farmed (primarily in valleys), resulting in stands with nothing but successional species in the understory. Soils underlying these communities are of two general types, i.e., those derived in residuum from calcareous shale and calcareous sandstone of the Middle Ordovician and those of some other origin. Series of the former type include Dandridge (Lithic Ruptic-Alfic Eutrochrepts), Tellico (Typic Rhododults), and Steekee (Ruptic-Ultic Dystrochrepts). Other soil series that this forest type may occur on include Litz, Dewey, Alcoa, Bland, Etowah, Lobdell and Neubert. All of these soils are well-drained and range in pH from moderate acid to very strongly acidic.

Vegetation Description: This forest typically has a very dense canopy of *Pinus virginiana* (Virginia pine) and little understory vegetation. *Pinus taeda* (loblolly pine) or *Pinus echinata* (shortleaf pine) may co-occur with *Pinus virginiana* (Virginia pine) in the canopy. The canopy can also have significant admixtures of early-successional deciduous trees (e.g., *Acer rubrum* (red maple), *Liquidambar styraciflua* (sweetgum), *Prunus serotina* var. *serotina* (black cherry), *Liriodendron tulipifera* (tuliptree)). Associated woody and herbaceous species vary with geography but are typically ruderal or exotic species; *Lonicera japonica* (Japanese honeysuckle) and *Rosa multiflora* (multiflora rose) are common. Shrub and herb strata are absent to sparse in coverage. In eastern Tennessee, the subcanopy may contain *Acer saccharum* (sugar maple) and *Cornus florida* (flowering dogwood); other associated species may include *Cercis canadensis* (eastern redbud), *Parthenocissus quinquefolia* (Virginia creeper), *Lonicera japonica* (Japanese honeysuckle), and *Microstegium vimineum* (Nepalese browntop) (Andreu and Tukman 1995). In the Central Appalachians, associates include *Pinus taeda* (loblolly pine), *Pinus echinata* (shortleaf pine), and *Pinus rigida* (pitch pine). Some stands may have a dense ericaceous shrub stratum containing *Vaccinium* spp. (blueberries), *Gaylussacia* spp. (huckleberries), *Kalmia latifolia* (mountain laurel), and *Rhododendron* spp. (rhododendrons).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Pinus virginiana</i> (Virginia pine)
Tree subcanopy	Needle-leaved tree	<i>Juniperus virginiana</i> var. <i>virginiana</i> (eastern redcedar)
Tree subcanopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple), <i>Cornus florida</i> (flowering dogwood), <i>Nyssa sylvatica</i> (blackgum), <i>Oxydendrum arboreum</i> (sourwood)
Tall shrub/sapling	Broad-leaved deciduous tree	<i>Cornus florida</i> (flowering dogwood), <i>Nyssa sylvatica</i> (blackgum), <i>Oxydendrum arboreum</i> (sourwood)
Tall shrub/sapling	Broad-leaved evergreen tree	<i>Vaccinium arboreum</i> (farkleberry)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Vaccinium stamineum</i> (deerberry)
Short shrub/sapling	Broad-leaved deciduous tree	<i>Cercis canadensis</i> (eastern redbud), <i>Cornus florida</i> (flowering dogwood), <i>Oxydendrum arboreum</i> (sourwood), <i>Quercus alba</i> (white oak), <i>Sassafras albidum</i> (sassafras)
Herb (field)	Vine/Liana	<i>Lonicera japonica</i> (Japanese honeysuckle), <i>Smilax glauca</i> (cat greenbrier), <i>Toxicodendron radicans</i> (eastern poison ivy)

Characteristic Species: *Pinus virginiana* (Virginia pine).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This successional community is possible in the Piedmont from Pennsylvania south to Alabama and ranges west into the Appalachians, Ridge and Valley, the Cumberland Plateau, and in scattered locales of the Interior Low Plateau.

States/Provinces: AL, GA, IN, KY, MD, NC, NJ, PA, SC, TN, VA, WV.

Federal Lands: NPS (Big South Fork, Blue Ridge Parkway?, Cumberland Gap, Fredericksburg-Spotsylvania, Gettysburg, Great Smoky Mountains, Kings Mountain, Lincoln Birthplace, Little River Canyon?, Mammoth Cave, Natchez Trace, New River Gorge, Obed, Shenandoah, Shiloh, Thomas Stone); TVA (Tellico); USFS (Bankhead, Chattahoochee, Chattahoochee (Piedmont), Chattahoochee (Southern Blue Ridge), Cherokee, Daniel Boone, George Washington, Jefferson, Sumter, Sumter (Mountains), Sumter (Piedmont), Uwharrie?).

CONSERVATION STATUS

Rank: GNA (ruderal) (13-Jun-2000).

Reasons: This forest represents early-successional vegetation and is thus not of conservation concern.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 1 – Strong.

Comments: Early successional *Pinus virginiana* (Virginia pine) vegetation occurring over calcareous substrates is classed in *Pinus virginiana* - *Juniperus virginiana* var. *virginiana* - *Ulmus alata* Forest (CEGL007121) and has species indicative of calcareous substrates.

Similar Associations:

- *Pinus echinata* Early-Successional Forest (CEGL006327)--occurs in similar environments but is dominated (>50% of canopy) by *Pinus echinata* instead of *Pinus virginiana*.
- *Pinus taeda* - *Liquidambar styraciflua* Semi-natural Forest (CEGL008462)--is commonly found in the same area as CEGL002591 in the Piedmont. CEGL008462 contains at least 50% *Pinus taeda* in the canopy, whereas CEGL002591 is mostly *Pinus virginiana*.
- *Pinus taeda* / *Liquidambar styraciflua* - *Acer rubrum* var. *rubrum* / *Vaccinium stamineum* Forest (CEGL006011)--occurs in similar environments with similar disturbance histories but is dominated by (>50% of canopy) *Pinus taeda* instead of *Pinus virginiana*.
- *Pinus virginiana* - *Juniperus virginiana* var. *virginiana* - *Ulmus alata* Forest (CEGL007121)--on more calcareous or circumneutral substrates.
- *Pinus virginiana* - *Pinus (rigida, echinata)* - (*Quercus prinus*) / *Vaccinium pallidum* Forest (CEGL007119)--can have a very similar canopy in the Piedmont and Blue Ridge ecoregions, but CEGL007119 is generally created and maintained by fire and/or logging but not heavy plowing and/or erosion. CEGL002591 generally has signs of heavy agricultural use such as sparse herbaceous or shrub layers, large percentage of invasive exotics such as *Lonicera japonica* in the herbaceous layer, old plowlines, human debris, and extremely even-aged canopy, whereas CEGL007119 generally has a more intact herbaceous/shrub layer (especially *Vaccinium pallidum*) and less signs of severe human disturbance.

Related Concepts:

- *Pinus virginiana* forest (Vanderhorst 2001b) =
- IA7c. Xeric Virginia Pine Ridge Forest (Allard 1990) B
- Pine-Oak Association of the Western Shore District (Shreve et al. 1910) B
- Unclassified Old-Field Successional Forest (Fleming and Moorhead 2000) ?
- Virginia Pine - Oak: 78 (Eyre 1980) B
- Virginia Pine Type (Schmalzer and DeSelm 1982) B
- Virginia Pine, RV (Pyne 1994) B
- Virginia Pine: 79 (Eyre 1980) B
- Virginia pine successional forest (Collins and Anderson 1994) =
- Xeric Pine Forest (Ambrose 1990) B

SOURCES

Description Authors: M. Andreu and M. Tukman, mod. K. D. Patterson and S. C. Gawler.

References: Allard 1990, Ambrose 1990, Andreu and Tukman 1995, Collins and Anderson 1994, Eyre 1980, Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 2000, Hall and Mathews 1974, Nelson 1986, Patterson et al. 1999, Pyne 1994, Schmalzer and DeSelm 1982, Schotz pers. comm., Shreve et al. 1910, Southeastern Ecology Working Group n.d., TDNH unpubl. data, TNC 1998b, Vanderhorst 2001b, Vanderhorst et al. 2007.



Figure I2. Successional Virginia Pine Forest photographed at Booker T. Washington National Monument. August 2007.

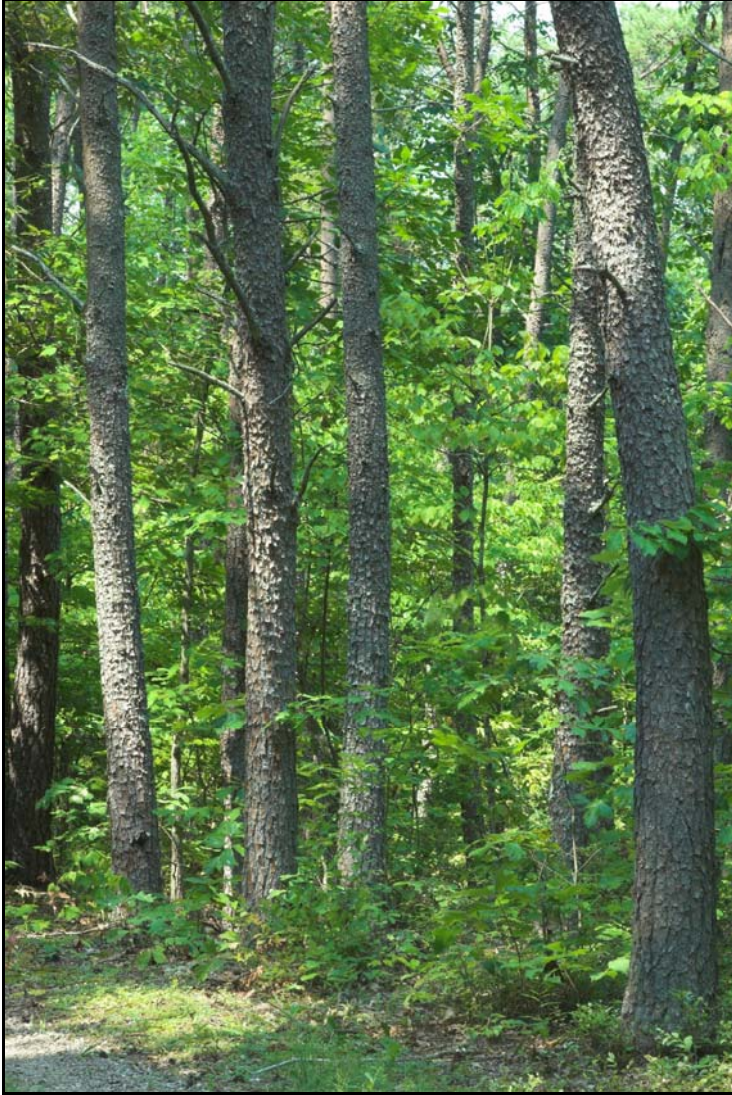


Figure I3. Successional Virginia Pine Forest photographed at Booker T. Washington National Monument. August 2007.

COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL RED-CEDAR FOREST

SYNONYMS

USNVC English Name: Eastern Red-cedar Forest
USNVC Scientific Name: *Juniperus virginiana* Forest
USNVC Identifier: CEG006024

LOCAL INFORMATION

Environmental Description: Successional Red-cedar Forest occurs on upland flats over various soil types throughout the park. It is typically found on abandoned fields or other clearings such as former homesites or along road edges.

Vegetation Description: Successional Red-cedar Forest includes dense forest stands dominated by *Juniperus virginiana* var. *virginiana* (eastern redcedar), typically on former fields, around former homesites, or along road edges. The canopy can be relatively short (6-10 m) and may include stems of successional species such as *Pinus virginiana* (Virginia pine), *Celtis* sp. (a hackberry), *Prunus serotina* var. *serotina* (black cherry), *Morus* sp. (a mulberry), and *Liquidambar styraciflua* (sweetgum), but always has *Juniperus virginiana* var. *virginiana* (eastern redcedar) as the main evergreen tree component. The herb layer is often dominated by leaf litter and can include grasses such as *Danthonia spicata* (poverty oatgrass) with mixtures of exotic species and other species typical of open disturbed areas, including *Vitis* sp. (a grape), *Eupatorium* sp. (a thoroughwort), *Lespedeza* sp. (a lespedeza), *Lonicera japonica* (Japanese honeysuckle), *Microstegium vimineum* (Nepalese browntop), *Rosa multiflora* (multiflora rose), *Rubus* sp. (a blackberry), and *Toxicodendron radicans* (eastern poison ivy).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree (canopy & subcanopy)	Needle-leaved tree	<i>Juniperus virginiana</i> var. <i>virginiana</i> (eastern redcedar)

Characteristic Species: *Juniperus virginiana* var. *virginiana* (eastern redcedar).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	plant	invasive nonnative
<i>Microstegium vimineum</i> (Nepalese browntop)	-	plant	invasive nonnative
<i>Rosa multiflora</i> (multiflora rose)	-	plant	invasive nonnative

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNA	.	.	[not crosswalked]	.

Local Range: Successional Red-cedar Forest is mapped in the park as 7 polygons ranging in size from 0.7 to 2 hectares. It covers a total of 8 hectares in the park.

Classification Comments: In Fredericksburg & Spotsylvania National Military Park, some stands of Successional Red-cedar Forest may be similar to areas of Successional Mixed Scrub (where *Juniperus virginiana* var. *virginiana* (eastern redcedar) can dominate but co-occurs with other woody species). It can be distinguished from Successional Mixed Scrub by having a high density of *Juniperus virginiana* var. *virginiana* (eastern redcedar) trees without scattered open herbaceous areas.

Other Comments: Information not available.

Local Description Authors: K. Taverna.

Plots: None.

Fredericksburg & Spotsylvania National Military 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	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
Formation	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c.)
Alliance	<i>Juniperus virginiana</i> Semi-natural Forest Alliance (A.137)
Alliance (English name)	Eastern Red-cedar Forest Alliance
Association	<i>Juniperus virginiana</i> Forest
Association (English name)	Eastern Red-cedar Forest
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

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

Environmental Description: This is a broadly defined old-field early-successional community occurring in a variety of environmental settings, typically on former agricultural land and other disturbed or degraded environmental settings. Soils are mesic to dry-mesic and moderately well-drained to well-drained.

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

Most Abundant Species:

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

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

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

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

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

Federal Lands: NPS (Cape Cod, Delaware Water Gap, Fire Island, Fredericksburg-Spotsylvania).

CONSERVATION STATUS

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

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

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 – Weak.

Comments: This association is currently very generally defined.

Similar Associations: Information not available.

Related Concepts: Information not available.

SOURCES

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

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



Figure I4. Successional Red-cedar Forest photographed at Appomattox Court House National Historical Park. August 2007. Photo by Robert Tillotson.

COMMON NAME (PARK-SPECIFIC): EASTERN WHITE PINE - HARDWOOD FOREST

SYNONYMS

USNVC English Name: Eastern White Pine - White Oak - Chestnut Oak / Deerberry Forest
USNVC Scientific Name: *Pinus strobus* - *Quercus alba* - *Quercus prinus* / *Vaccinium stamineum* Forest
USNVC Identifier: CEG008539

LOCAL INFORMATION

Environmental Description: Eastern White Pine - Hardwood Forest is a dry forest occurring on upper slopes and upland flats in Wilderness Battlefield. Sites are underlain primarily by acidic metamorphic and igneous rocks.

Vegetation Description: Vegetation is a mixed forest codominated by *Pinus strobus* (eastern white pine) (25-75% canopy cover) and various oaks, particularly *Quercus alba* (white oak), *Quercus rubra* (northern red oak), and *Quercus velutina* (black oak). Minor canopy associates include *Carya glabra* (pignut hickory), *Carya alba* (mockernut hickory), and *Pinus virginiana* (Virginia pine). *Acer rubrum* (red maple) and *Nyssa sylvatica* (blackgum) are abundant understory trees, along with *Cornus florida* (flowering dogwood) and *Sassafras albidum* (sassafras). The shrub layer is patchy and is predominantly ericaceous with *Vaccinium stamineum* (deerberry) and *Gaylussacia baccata* (black huckleberry). *Pinus strobus* (eastern white pine) is also often present in the shrub layer. Other frequent but low-cover shrub-layer species include *Viburnum acerifolium* (mapleleaf viburnum), *Smilax rotundifolia* (roundleaf greenbrier), *Sassafras albidum* (sassafras), and *Diospyros virginiana* (common persimmon). Soils are extremely acidic and the herb layer is typically very sparse, primarily composed of tree seedlings.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree (canopy & subcanopy)	Needle-leaved tree	<i>Pinus strobus</i> (eastern white pine)
Tree canopy	Broad-leaved deciduous tree	<i>Quercus alba</i> (white oak)

Characteristic Species: *Gaylussacia baccata* (black huckleberry), *Nyssa sylvatica* (blackgum), *Pinus strobus* (eastern white pine), *Quercus alba* (white oak), *Sassafras albidum* (sassafras).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNR*	B	C	Eastern White Pine - Hardwood Forest	Fleming et al. 2006

Local Range: Individual trees or clusters of *Pinus strobus* (eastern white pine) can be found scattered throughout Fredericksburg & Spotsylvania National Military Park, but there is only one stand (>0.5 ha) of Eastern White Pine - Hardwood Forest documented in the park in the northwestern end of Wilderness Battlefield. It covers a total of 4 hectares and is mapped as 1 polygon.

Classification Comments: Eastern White Pine - Hardwood Forest can be distinguished from other evergreen or hardwood forests by the prevalence of *Pinus strobus* (eastern white pine) in association with other common canopy trees such as *Quercus alba* (white oak) and *Quercus rubra* (northern red oak).

Other Comments: Information not available.

Local Description Authors: K. Taverna.

Plots: FRSP.16.

Fredericksburg & Spotsylvania National Military 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	<i>Pinus strobus</i> - <i>Quercus (coccinea, prinus)</i> Forest Alliance (A.402)
Alliance (English name)	Eastern White Pine - (Scarlet Oak, Chestnut Oak) Forest Alliance
Association	<i>Pinus strobus</i> - <i>Quercus alba</i> - <i>Quercus prinus</i> / <i>Vaccinium stamineum</i> Forest
Association (English name)	Eastern White Pine - White Oak - Chestnut Oak / Deerberry Forest
Ecological System(s):	Central Appalachian Dry Oak-Pine Forest (CES202.591)

GLOBAL DESCRIPTION

Concept Summary: The known range of this community includes the Central Appalachian region of Virginia, Maryland, and West Virginia, and the northern and central Piedmont of Virginia. The type is particularly abundant and widespread on low shale mountains and hills in west-central Virginia and adjacent West Virginia. Sites are underlain primarily by shale and similar sedimentary rocks (siltstone, metasiltstone, phyllite) or, less commonly, sandstone in the mountains and by a variety of acidic metamorphic and igneous rocks in the Piedmont. Stands occupy middle and upper slopes, ridge crests, dry ravines, and bluffs, mostly below 760 m (2500 feet) elevation in the mountains and above 75 m (240 feet) in the Piedmont. Aspect is variable, and site moisture is typically assessed as subxeric or submesic. Vegetation is a mixed forest codominated by *Pinus strobus* (eastern white pine) and various oaks, particularly *Quercus alba* (white oak), *Quercus coccinea* (scarlet oak), *Quercus rubra* (northern red oak), and *Quercus prinus* (chestnut oak). Minor canopy associates include *Acer rubrum* (red maple), *Carya alba* (mockernut hickory), *Carya glabra* (pignut hickory), *Fagus grandifolia* (American beech) (mostly Piedmont), *Liriodendron tulipifera* (tuliptree), *Nyssa sylvatica* (blackgum), *Pinus virginiana* (Virginia pine), *Quercus falcata* (southern red oak) (mostly Piedmont), *Quercus velutina* (black oak), and *Tsuga canadensis* (eastern hemlock). *Acer rubrum* (red maple) and *Nyssa sylvatica* (blackgum) are abundant understory trees, along with *Cornus florida* (flowering dogwood). The shrub layer is predominantly ericaceous and varies from sparse and patchy to occasionally dense. *Vaccinium stamineum* (deerberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Gaylussacia baccata* (black huckleberry), and *Kalmia latifolia* (mountain laurel) are characteristic ericads. Other frequent but low-cover shrub-layer species include *Viburnum acerifolium* (mapleleaf viburnum), *Smilax rotundifolia* (roundleaf greenbrier), *Sassafras albidum* (sassafras), and *Diospyros virginiana* (common persimmon). The herb layer is typically sparse, but occasionally contains dense graminoid patches of *Danthonia spicata* (poverty oatgrass), *Deschampsia flexuosa* (wavy hairgrass), or *Carex pensylvanica* (Pennsylvania sedge).

Environmental Description: Sites are underlain primarily by shale and similar sedimentary rocks (siltstone, metasiltstone, phyllite) or, less commonly, sandstone in the mountains and by a

variety of acidic metamorphic and igneous rocks in the Piedmont. Stands occupy middle and upper slopes, ridge crests, dry ravines, and bluffs, mostly below 760 m (2500 feet) elevation in the mountains and above 75 m (240 feet) in the Piedmont. Aspect is variable, and site moisture is typically assessed as subxeric or submesic. Soils are extremely acidic (mean pH = 4.2) with very low base cation levels.

Vegetation Description: Vegetation is a mixed forest codominated by *Pinus strobus* (eastern white pine) (25-75% canopy cover) and various oaks, particularly *Quercus alba* (white oak), *Quercus coccinea* (scarlet oak), *Quercus rubra* (northern red oak), and *Quercus prinus* (chestnut oak). Minor canopy associates include *Acer rubrum* (red maple), *Carya alba* (mockernut hickory), *Carya glabra* (pignut hickory), *Fagus grandifolia* (American beech) (mostly Piedmont), *Liriodendron tulipifera* (tuliptree), *Nyssa sylvatica* (blackgum), *Pinus virginiana* (Virginia pine), *Quercus falcata* (southern red oak) (mostly Piedmont), *Quercus velutina* (black oak), and *Tsuga canadensis* (eastern hemlock). *Acer rubrum* (red maple) and *Nyssa sylvatica* (blackgum) are abundant understory trees, along with *Cornus florida* (flowering dogwood). The shrub layer is predominantly ericaceous and varies from sparse and patchy to occasionally dense. *Vaccinium stamineum* (deerberry), *Vaccinium pallidum* (Blue Ridge blueberry), and *Kalmia latifolia* (mountain laurel), in descending order of frequency in plots, are characteristic ericads. Other frequent but low-cover shrub-layer species include *Viburnum acerifolium* (mapleleaf viburnum), *Smilax rotundifolia* (roundleaf greenbrier), *Sassafras albidum* (sassafras), and *Diospyros virginiana* (common persimmon). The herb layer is typically sparse, consisting mostly of woody seedlings and scattered individuals of *Chimaphila maculata* (striped prince's pine), *Polygonatum biflorum* (smooth Solomon's seal), *Mitchella repens* (partridgeberry), *Cypripedium acaule* (moccasin flower), and other acidophiles. Occasional stands, especially on shale substrates, contain dense graminoid patches of *Danthonia spicata* (poverty oatgrass), *Deschampsia flexuosa* (wavy hairgrass), or *Carex pensylvanica* (Pennsylvania sedge). Species richness of plot-sampled stands ranges from 16 to 65 taxa per 400 square meters (mean = 36).

Most Abundant Species: Information not available.

Characteristic Species: *Carya alba* (mockernut hickory), *Chimaphila umbellata* ssp. *cisatlantica*, *Diospyros virginiana* (common persimmon), *Pinus strobus* (eastern white pine), *Pinus virginiana* (Virginia pine), *Quercus alba* (white oak), *Quercus coccinea* (scarlet oak), *Quercus falcata* (southern red oak), *Quercus stellata* (post oak), *Vaccinium stamineum* (deerberry).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: The known range of this community includes the Central Appalachian region of Virginia, Maryland, and West Virginia, and the northern and central Piedmont of Virginia. The type is particularly abundant and widespread on low shale mountains and hills in the west-central Virginia (Alleghany, Bath, and Craig counties) and adjacent West Virginia.

States/Provinces: MD, VA:S4?, WV.

Federal Lands: NPS (Blue Ridge Parkway, C&O Canal, Fredericksburg-Spotsylvania, Manassas); USFS (George Washington, Jefferson).

CONSERVATION STATUS

Rank: G4 (21-Jan-2009).

Reasons: Although currently known from a relatively small geographic range, this community type locally covers extensive areas in the Ridge and Valley portion of the Central Appalachians.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: No information.

Comments: The circumscription of this type is based on analysis of 16 plot samples from the Virginia Piedmont and Blue Ridge, and Maryland Ridge and Valley. Additional data, particularly from Central Appalachian regions where white pine is prevalent, would assist in making the classification more robust and identifying potential regional patterns of variation. Central Appalachian white pine - hardwood forests are distinguished from similar vegetation of the Southern Appalachians, e.g., *Pinus strobus* - *Quercus alba* - (*Carya alba*) / *Gaylussacia ursina* Forest (CEGL007517) and *Pinus strobus* - *Quercus (coccinea, prinus)* / (*Gaylussacia ursina*, *Vaccinium stamineum*) Forest (CEGL007519) by the absence of Southern Appalachian species such as *Gaylussacia ursina* (bear huckleberry), *Leucothoe recurva* (redtwig doghobble), *Rhododendron minus* (piedmont rhododendron), *Arundinaria gigantea* (giant cane), and *Hydrangea radiata* (silverleaf hydrangea).

Similar Associations:

- *Pinus strobus* - *Quercus (coccinea, prinus)* / (*Gaylussacia ursina*, *Vaccinium stamineum*) Forest (CEGL007519)--of the Southern Appalachians.
- *Pinus strobus* - *Quercus (rubra, alba)* - *Liriodendron tulipifera* Forest (CEGL006304)--of more mesic habitats (e.g., acidic coves) in Maryland, Virginia, and West Virginia.
- *Pinus strobus* - *Quercus (rubra, velutina)* - *Fagus grandifolia* Forest (CEGL006293).
- *Pinus strobus* - *Quercus alba* - (*Carya alba*) / *Gaylussacia ursina* Forest (CEGL007517)--of the Southern Appalachians.

Related Concepts:

- *Pinus strobus* - *Quercus alba* - *Quercus coccinea* / *Vaccinium stamineum* Forest (Fleming and Coulling 2001) =
- *Quercus montana* - *Pinus strobus* / *Ostrya virginiana* Forest (Fleming and Moorhead 2000) F
- White Pine - Chestnut Oak: 51 (Eyre 1980) B

SOURCES

Description Authors: G. P. Fleming and P. P. Coulling, mod. G. P. Fleming.

References: Eyre 1980, Fleming 1999, Fleming and Coulling 2001, Fleming and Moorhead 2000, Fleming et al. 2001, Rhoades 1995, VDNH 2003.



Figures I5. Eastern White Pine - Hardwood Forest (plot FRSP.16) at Fredericksburg and Spotsylvania National Military Park. June 2004. NAD 1983 / UTM easting 258523, northing 4244993.

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: CEGLO06075

LOCAL INFORMATION

Environmental Description: Mesic Mixed Hardwood Forest is a mesic to submesic deciduous forest that occurs on lower slopes adjacent to small streams and creeks or gentle gradients throughout Fredericksburg & Spotsylvania National Military Park. It is a mixed forest with soils that are typically well-drained, acidic sandy and silt loams derived from parent material of low to moderate fertility.

Vegetation Description: The canopy is composed of variable combinations of *Fagus grandifolia* (American beech), *Liriodendron tulipifera* (tuliptree), *Quercus alba* (white oak), and *Quercus rubra* (northern red oak). Stands may be dominated by *Fagus grandifolia* (American beech), *Liriodendron tulipifera* (tuliptree), or *Quercus alba* (white oak). Stands dominated by *Quercus alba* (white oak) typically have high cover of *Fagus grandifolia* (American beech) in the subcanopy. Other species that can be associates in the canopy include *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), *Quercus falcata* (southern red oak), *Carya alba* (mockernut hickory), *Carya glabra* (pignut hickory), and *Pinus virginiana* (Virginia pine). Common subcanopy and tall-shrub species include *Acer rubrum* (red maple), *Carpinus caroliniana* (American hornbeam), *Ilex opaca* var. *opaca* (American holly), *Cornus florida* (flowering dogwood), and *Nyssa sylvatica* (blackgum). Low-shrub species include *Viburnum acerifolium* (mapleleaf viburnum), *Vaccinium* spp. (blueberries), and *Viburnum dentatum* (southern arrowwood). Common woody vines are *Parthenocissus quinquefolia* (Virginia creeper), *Smilax rotundifolia* (roundleaf greenbrier), *Vitis* sp. (a grape), and *Lonicera japonica* (Japanese honeysuckle). The herbaceous stratum is often sparse; the most constant species are *Mitchella repens* (partridgeberry), *Polystichum acrostichoides* (Christmas fern), and *Lycopodium digitatum* (fan clubmoss). Other characteristic species include *Euonymus americanus* (strawberry bush), *Desmodium nudiflorum* (naked-stem tick-trefoil), *Galium circaezans* (licorice bedstraw), *Maianthemum racemosum* ssp. *racemosum* (feathery false lily of the valley), *Carex* spp. (sedges), *Chimaphila maculata* (striped prince's pine), *Phegopteris hexagonoptera* (broad beechfern), *Polygonatum biflorum* var. *biflorum* (smooth Solomon's-seal), and *Thelypteris noveboracensis* (New York fern).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	<i>Fagus grandifolia</i> (American beech), <i>Quercus alba</i> (white oak)
Tree canopy	Broad-leaved deciduous tree	<i>Liriodendron tulipifera</i> (tuliptree)

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

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Isotria medeoloides</i> (small whorled pogonia)	G2	plant	Federally listed; VA state rare
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	plant	invasive nonnative

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNR*	B	C	Mesic Mixed Hardwood Forest	Fleming et al. 2006

Local Range: Mesic Mixed Hardwood Forest covers a total of 72 hectares and is mapped as 14 polygons ranging in size from 1 to 13 hectares.

Classification Comments: Some stands of Mesic Mixed Hardwood Forest may be confused with Acidic Oak-Hickory Forest. Acidic Oak-Hickory Forest occurs on rolling uplands and typically only has *Fagus grandifolia* (American beech) present as scattered individuals in the shrub layer. Mesic Mixed Hardwood Forest may also have many species in common with stands of Successional Tuliptree Forest. It is distinguished by having a more diverse canopy, with *Fagus grandifolia* (American beech) and *Quercus alba* (white oak) often dominant, and low cover (if present) of herbaceous species associated with disturbance and canopy openings such as *Microstegium vimineum* (Nepalese browntop) and *Lycopodium digitatum* (fan clubmoss).

Other Comments: Polygons mapped as this association may contain small inclusions of the map class Coastal Plain / Piedmont Floodplain Forest if the occurrence was too narrow to map.

Local Description Authors: K. Taverna.

Plots: FRSP.10, FRSP.24, FRSP.25.

Fredericksburg & Spotsylvania National Military 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	<i>Fagus grandifolia</i> - <i>Quercus rubra</i> - <i>Quercus alba</i> Forest Alliance (A.229)
Alliance (English name)	American Beech - Northern Red Oak - White Oak Forest Alliance
Association	<i>Fagus grandifolia</i> - <i>Quercus</i> (<i>alba</i> , <i>rubra</i>) - <i>Liriodendron tulipifera</i> / (<i>Ilex opaca</i> var. <i>opaca</i>) / <i>Polystichum acrostichoides</i> 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) Northern Atlantic Coastal Plain Dry 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 crane fly), *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 crane fly), *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:

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

Characteristic Species: *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, Blue Ridge Parkway?, C&O Canal, Colonial, Fredericksburg-Spotsylvania, George Washington Parkway, National Capital-East, Petersburg, Prince William, Richmond, Rock Creek, 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.



Figure I6. Mesic Mixed Hardwood Forest (plot FRSP.25) at Fredericksburg and Spotsylvania National Military Park. August 2004. NAD 1983 / UTM easting 272905, 4233092 northing.

COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL TULIPTREE FOREST

SYNONYMS

USNVC English Name: Tuliptree - Oak species Forest
USNVC Scientific Name: *Liriodendron tulipifera* - *Quercus* spp. Forest
USNVC Identifier: CEGLO07221

LOCAL INFORMATION

Environmental Description: Successional Tuliptree Forest is an early- to mid-successional forest and is considered a semi-natural association. It occurs on areas which were once clearcut, old fields, or cleared by fire or other natural disturbances. It occurs on lower slopes, floodplains, and in draws, on all aspects and elevations in Fredericksburg & Spotsylvania National Military Park. Soils are often eroded with little to no organic matter or A-horizon development.

Vegetation Description: The canopy of this deciduous forest often consists of even-aged *Liriodendron tulipifera* (tuliptree), occurring with other early-successional trees such as *Acer rubrum* (red maple), *Liquidambar styraciflua* (sweetgum), and *Pinus virginiana* (Virginia pine). Older successional stands can have *Quercus alba* (white oak) as a codominant in the canopy. Other deciduous trees, such as *Quercus rubra* (northern red oak), *Fraxinus americana* (white ash), and *Carya alba* (mockernut hickory), may also be found in the canopy, but these species typically do not dominate. Successional Virginia Pine Forest is often the precursor of this association, thus standing dead or fallen *Pinus virginiana* (Virginia pine) are often present. If a distinct subcanopy has developed, typical trees include *Cornus florida* (flowering dogwood), *Fagus grandifolia* (American beech), *Acer rubrum* (red maple), *Ilex opaca* var. *opaca* (American holly), *Nyssa sylvatica* (blackgum), *Sassafras albidum* (sassafras), and *Carpinus caroliniana* (American hornbeam). Shrubs are mostly *Viburnum acerifolium* (mapleleaf viburnum), *Smilax* sp. (greenbrier) vines, *Lonicera japonica* (Japanese honeysuckle), *Toxicodendron radicans* (eastern poison ivy), and sometimes *Ligustrum sinense* (Chinese privet). The ground layer is usually a mix of mesic forest herbs and species typical of disturbed areas, as well as exotic vines, shrubs, and herbs. A typical dominant species is *Lycopodium digitatum* (fan clubmoss). Other common species include *Desmodium nudiflorum* (naked-stem tick-trefoil), *Microstegium vimineum* (Nepalese browntop), *Polystichum acrostichoides* (Christmas fern), *Thelypteris noveboracensis* (New York fern), *Euonymus americanus* (strawberry bush), *Mitchella repens* (partridgeberry), and *Dichanthelium* spp. (rosette grasses).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Liriodendron tulipifera</i> (tuliptree)
Herb (field)	Fern or fern ally	<i>Lycopodium digitatum</i> (fan clubmoss)

Characteristic Species: *Acer rubrum* (red maple), *Liriodendron tulipifera* (tuliptree), *Lycopodium digitatum* (fan clubmoss), *Quercus alba* (white oak).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Ailanthus altissima</i> (tree of heaven)	-	plant	invasive nonnative
<i>Hedera helix</i> (English ivy)	-	plant	invasive nonnative
<i>Ligustrum sinense</i> (Chinese privet)	-	plant	invasive nonnative
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	plant	invasive nonnative
<i>Microstegium vimineum</i> (Nepalese browntop)	-	plant	invasive nonnative

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNA	.	.	[not crosswalked]	.

Local Range: Successional Tuliptree Forest occurs throughout Fredericksburg & Spotsylvania National Military Park. It is mapped as 44 polygons, ranging in size from 0.5 to 45 hectares, covering a total of 238 hectares in the park.

Classification Comments: The composition of Successional Tuliptree Forest varies greatly within Fredericksburg & Spotsylvania National Military Park depending mostly on stand age and topographic position. The associated species of shrubs, herbs and occasional trees vary with the type of forest that once occurred on the site. Stands on or near disturbed floodplains may have *Platanus occidentalis* (American sycamore) and other species typical of temporarily flooded forests, such as *Carpinus caroliniana* (American hornbeam), *Celtis occidentalis* (common hackberry), and *Thelypteris noveboracensis* (New York fern). Some small inclusions of streamside vegetation are mapped as Successional Tuliptree Forest if below minimum mapping unit (0.5 ha). Former Successional Virginia Pine Forest stands that have developed >75% deciduous canopies are included in this association and may have scattered *Pinus virginiana* (Virginia pine) in the canopy. Stands that were former pastures may have open grown *Quercus* (Oak) species in the canopy (used as pasture shade trees). Stands near homesites typically have a higher diversity of species not common in more interior forest stands. These include *Juglans nigra* (black walnut), *Robinia pseudoacacia* (black locust), and the nonnative species *Ailanthus altissima* (tree of heaven) and *Ligustrum sinense* (Chinese privet).

Other Comments: Depending on soil chemistry and other site characteristics, this association, if left undisturbed, will succeed to one of the later successional hardwood forests occurring in the area, such as Acidic Oak-Hickory Forest, Mesic Mixed Hardwood Forest, or Coastal Plain / Piedmont Small Stream Floodplain Forest.

Local Description Authors: K. Taverna and K. D. Patterson.

Plots: None.

Fredericksburg & Spotsylvania National Military 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	<i>Liriodendron tulipifera</i> Forest Alliance (A.236)
Alliance (English name)	Tuliptree Forest Alliance
Association	<i>Liriodendron tulipifera</i> - <i>Quercus</i> spp. Forest
Association (English name)	Tuliptree - Oak species Forest
Ecological System(s):	Southern Coastal Plain Mesic Slope Forest (CES203.476) Southern Interior Low Plateau Dry-Mesic Oak Forest (CES202.898) East Gulf Coastal Plain Northern Dry Upland Hardwood Forest (CES203.483)

GLOBAL DESCRIPTION

Concept Summary: This broadly defined semi-natural or successional community is one of several described upland associations dominated by *Liriodendron tulipifera* (tuliptree). It ranges from the southern Cumberland Plateau, Piedmont, and Interior Low Plateau of the southeastern

U.S. north to the northern Piedmont of New Jersey. Species found in stands attributable to this type may include a fairly diverse and varied composition. *Acer rubrum* (red maple), *Quercus* spp. (oaks), and occasionally *Liquidambar styraciflua* (sweetgum) or *Robinia pseudoacacia* (black locust) may be common in stands of this type; *Betula lenta* (sweet birch) often occurs at the northern end of the range. Examples are common across large areas of the upland landscape which have previously been disturbed. These successional forests often follow cropping, clearcut logging, or other severe disturbance, and are successional to mixed oak-hickory forests. The oaks in these stands are frequently multi-stemmed, resulting from coppicing. Shrub composition is variable but may include *Sambucus canadensis* (= *Sambucus nigra* ssp. *canadensis*) (common elderberry) and *Vaccinium pallidum* (Blue Ridge blueberry). Herbs are likewise variable; West Virginia samples feature *Dioscorea quaternata* (fourleaf yam), *Lysimachia quadrifolia* (whorled yellow loosestrife), *Maianthemum racemosum* (feathery false lily of the valley), *Solidago curtisii* (mountain decumbent goldenrod), *Symphyotrichum prenanthoides* (crookedstem aster), and *Geranium maculatum* (spotted geranium). This association differs from other described types in the alliance based on the lack of a significant pine component [see *Liriodendron tulipifera* - *Pinus taeda* Forest (CEGL007521)] and the absence of species affiliated with circumneutral conditions [see *Liriodendron tulipifera* / (*Cercis canadensis*) / (*Lindera benzoin*) Forest (CEGL007220)]; it is later successional and more diverse than *Liriodendron tulipifera* Forest (CEGL007218) or *Liriodendron tulipifera* - *Robinia pseudoacacia* Forest (CEGL007219).

Environmental Description: These semi-natural upland deciduous forests are found primarily in areas which were once clearcuts, old fields, or were cleared by fire or other natural disturbances. These non-wetland forests are also found along mesic stream terraces. In previously logged areas on West Virginia plateaus which span a topographic gradient, this association occurs in water-collecting positions (lower slopes, coves), while water-shedding positions (upper slopes, ridges) are occupied by oak-dominated forests.

Vegetation Description: The canopy of this semi-natural upland association is dominated by *Liriodendron tulipifera* (tuliptree). *Quercus* (Oak) species (*Quercus alba* (white oak), *Quercus rubra* (northern red oak), *Quercus falcata* (southern red oak), *Quercus nigra* (water oak), *Quercus velutina* (black oak)) are often present; additional associates may include *Acer rubrum* (red maple), *Carya* spp. (hickories), *Fagus grandifolia* (American beech), *Nyssa sylvatica* (blackgum), *Cornus florida* (flowering dogwood), and *Robinia pseudoacacia* (black locust). *Betula lenta* (sweet birch) is a common associate at the northern range limit. Shrub layers may include saplings of the canopy species and *Acer pensylvanicum* (striped maple), *Amelanchier arborea* (common serviceberry), *Hamamelis virginiana* (American witchhazel), *Lindera benzoin* (northern spicebush) (in small amounts), and *Vaccinium pallidum* (Blue Ridge blueberry). Herbs vary across the range but may include *Actaea racemosa* (black bugbane), *Dichanthelium clandestinum* (deertongue), *Dioscorea quaternata* (fourleaf yam), *Galium circaeazans* (licorice bedstraw), *Geranium maculatum* (spotted geranium), *Goodyera pubescens* (downy rattlesnake plantain), *Medeola virginiana* (Indian cucumber), *Potentilla simplex* (common cinquefoil), *Scutellaria serrata* (showy skullcap), *Thelypteris noveboracensis* (New York fern), and *Uvularia perfoliata* (perfoliate bellwort). *Lycopodium digitatum* (fan clubmoss) may be abundant in some stands.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	<i>Liriodendron tulipifera</i> (tuliptree)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Cornus florida</i> (flowering dogwood)
Herb (field)	Fern or fern ally	<i>Lycopodium digitatum</i> (fan clubmoss)

Characteristic Species: *Acer pensylvanicum* (striped maple), *Acer rubrum* (red maple), *Actaea racemosa* (black bugbane), *Amelanchier arborea* (common serviceberry), *Carya glabra* (pignut hickory), *Dichanthelium clandestinum* (deertongue), *Fagus grandifolia* (American beech), *Galium circaezans* (licorice bedstraw), *Geranium maculatum* (spotted geranium), *Goodyera pubescens* (downy rattlesnake plantain), *Hamamelis virginiana* (American witchhazel), *Lycopodium digitatum* (fan clubmoss), *Medeola virginiana* (Indian cucumber), *Nyssa sylvatica* (blackgum), *Quercus rubra* (northern red oak), *Quercus velutina* (black oak), *Robinia pseudoacacia* (black locust), *Thelypteris noveboracensis* (New York fern), *Uvularia perfoliata* (perfoliate bellwort), *Vaccinium pallidum* (Blue Ridge blueberry).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association is known from the southern Cumberland Plateau, Piedmont, and Interior Low Plateau of the southeastern U.S. and may also occur in the Upper East Gulf Coastal Plain. It ranges north to the northern Piedmont of New Jersey and adjacent Pennsylvania. It is also known from Alabama, Georgia, Kentucky, Maryland, North Carolina, South Carolina, Tennessee, West Virginia, and possibly Virginia and Delaware.

States/Provinces: AL, DE?, GA, KY, MD, NC, NJ, PA, SC, TN, VA, WV.

Federal Lands: DOD (Camp Dawson, Fort Benning); NPS (Big South Fork, Blue Ridge Parkway, Booker T. Washington, Chickamauga-Chattanooga?, Cowpens, Cumberland Gap, Fredericksburg-Spotsylvania, Guilford Courthouse, Kennesaw Mountain, Kings Mountain, Mammoth Cave, Morristown, Natchez Trace, New River Gorge, Ninety Six, Obed, Shiloh, Valley Forge); USFS (Bankhead, Daniel Boone, Oconee?, Talladega, Talladega (Oakmulgee)?, Talladega (Talladega)).

CONSERVATION STATUS

Rank: GNA (ruderal) (19-Aug-2002).

Reasons: This forest represents early-successional vegetation and is thus not of conservation concern. This is a successional vegetation type composed of native species. Its conservation value is limited, but mature examples could provide buffer for communities of greater conservation value.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 – Moderate.

Comments: Within its range, it differs from other described types based on the lack of a significant pine component [see *Liriodendron tulipifera* - *Pinus taeda* Forest (CEGL007521)] and the absence of species affiliated with circumneutral conditions [see *Liriodendron tulipifera* / (*Cercis canadensis*) / (*Lindera benzoin*) Forest (CEGL007220)]; it is later successional and more diverse than *Liriodendron tulipifera* Forest (CEGL007218) and tends to be found on more stable soil substrates and less steep slopes than *Liriodendron tulipifera* - *Robinia pseudoacacia* Forest (CEGL007219).

Similar Associations:

- *Liriodendron tulipifera* - *Acer negundo* Forest (CEGL007184)--a bottomland type.
- *Liriodendron tulipifera* - *Robinia pseudoacacia* Forest (CEGL007219)--is generally found on steeper slopes and/or shallow soils and with a more intense history of disturbance.
- *Liriodendron tulipifera* / (*Cercis canadensis*) / (*Lindera benzoin*) Forest (CEGL007220)--is generally found on calcareous or at least pH neutral soils.
- *Prunus serotina* - *Liriodendron tulipifera* - *Acer rubrum* - *Fraxinus americana* Forest (CEGL006599).
- *Prunus serotina* - *Sassafras albidum* - (*Fraxinus americana*) / *Juniperus virginiana* Forest (CEGL004133).

Related Concepts:

- Successional forest of low-elevation plateaus (Vanderhorst 2001a) B
- Tulip Poplar Type (Schmalzer and DeSelm 1982) B
- Yellow poplar community (Ehrenfeld 1977) =

SOURCES

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

References: Ehrenfeld 1977, Gallyoun et al. 1996, Keever 1973, NatureServe Ecology - Southeastern U.S. unpubl. data, Overlease 1987, Russell and Schuyler 1988, Schmalzer and DeSelm 1982, Schotz pers. comm., Southeastern Ecology Working Group n.d., TDNH unpubl. data, Vanderhorst 2001a, Vanderhorst and Streets 2006.



Figure 17. Successional Tuliptree Forest photographed at Booker T. Washington National Monument. August 2007.

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: CEG008475

LOCAL INFORMATION

Environmental Description: Acidic Oak-Hickory Forest is a deciduous forest that occurs on rolling uplands throughout Fredericksburg & Spotsylvania National Military Park over deep, well-drained soils. Stands occurring on more fertile soils tend to have higher cover of herbaceous species, while stands over more acidic soils tend to have patchy cover of ericaceous shrubs. Acidic Oak-Hickory Forest often occurs on sideslopes adjacent to areas mapped as Oak / Heath Forest, which is predominantly located on local crests and ridges.

Vegetation Description: Overstory composition varies somewhat from stand to stand, but it is typically dominated by mixtures of oak and hickory, such as *Quercus alba* (white oak), *Quercus rubra* (northern red oak), *Carya alba* (mockernut hickory), and *Carya glabra* (pignut hickory). The association can occur in the park with little to no hickory cover and occasionally has a nearly monospecific overstory of white oak. Other common canopy trees include *Liriodendron tulipifera* (tuliptree), *Quercus falcata* (southern red oak), *Quercus velutina* (black oak), and *Nyssa sylvatica* (blackgum). *Pinus virginiana* (Virginia pine) is often scattered throughout the canopy but is not a dominant. *Acer rubrum* (red maple), *Cornus florida* (flowering dogwood), *Liquidambar styraciflua* (sweetgum), *Ilex opaca* var. *opaca* (American holly), and *Sassafras albidum* (sassafras) are common understory/tall-shrub species. Other mesic species such as *Fagus grandifolia* (American beech) and *Fraxinus* spp. (ash species) are occasionally scattered throughout the understory. The shrub stratum varies from open to quite dense, with species from the overstory often occurring as woody saplings. Other common shrubs include *Viburnum acerifolium* (mapleleaf viburnum) and ericaceous species such as *Vaccinium stamineum* (deerberry), *Vaccinium pallidum* (Blue Ridge blueberry), and *Gaylussacia baccata* (black huckleberry). The ericaceous shrubs can exhibit small-scale patch-dominance, but do not dominate the entire shrub layer, as is typical with associations in the Oak - Heath Forest map class. The herb layer is generally sparse or patchy but can be quite species-rich; it supports diverse mixtures of both mesophytic and dry-site species. Some typical herb species found in this association include *Desmodium nudiflorum* (naked-stem tick-trefoil), *Mitchella repens* (partridgeberry), *Polystichum acrostichoides* (Christmas fern), *Maianthemum racemosum* ssp. *racemosum* (feathery false lily of the valley), *Galium circaezans* (licorice bedstraw), *Chimaphila maculata* (striped prince's pine), *Polygonatum biflorum* (smooth Solomon's seal), *Dichanthelium dichotomum* (cypress panicgrass), *Dichanthelium boscii* (Bosc's panicgrass), *Carex* spp. (sedges), *Amphicarpaea bracteata* (American hogpeanut), and *Dioscorea quaternata* (fourleaf yam).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Liriodendron tulipifera</i> (tuliptree), <i>Quercus alba</i> (white oak)

Characteristic Species: *Carya alba* (mockernut hickory), *Carya glabra* (pignut hickory), *Cornus florida* (flowering dogwood), *Quercus alba* (white oak), *Viburnum acerifolium* (mapleleaf viburnum), *Desmodium nudiflorum* (naked-stem tick-trefoil).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	plant	invasive nonnative
<i>Microstegium vimineum</i> (Nepalese browntop)	-	plant	invasive nonnative

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNR*	B	C	Acidic Oak - Hickory Forest	Fleming et al. 2006

Local Range: This deciduous forest occurs on rolling uplands throughout the park. It is mapped as 60 polygons, ranging in size from 0.6 to 94 hectares. It covers a total of 464 hectares in the park.

Classification Comments: Acidic Oak-Hickory Forests can be distinguished from other hardwood forests by canopy dominance of oaks (often with hickories) and by their landscape position on sideslopes. It can be distinguished from Mesic Mixed Hardwood Forest by the absence of *Fagus grandifolia* (American beech) as a canopy or subcanopy dominant, although *Fagus grandifolia* (American beech) can be present in the shrub layer (even locally dominant). This forest is distinguished from forests mapped as Oak / Heath Forest by lacking a more-or-less continuous, dense ericaceous shrub layer.

Other Comments: Polygons of this association can have inclusions of associations in the Oak / Heath Forest map class (primarily distinguished by patches of higher heath density). In some cases, Oak / Heath Forest was included in an Acidic Oak-Hickory Forest polygon if the patch was below minimum mapping unit (0.5 ha). There are also instances where this association includes small inclusions of the map class Coastal Plain / Piedmont Floodplain Forest (often below minimum mapping unit) in narrow valleys along rolling uplands.

Local Description Authors: K. Taverna and K. D. Patterson.

Plots: FRSP.1, FRSP.2, FRSP.4, FRSP.8, FRSP.21, FRSP.23.

Fredericksburg & Spotsylvania National Military 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	<i>Quercus alba</i> - (<i>Quercus rubra</i> , <i>Carya</i> spp.) Forest Alliance (A.239)
Alliance (English name)	White Oak - (Northern Red Oak, Hickory species) Forest Alliance
Association	<i>Quercus alba</i> - <i>Quercus rubra</i> - <i>Carya alba</i> / <i>Cornus florida</i> / <i>Vaccinium stamineum</i> / <i>Desmodium nudiflorum</i> 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 Dry Hardwood Forest (CES203.475)
Northeastern Interior Dry-Mesic Oak Forest (CES202.592)
Southern Piedmont Dry Oak-(Pine) Forest (CES202.339)
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. (heartleaf species), *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 crane-fly), 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. (heartleaf species), *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 crane fly), 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:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Quercus alba</i> (white oak)

Characteristic Species: *Quercus alba* (white oak).

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 elliotii* 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 (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 1988b) ?
- White oak - northern red oak - false Solomon's seal (*Quercus alba* - *Quercus rubra* - *Smilacina racemosa*) community type (Jones 1988a) ?

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 I8. Acidic Oak – Hickory Forest (plot FRSP.23) at Fredericksburg and Spotsylvania National Military Park. August 2004. NAD 1983 / UTM easting 273172, northing 4232684.



Figure I9. Acidic Oak – Hickory Forest (plot FRSP.21) at Fredericksburg and Spotsylvania National Military Park. July 2004. NAD 1983 / UTM easting 271415, northing 4233657.

COMMON NAME (PARK-SPECIFIC): COASTAL PLAIN MIXED OAK / HEATH FOREST

SYNONYMS

USNVC English Name: White Oak - Southern Red Oak - (Sand Hickory) / Dangleberry Forest
USNVC Scientific Name: *Quercus alba* - *Quercus falcata* - (*Carya pallida*) / *Gaylussacia frondosa* Forest
USNVC Identifier: CEG006269

LOCAL INFORMATION

Environmental Description: This association is a dry, deciduous, oak-dominated forest occurring on low sideslopes in Fredericksburg & Spotsylvania National Military Park, bordering broad wetland flats. It generally occurs on well-drained acidic soils, primarily sandy loams and silty/clay loams. This association is restricted to the Coastal Plain region of the park and is only documented in Fredericksburg Battlefield bordering Non-Riverine Saturated Forest.

Vegetation Description: The canopy is dominated by a mixture of oaks, such as *Quercus alba* (white oak), *Quercus rubra* (northern red oak), and *Quercus coccinea* (scarlet oak). *Liriodendron tulipifera* (tuliptree) is also a common canopy dominant. Associates include *Liquidambar styraciflua* (sweetgum), *Nyssa sylvatica* (blackgum), *Quercus falcata* (southern red oak), *Carya* spp. (hickories), and *Pinus taeda* (loblolly pine), with *Acer rubrum* (red maple), *Ilex opaca* var. *opaca* (American holly), and *Cornus florida* (flowering dogwood) often forming a subcanopy. The shrub layer is well-developed and dominated by ericaceous species such as *Gaylussacia frondosa* (blue huckleberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Vaccinium stamineum* (deerberry), *Gaylussacia baccata* (black huckleberry), and occasionally *Vaccinium formosum* (southern blueberry) and/or *Vaccinium corymbosum* (highbush blueberry). The herbaceous layer is generally sparse and can include *Chimaphila maculata* (striped prince's pine), *Mitchella repens* (partridgeberry), *Polygonatum biflorum* (smooth Solomon's seal), and *Gaultheria procumbens* (eastern teaberry).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	<i>Liriodendron tulipifera</i> (tuliptree), <i>Quercus alba</i> (white oak)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Gaylussacia frondosa</i> (blue huckleberry)

Characteristic Species: *Gaylussacia frondosa* (blue huckleberry), *Liquidambar styraciflua* (sweetgum), *Liriodendron tulipifera* (tuliptree), *Quercus alba* (white oak), *Vaccinium formosum* (southern blueberry).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNR*	B	C	Oak / Heath Forest	Fleming et al. 2006

Local Range: Coastal Plain Mixed Oak / Heath Forest is part of the map class Oak / Heath Forest, which includes two associations and is mapped as 67 polygons, covering 678.6 hectares (1676.8 acres) throughout FRSP.

Classification Comments: Coastal Plain Mixed Oak / Heath Forest can be distinguished from Piedmont / Low Elevation Mixed Oak / Heath Forest by its location on lower slopes in the Coastal Plain region of Fredericksburg & Spotsylvania National Military Park and by the

dominance of *Gaylussacia frondosa* (blue huckleberry) in the shrub layer, rather than *Gaylussacia baccata* (black huckleberry). This association also has higher coverage of *Liriodendron tulipifera* (tuliptree) in the canopy than is typical for Piedmont / Low Elevation Oak / Heath Forest, although this is likely an artifact of past disturbance.

Other Comments: Coastal Plain Mixed Oak / Heath Forest may be difficult to distinguish from Piedmont / Low Elevation Mixed Oak / Heath Forest, and therefore these two associations were combined into one map class: Oak / Heath Forest. Coastal Plain Mixed Oak / Heath Forest occurs in the Coastal Plain physiographic province, in the eastern portion of FRSP.

Local Description Authors: K. Taverna.

Plots: FRSP.19.

Fredericksburg & Spotsylvania National Military 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	<i>Quercus alba</i> - <i>Quercus (falcata, stellata)</i> Forest Alliance (A.241)
Alliance (English name)	White Oak - (Southern Red Oak, Post Oak) Forest Alliance
Association	<i>Quercus alba</i> - <i>Quercus falcata</i> - (<i>Carya pallida</i>) / <i>Gaylussacia frondosa</i> Forest
Association (English name)	White Oak - Southern Red Oak - (Sand Hickory) / Dangleberry Forest
Ecological System(s):	Northern Atlantic Coastal Plain Dry Hardwood Forest (CES203.475)

GLOBAL DESCRIPTION

Concept Summary: This oak forest of the unglaciated northeastern Coastal Plain generally occurs on well-drained acidic soils, primarily loamy sands, sandy loams and silty/clay loams. Occasional stands occur on imperfectly drained, alternately wet and dry upland flats with hardpan subsoils. The canopy is dominated by a mixture of oaks, especially *Quercus alba* (white oak), *Quercus falcata* (southern red oak), and *Quercus velutina* (black oak). Associates include *Sassafras albidum* (sassafras), *Quercus coccinea* (scarlet oak), *Quercus stellata* (post oak), *Liquidambar styraciflua* (sweetgum), *Nyssa sylvatica* (blackgum), *Carya* spp. (hickories), and *Pinus taeda* (loblolly pine), with *Acer rubrum* (red maple), *Ilex opaca* var. *opaca* (American holly), and *Cornus florida* (flowering dogwood) often forming a subcanopy. The shrub layer is well-developed and dominated by the deciduous ericads *Gaylussacia frondosa* (blue huckleberry), *Gaylussacia baccata* (black huckleberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Vaccinium stamineum* (deerberry), and occasionally *Lyonia mariana* (piedmont staggerbush). The herbaceous layer is generally sparse and characterized by xerophytes such as *Pteridium aquilinum* (western brackenfern), *Cypripedium acaule* (moccasin flower), *Chimaphila maculata* (striped prince's pine), and *Gaultheria procumbens* (eastern teaberry).

Environmental Description: This community generally occurs on well-drained acidic soils, primarily loamy sands, sandy loams and silty/clay loams. Occasional stands occur on imperfectly drained, alternately wet and dry, upland flats with hardpan subsoils. Even on the latter, moisture potential of most sites supporting this vegetation can be characterized as subxeric to xeric. Soil samples collected from plots of this vegetation type in Virginia are extremely acidic, with very low base cation levels and total base saturation.

Vegetation Description: Physiognomy is generally a closed to somewhat open forest. The overstory of mid- to late-successional stands is dominated by a mixture of oaks, especially *Quercus alba* (white oak), *Quercus falcata* (southern red oak), and *Quercus velutina* (black oak). Early-successional stands recovering from recent logging or agricultural conversion usually have a strong admixture of *Pinus taeda* (loblolly pine). Other canopy associates include *Sassafras albidum* (sassafras), *Quercus coccinea* (scarlet oak) (occasionally codominant), *Quercus stellata* (post oak), *Liquidambar styraciflua* (sweetgum), *Nyssa sylvatica* (blackgum), *Carya alba* (mockernut hickory), and *Carya pallida* (sand hickory) (occasionally codominant). *Acer rubrum* (red maple), *Ilex opaca* var. *opaca* (American holly), and *Cornus florida* (flowering dogwood) are the principal subcanopy trees. In the southern part of the range, *Oxydendrum arboreum* (sourwood) and scrambling vines of *Vitis rotundifolia* (muscadine) can be important in the understory. The shrub layer is well-developed and dominated by the deciduous ericads *Gaylussacia frondosa* (blue huckleberry), *Gaylussacia baccata* (black huckleberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Vaccinium stamineum* (deerberry), and occasionally *Lyonia mariana* (piedmont staggerbush). The herbaceous layer is generally sparse and characterized by xerophytes such as *Pteridium aquilinum* (western brackenfern), *Cypripedium acaule* (moccasin flower), *Chimaphila maculata* (striped prince's pine), and *Gaultheria procumbens* (eastern teaberry).

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 occurs on the Coastal Plain from New Jersey to Virginia and possibly northeastern North Carolina. In central and southeastern Virginia, it extends slightly into the eastern portion of the Piedmont.

States/Provinces: DE, MD, NC?, NJ:S3S4, VA:S4S5.

Federal Lands: DOD (Fort A.P. Hill, Yorktown); NPS (Fredericksburg-Spotsylvania, National Capital-East?, Petersburg, Richmond); USFWS (Blackwater, Chesapeake Marshlands, Prime Hook).

CONSERVATION STATUS

Rank: G4G5 (1-Dec-1997).

Reasons: The type is common and widespread on the Coastal Plain from New Jersey to Virginia. Mature examples are uncommon, and all stands are vulnerable to logging disturbances and fire suppression.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 – Moderate.

Comments: Classification is supported by analysis of a 1250-plot regional dataset assembled for the NCR and mid-Atlantic national parks vegetation mapping projects. In that classification, this association was represented by 18 plots. (*Pinus taeda*) - *Quercus falcata* / *Gaylussacia frondosa* Forest (CEGL006169) has been archived and incorporated into this type by Gary Fleming.

Similar Associations:

- *Quercus alba* - *Quercus (coccinea, velutina, prinus)* / *Gaylussacia baccata* Forest (CEGL008521)--Piedmont analogue of CEGl006269; has more *Quercus prinus*, less *Quercus falcata*, and lacks *Gaylussacia frondosa* and other species more characteristic of the Coastal Plain.

Related Concepts:

- *Quercus alba* - *Quercus falcata* - (*Pinus taeda*) / *Gaylussacia frondosa* Forest (Fleming pers. comm.) =
- Dry Oak-Pine Forest, mixed oak-pine forest subtype (Breden 1989) ?
- Pine - oak association (Shreve et al. 1910) B

SOURCES

Description Authors: G. P. Fleming.

References: Breden 1989, Breden et al. 2001, Eastern Ecology Working Group n.d., Fleming et al. 2001, Fleming pers. comm., Harrison 2004, Shreve et al. 1910, Sneddon et al. 1996, VDNH 2003.



Figure I10. Coastal Plain Mixed Oak / Heath Forest photographed at Richmond National Battlefield Park. April 2002.



Figure I11. Coastal Plain Mixed Oak / Heath Forest photographed at Petersburg National Battlefield. September 2005.

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: This association is a dry, deciduous, oak-dominated forest occurring on upland flats and upper slope convexities throughout Fredericksburg & Spotsylvania National Military Park. Soils are typically deep, oligotrophic, gravelly loams. Soils are acidic with low pH values (average = 4.2) and low percentage base saturation (average = 12%). Exposed rocks of any kind (outcrops, boulders, or stones) are usually sparse to absent.

Vegetation Description: The canopy is mixed with variable dominance by *Quercus alba* (white oak), *Quercus rubra* (northern red oak), and *Quercus prinus* (chestnut oak). Frequent canopy and subcanopy associates include *Quercus falcata* (southern red oak), *Quercus coccinea* (scarlet oak), *Nyssa sylvatica* (blackgum), *Acer rubrum* (red maple), *Ilex opaca* var. *opaca* (American holly), *Carya glabra* (pignut hickory), *Cornus florida* (flowering dogwood), and *Sassafras albidum* (sassafras). *Pinus virginiana* (Virginia pine) is often scattered throughout the canopy, particularly following recent disturbance. The shrub layer may be patchy to dense and continuous and is often dominated by the ericaceous shrubs *Gaylussacia baccata* (black huckleberry), *Kalmia latifolia* (mountain laurel), *Vaccinium stamineum* (deerberry), and/or *Vaccinium pallidum* (Blue Ridge blueberry). Other shrubs often include saplings of canopy species, *Viburnum acerifolium* (mapleleaf viburnum), *Diospyros virginiana* (common persimmon), and *Smilax rotundifolia* (roundleaf greenbrier). Herbs are typically sparse and include *Chimaphila maculata* (striped prince's pine), *Mitchella repens* (partridgeberry), and *Polygonatum biflorum* (smooth Solomon's seal). Species richness is typically moderate to very low, with an average of 25 species per 400-square-meter quadrat.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	<i>Quercus alba</i> (white oak)
Tree canopy	Broad-leaved deciduous tree	<i>Quercus prinus</i> (chestnut oak)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Gaylussacia baccata</i> (black huckleberry)

Characteristic Species: *Gaylussacia baccata* (black huckleberry), *Nyssa sylvatica* (blackgum), *Quercus alba* (white oak), *Quercus prinus* (chestnut oak), *Vaccinium stamineum* (deerberry).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Gaylussacia dumosa</i> (dwarf huckleberry)	-	plant	Spotsylvania County Record; VA State watchlist

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNR*	B	C	Oak / Heath Forest	Fleming et al. 2006

Local Range: Piedmont / Low Elevation Mixed Oak / Heath Forest is part of the map class Oak / Heath Forest, which includes two associations and is mapped as 67 polygons ranging in size from 0.5 to 157 hectares, covering a total of 678.6 hectares (1676.8 acres) throughout FRSP.

Classification Comments: Piedmont / Low Elevation Mixed Oak / Heath Forest can be 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: Stands can vary based on canopy dominants like *Quercus alba* (white oak) versus *Quercus prinus* (chestnut oak) and coverage of ericaceous shrubs. Piedmont / Low Elevation Mixed Oak / Heath Forest may be difficult to distinguish from Coastal Plain Mixed Oak / Heath Forest, and therefore these two associations were combined into one map class: Oak / Heath Forest.

Local Description Authors: K. Taverna.

Plots: FRSP.3, FRSP.6, FRSP.15, FRSP.20.

Fredericksburg & Spotsylvania National Military 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	<i>Quercus velutina</i> - <i>Quercus alba</i> - (<i>Quercus coccinea</i>) Forest Alliance (A.1911)
Alliance (English name)	Black Oak - White Oak - (Scarlet Oak) Forest Alliance
Association	<i>Quercus alba</i> - <i>Quercus (coccinea, velutina, prinus)</i> / <i>Gaylussacia baccata</i> Forest
Association (English name)	White Oak - (Scarlet Oak, Black Oak, Chestnut Oak) / Black Huckleberry Forest
Ecological System(s):	Northeastern Interior Dry-Mesic Oak Forest (CES202.592) Northern Atlantic Coastal Plain Dry Hardwood Forest (CES203.475)

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 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
- 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 unpublished data.



Figure I12. Piedmont / Low Elevation Mixed Oak / Heath Forest (plot FRSP.15) at Fredericksburg and Spotsylvania National Military Park. June 2004. NAD 1983 / UTM easting 261041, northing 4241993.

COMMON NAME (PARK-SPECIFIC): **PIEDMONT / MOUNTAIN FLOODPLAIN FOREST**

SYNONYMS

USNVC English Name: **Silver Maple - Box-elder / White Snakeroot - Canadian Wood-nettle - (Virginia Wild Rye) Forest**

USNVC Scientific Name: ***Acer saccharinum* - *Acer negundo* / *Ageratina altissima* - *Laportea canadensis* - (*Elymus virginicus*) Forest**

USNVC Identifier: **CEGL006217**

LOCAL INFORMATION

Environmental Description: Piedmont / Mountain Floodplain Forest is a deciduous forest of large river floodplains found only along the Rappahannock River in Fredericksburg & Spotsylvania National Military Park. This forest occupies banks of major rivers that are temporarily inundated, annually or less often, in major flood events. It occurs as a narrow linear feature along the Rappahannock River near Chatham Manor.

Vegetation Description: The canopy is typically closed and dominated by *Acer saccharinum* (silver maple), with *Acer negundo* (boxelder) dominating the subcanopy layer. Other canopy and understory associates include *Liquidambar styraciflua* (sweetgum), *Platanus occidentalis* (American sycamore), *Robinia pseudoacacia* (black locust), and *Celtis occidentalis* (common hackberry). The shrub layer is often sparse but can include *Lindera benzoin* (northern spicebush), with woody vines such as *Toxicodendron radicans* (eastern poison ivy), *Parthenocissus quinquefolia* (Virginia creeper), and *Campsis radicans* (trumpet creeper). The herb layer is often dominated by invasive exotics such as *Stellaria media* (common chickweed) and *Microstegium vimineum* (Nepalese browntop). Additional native herbs that are frequently present include *Ageratina altissima* (white snakeroot), *Impatiens* sp. (touch-me-not), *Polygonum* sp. (a knotweed), *Leersia virginica* (whitegrass), and *Carex* spp. (sedges).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Acer saccharinum</i> (silver maple)

Characteristic Species: *Acer negundo* (boxelder), *Acer saccharinum* (silver maple), *Platanus occidentalis* (American sycamore).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Microstegium vimineum</i> (Nepalese browntop)	-	plant	invasive nonnative
<i>Stellaria media</i> (common chickweed)	-	plant	invasive nonnative

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNR*	B	C	Piedmont / Mountain Floodplain Forests	Fleming et al. 2006

Local Range: This association is found only along the Rappahannock River in Fredericksburg & Spotsylvania National Military Park. It occurs as a narrow linear feature along the Rappahannock River near Chatham Manor. It is mapped as 2 polygons, covering a total of 9 hectares in the park.

Classification Comments: Piedmont / Mountain Floodplain Forest can be distinguished from other floodplain forests in the park by the dominance of *Acer saccharinum* (silver maple) and/or location on the Rappahannock River, the only major river in the park.

Other Comments: Stands of this association can have inclusions of open herbaceous/shrubby areas with no overstory trees. These areas are typically poorly drained and likely more disturbed than the adjacent closed-canopy floodplain forest dominated by *Acer saccharinum* (silver maple).

Local Description Authors: K. Taverna.

Plots: None.

Fredericksburg & Spotsylvania National Military 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	<i>Acer saccharinum</i> Temporarily Flooded Forest Alliance (A.279)
Alliance (English name)	Silver Maple Temporarily Flooded Forest Alliance
Association	<i>Acer saccharinum</i> - <i>Acer negundo</i> / <i>Ageratina altissima</i> - <i>Laportea canadensis</i> - (<i>Elymus virginicus</i>) Forest
Association (English name)	Silver Maple - Box-elder / White Snakeroot - Canadian Wood-nettle - (Virginia Wild Rye) Forest
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This is a forested community of large river floodplains in the mid-Atlantic states of Maryland, Virginia, and West Virginia, and Pennsylvania. These forests occupy banks and first bottoms of major rivers with nutrient-rich silt loams, sand loams, and sands that are temporarily inundated, annually or less often, in major flood events. Canopies are closed and dominated by *Acer saccharinum* (silver maple), with *Acer negundo* (boxelder) dominating a subcanopy layer. Other minor overstory and understory associates include *Populus deltoides* (eastern cottonwood), *Celtis occidentalis* (common hackberry), *Fraxinus pennsylvanica* (green ash), *Ulmus americana* (American elm), and *Juglans nigra* (black walnut). The shrub layer ranges from sparse to dense but is usually dominated by *Lindera benzoin* (northern spicebush). Characteristic species of the herb layer are *Ageratina altissima* (white snakeroot), *Laportea canadensis* (Canadian woodnettle), *Impatiens pallida* (pale touch-me-not), *Viola sororia* (common blue violet), *Leersia virginica* (whitegrass), *Verbesina alternifolia* (wingstem), *Urtica dioica* ssp. *dioica* (stinging nettle), *Elymus virginicus* (Virginia wildrye), *Elymus riparius* (riverbank wildrye), *Geum canadense* (white avens), *Pilea pumila* (Canadian clearweed), *Rudbeckia laciniata* (cutleaf coneflower), and *Cryptotaenia canadensis* (Canadian honewort). Vines of *Toxicodendron radicans* (eastern poison ivy) and *Parthenocissus quinquefolia* (Virginia creeper) are common. Early-successional stands are usually strongly dominated by even-aged *Acer saccharinum* (silver maple). This type was defined to cover *Acer saccharinum* (silver maple) forests of the Mid-Atlantic Piedmont and Central Appalachians. It was split off from the more broadly defined *Acer saccharinum* - *Ulmus americana* Forest (CEGL002586).

Environmental Description: This community is restricted to large river floodplains, where it occurs on first bottoms and banks immediately adjacent to the river. Sites are usually well-drained to moderately well-drained. Soils are nutrient-rich with textures ranging from silt loams

to sandy loams and occasionally sands. Habitats are temporarily inundated, annually or less often, in major flood events. In the Potomac Gorge, the average flood-return interval was from about 0.5 to 2.5 years (Lea 2000).

Vegetation Description: This community is a closed forest typically dominated by *Acer saccharinum* (silver maple), with *Acer negundo* (boxelder) dominating a subcanopy layer. Along the Potomac, particularly on sandier sites, *Platanus occidentalis* (American sycamore) may codominate the canopy layer. Minor overstory and understory associates include *Populus deltoides* (eastern cottonwood), *Celtis occidentalis* (common hackberry), *Fraxinus pennsylvanica* (green ash), *Ulmus americana* (American elm), and *Juglans nigra* (black walnut). At topographically lower sites, the shrub layer is often sparse; on higher surfaces, it may be moderately dense, with *Lindera benzoin* (northern spicebush) usually the dominant species. Characteristic species of the herb layer are *Ageratina altissima* (white snakeroot), *Laportea canadensis* (Canadian woodnettle), *Impatiens pallida* (pale touch-me-not), *Viola sororia* (common blue violet), *Leersia virginica* (whitegrass), *Verbesina alternifolia* (wingstem), *Urtica dioica* ssp. *dioica* (stinging nettle), *Elymus virginicus* (Virginia wildrye), *Elymus riparius* (riverbank wildrye), *Geum canadense* (white avens), *Pilea pumila* (Canadian clearweed), *Rudbeckia laciniata* (cutleaf coneflower), and *Cryptotaenia canadensis* (Canadian honewort). Vines of *Toxicodendron radicans* (eastern poison ivy) and *Parthenocissus quinquefolia* (Virginia creeper) are common. Invasive introduced species such as *Alliaria petiolata* (garlic mustard), *Stellaria media* (common chickweed), *Microstegium vimineum* (Nepalese browntop), *Glechoma hederacea* (ground ivy), *Urtica dioica* ssp. *dioica* (stinging nettle), and *Humulus japonicus* (Japanese hop) are often rampant in this vegetation type. Early-successional stands are assigned to the same type and are usually strongly dominated by even-aged *Acer saccharinum* (silver maple).

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 community occurs on floodplains of major mid-Atlantic rivers, including the Potomac, Shenandoah, James, Rappahannock, Monocacy, and Susquehanna.

States/Provinces: MD, PA, VA, WV.

Federal Lands: NPS (Blue Ridge Parkway, C&O Canal, Fredericksburg-Spotsylvania, George Washington Parkway, Harpers Ferry, Monocacy, National Capital-East); USFS (George Washington).

CONSERVATION STATUS

Rank: G4 (24-Jan-2005).

Reasons: The type is not rare but has a restricted geographic range, is confined to larger rivers in the mid-Atlantic region, and is subject to continuing degradation by invasive species.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 1 – Strong.

Comments: This type was defined through analysis of 41 plot samples from Virginia and Maryland and through consultation with ecologists from those states and West Virginia. It has also been confirmed for Pennsylvania by ecologists in that state. It was decided to split this unit off from the more broadly defined USNVC unit *Acer saccharinum* - *Ulmus americana* Forest (CEGL002586).

Similar Associations:

- *Acer saccharinum* - (*Populus deltoides*) / *Matteuccia struthiopteris* - *Laportea canadensis* Forest (CEGL006147).
- *Acer saccharinum* - *Ulmus americana* Forest (CEGL002586).
- *Platanus occidentalis* - *Acer negundo* - *Juglans nigra* / *Asimina triloba* / *Mertensia virginica* Forest (CEGL004073).
- *Platanus occidentalis* - *Acer saccharinum* - *Juglans nigra* - *Ulmus rubra* Forest (CEGL007334).

Related Concepts:

- *Acer saccharinum* - *Acer negundo* - *Ulmus americana* / *Eupatorium rugosum* Forest (Lea 2000) =
- *Acer saccharinum* - *Acer negundo* / *Elymus virginicus* - *Laportea canadensis* Forest (Fleming and Coulling 2001) =
- *Acer saccharinum* - *Ulmus americana* - (*Populus deltoides*) Forest (Thomson et al. 1999) =
- *Acer saccharinum* Floodplain Forest (Vanderhorst 2000) =
- Silver Maple Floodplain Forest (Podniesinski and Wagner 2002) =

SOURCES

Description Authors: G. P. Fleming and K. D. Patterson, mod. G. P. Fleming.

References: Eastern Ecology Working Group n.d., Fleming and Coulling 2001, Harrison 2004, Lea 2000, Podniesinski and Wagner 2002, Thomson et al. 1999, VDNH 2003, Vanderhorst 2000.

COMMON NAME (PARK-SPECIFIC): **SUCCESSIONAL RIVER BIRCH - RED MAPLE
FLOODPLAIN FOREST**

SYNONYMS

USNVC English Name: **River Birch - (Sycamore) Forest**
USNVC Scientific Name: ***Betula nigra* - (*Platanus occidentalis*) Forest**
USNVC Identifier: **CEGL006976**

LOCAL INFORMATION

Environmental Description: Successional River Birch - Red Maple Floodplain Forest is a disturbed forest occurring on temporarily flooded, well-developed alluvial floodplains and stream terraces. This early-successional forest occurs on sites recovering from disturbances such as logging or undergoing natural succession from open wetland to forest. In Fredericksburg & Spotsylvania National Military Park, it occurs along the Ni River in Chancellorsville Battlefield.

Vegetation Description: The canopy is often even-aged and canopy cover can vary from quite open to >75%. The canopy is dominated by young stems of *Betula nigra* (river birch), with *Acer rubrum* (red maple) a common associate. Common subcanopy trees include *Liquidambar styraciflua* (sweetgum), *Liriodendron tulipifera* (tuliptree), *Carpinus caroliniana* (American hornbeam), and *Quercus phellos* (willow oak). Shrub cover varies, as some areas have a high cover of woody vines such as *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy), and *Lonicera japonica* (Japanese honeysuckle), whereas other areas have a more open shrub layer with species such as *Ilex opaca* var. *opaca* (American holly), *Carpinus caroliniana* (American hornbeam), *Rubus* sp. (a blackberry), and *Clethra alnifolia* (coastal sweetpepperbush). The herb layer is often quite dense; typical species include *Thelypteris noveboracensis* (New York fern), *Cinna arundinacea* (sweet woodreed), *Carex* spp. (sedges), *Dichanthelium clandestinum* (deertongue), *Chasmanthium laxum* (slender woodoats), *Boehmeria cylindrica* (smallspike false nettle), and *Lycopus virginicus* (Virginia water horehound). The exotic grass *Microstegium vimineum* (Nepalese browntop) may be abundant.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	<i>Betula nigra</i> (river birch)

Characteristic Species: *Acer rubrum* (red maple), *Betula nigra* (river birch), *Carpinus caroliniana* (American hornbeam), *Dichanthelium clandestinum* (deertongue), *Thelypteris noveboracensis* (New York fern).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	plant	invasive nonnative
<i>Microstegium vimineum</i> (Nepalese browntop)	-	plant	invasive nonnative

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNR*	B	S	Coastal Plain / Piedmont Floodplain Forests	Fleming et al. 2006

Local Range: Successional River Birch – Red Maple Floodplain Forest is part of the map class Coastal Plain / Piedmont Floodplain Forest, which includes three associations and is mapped as 56 polygons, covering a total of 188.1 hectares (464.8 acres) throughout FRSP. The majority of Successional River Birch - Red Maple Floodplain Forest occurs along the Ni River in Chancellorsville Battlefield.

Classification Comments: Successional River Birch - Red Maple Forest can be recognized by its occurrence on well-developed floodplains and stream terraces, its distinctive canopy composition of *Betula nigra* (river birch) and *Acer rubrum* (red maple), and its temporarily flooded hydrology.

Other Comments: The structure of Successional River Birch - Red Maple Floodplain Forest varies depending on stand age and degree of past disturbance. Younger stands typically have a more open canopy, whereas older stands have a taller closed canopy of *Betula nigra* (river birch) and *Acer rubrum* (red maple). This floodplain forest often transitions into the more mature swamp forest Coastal Plain / Piedmont Floodplain Swamp (Mixed Oak - Red Maple Type) that occurs as back swamps on the broad alluvial floodplain of the Ni River in Chancellorsville.

Successional River Birch - Red Maple Floodplain Forest may be difficult to distinguish from Coastal Plain / Piedmont Small Stream Floodplain Forest and Successional Tuliptree Floodplain Forest, and therefore these three associations were combined into one map class: Coastal Plain / Piedmont Floodplain Forest.

Local Description Authors: K. Taverna.

Plots: None.

Fredericksburg & Spotsylvania National Military 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	<i>Betula nigra</i> - (<i>Platanus occidentalis</i>) Temporarily Flooded Forest Alliance (A.280)
Alliance (English name)	River Birch - (Sycamore) Temporarily Flooded Forest Alliance
Association	<i>Betula nigra</i> - (<i>Platanus occidentalis</i>) Forest
Association (English name)	River Birch - (Sycamore) Forest
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: Temporary placeholder association.

Environmental Description: Information not available.

Vegetation Description: Information not available.

Most Abundant Species: Information not available.

Characteristic Species: Information not available.

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: Information not available.

States/Provinces: MD, NJ, VA.

Federal Lands: NPS (Fredericksburg-Spotsylvania, Thomas Stone).

CONSERVATION STATUS

Rank: GNR (8-Nov-2000).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Nonstandard.

Confidence: No information.

Comments: Information not available.

Similar Associations:

- *Betula nigra* - *Quercus palustris* / *Cornus amomum* Forest (CEGL006948).

Related Concepts: Information not available.

SOURCES

Description Authors: No information.

References: Eastern Ecology Working Group n.d.



Figure I13. Successional River Birch - Red Maple Floodplain Forest in Fredericksburg and Spotsylvania National Military Park. September 2003. NAD 1983/ UTM easting 268503, northing 4241511. Photo by NCSU-CEO.

COMMON NAME (PARK-SPECIFIC): **SUCCESIONAL TULIPTREE FLOODPLAIN FOREST**

SYNONYMS

USNVC English Name: **Sweetgum - (Tuliptree) Temporarily Flooded Forest**
USNVC Scientific Name: ***Liquidambar styraciflua* - (*Liriodendron tulipifera*) Temporarily Flooded Forest**
USNVC Identifier: **CEGL007330**

LOCAL INFORMATION

Environmental Description: Successional Tuliptree Floodplain Forest is a successional deciduous forest that develops following clearcutting or other disturbance along well-drained alluvial floodplains of small streams and other temporarily flooded areas. Over time, this forest can succeed to Coastal Plain / Piedmont Small Stream Floodplain Forest.

Vegetation Description: This disturbed association generally has an even-aged canopy dominated by the early-successional species *Liriodendron tulipifera* (tuliptree) and/or *Liquidambar styraciflua* (sweetgum). *Acer rubrum* (red maple) may be a major component of the canopy and subcanopy and may even codominate in some instances. The shrub layer often contains *Carpinus caroliniana* (American hornbeam), *Lindera benzoin* (northern spicebush), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax rotundifolia* (roundleaf greenbrier), and *Rubus* sp. (a blackberry), in addition to canopy/subcanopy species. The ground layer in highly disturbed examples can be dense *Microstegium vimineum* (Nepalese browntop) or a tangle of *Smilax rotundifolia* (roundleaf greenbrier), *Lonicera japonica* (Japanese honeysuckle), and *Rubus* sp. (a blackberry). The herbaceous layer may include *Thelypteris noveboracensis* (New York fern), *Boehmeria cylindrica* (smallspike false nettle), *Circaea lutetiana* (broadleaf enchanter's nightshade), *Arisaema triphyllum* (Jack in the pulpit), *Dichanthelium clandestinum* (deertongue), and *Polystichum acrostichoides* (Christmas fern). Various species of *Carex* (sedge) may be present.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Liquidambar styraciflua</i> (sweetgum), <i>Liriodendron tulipifera</i> (tuliptree)

Characteristic Species: *Acer rubrum* (red maple), *Carpinus caroliniana* (American hornbeam), *Liquidambar styraciflua* (sweetgum), *Liriodendron tulipifera* (tuliptree), *Smilax rotundifolia* (roundleaf greenbrier).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	plant	invasive nonnative
<i>Microstegium vimineum</i> (Nepalese browntop)	-	plant	invasive nonnative

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNA	.	.	[not crosswalked]	.

Local Range: Successional Tuliptree Floodplain Forest is part of the map class Coastal Plain / Piedmont Floodplain Forest, which includes three associations and is mapped as 56 polygons, covering a total of 188.1 hectares (464.8 acres) occurring throughout Fredericksburg & Spotsylvania National Military Park.

Classification Comments: Successional Tuliptree Floodplain Forest can be distinguished from Successional Tuliptree Forest by its location along small streams and the prevalence of species more typical of floodplain habitats such as *Platanus occidentalis* (American sycamore), *Carpinus caroliniana* (American hornbeam), *Arisaema triphyllum* (Jack in the pulpit), *Osmunda* spp. (osmunda species), and *Boehmeria cylindrica* (smallspike false nettle).

Other Comments: This association occurs in the same landscape position as Coastal Plain / Piedmont Small Stream Floodplain Forest but represents disturbed examples dominated by successional species. Because Successional Tuliptree Floodplain Forest may be difficult to distinguish from Coastal Plain / Piedmont Small Stream Floodplain Forest and Successional River Birch - Red Maple Floodplain Forest, these three associations were combined into one map class: Coastal Plain / Piedmont Floodplain Forest.

Local Description Authors: K. Taverna.

Plots: None.

Fredericksburg & Spotsylvania National Military 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	<i>Liquidambar styraciflua</i> - (<i>Liriodendron tulipifera</i> , <i>Acer rubrum</i>) Temporarily Flooded Forest Alliance (A.287)
Alliance (English name)	Sweetgum - (Tuliptree, Red Maple) Temporarily Flooded Forest Alliance
Association	<i>Liquidambar styraciflua</i> - (<i>Liriodendron tulipifera</i>) Temporarily Flooded Forest
Association (English name)	Sweetgum - (Tuliptree) Temporarily Flooded Forest
Ecological System(s):	Atlantic Coastal Plain Small Brownwater River Floodplain Forest (CES203.250) East Gulf Coastal Plain Large River Floodplain Forest (CES203.489) East Gulf Coastal Plain Small Stream and River Floodplain Forest (CES203.559) Southern Piedmont Small Floodplain and Riparian Forest (CES202.323) South-Central Interior Small Stream and Riparian (CES202.706)

GLOBAL DESCRIPTION

Concept Summary: This widespread association of the southeastern United States is dominated by *Liquidambar styraciflua* (sweetgum), but can be dominated by *Liriodendron tulipifera* (tuliptree) in some cases, and occurs on heavily disturbed sites such as wetland old fields that have been recovering for the past 10-60 years. This is a successional community that develops following clearcutting or other disturbance along floodplains of major creeks and other temporarily flooded areas. As this community ages, it often begins to approach the composition of more natural *Liquidambar styraciflua* - *Liriodendron tulipifera* / *Lindera benzoin* / *Arisaema triphyllum* ssp. *triphyllum* Forest (CEGL004418). This association is known from the Piedmont, Interior Low Plateau, Inner South Atlantic Coastal Plain, Upper East Gulf Coastal Plain, and possibly other provinces. *Acer rubrum* (red maple) may be a major component of the canopy and subcanopy and may even partially dominate in some instances. In more mature examples, other canopy/subcanopy species which may occur to a lesser extent and often as scattered emergents are *Quercus alba* (white oak), *Quercus phellos* (willow oak), *Quercus nigra* (water oak), *Nyssa*

sylvatica (blackgum), and *Cornus florida* (flowering dogwood). Stands in the Inner Coastal Plain of South Carolina typically contain *Persea palustris* (swamp bay) and *Magnolia virginiana* (sweetbay). The shrub layer can contain *Carpinus caroliniana* (American hornbeam), *Itea virginica* (Virginia sweetspire), *Vitis rotundifolia* (muscadine), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax rotundifolia* (roundleaf greenbrier), and/or *Rubus* sp. (a blackberry), in addition to canopy/subcanopy species. *Lonicera japonica* (Japanese honeysuckle) is often abundant in the understory. On disturbed sites, the shrub layer is often dominated by *Ligustrum sinense* (Chinese privet), and the ground layer is typically solid *Microstegium vimineum* (Nepalese browntop) or a tangle of *Smilax rotundifolia* (roundleaf greenbrier) and *Rubus* sp. (a blackberry). The herbaceous layer may include *Chasmanthium laxum* (slender woodoats), *Carex* spp. (sedges), *Boehmeria cylindrica* (smallspike false nettle), and *Botrychium biternatum* (sparselobe grapefern), sometimes growing on hummocks in standing water.

Environmental Description: This association occurs on disturbed sites such as wetland old fields. This is a successional community that develops following clearcutting or other disturbance along floodplains of major creeks and other temporarily flooded areas. These are productive stream terraces subject to occasional flooding (Jones et al. 1981).

Vegetation Description: The canopy of this association is dominated by *Liquidambar styraciflua* (sweetgum) but can be dominated by *Liriodendron tulipifera* (tuliptree) in some cases. *Acer rubrum* (red maple) may be a major component of the canopy and subcanopy and may even partially dominate in some instances (TNC 1998a). In more mature examples, other canopy/subcanopy species which may occur to a lesser extent and often as scattered emergents are *Quercus alba* (white oak), *Quercus phellos* (willow oak), *Quercus nigra* (water oak), *Fraxinus americana* (white ash), *Carya* spp. (hickories), *Nyssa sylvatica* (blackgum), and *Cornus florida* (flowering dogwood). Stands in the Inner Coastal Plain of South Carolina typically contain *Persea palustris* (swamp bay) and *Magnolia virginiana* (sweetbay) (Jones et al. 1981). The shrub layer contains *Carpinus caroliniana* (American hornbeam), *Itea virginica* (Virginia sweetspire), *Vitis rotundifolia* (muscadine), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax rotundifolia* (roundleaf greenbrier), and *Rubus* sp. (a blackberry), in addition to canopy/subcanopy species. *Lonicera japonica* (Japanese honeysuckle) is often abundant in the understory. On disturbed sites, the shrub layer is often dominated by *Ligustrum sinense* (Chinese privet), and the ground layer is typically solid *Microstegium vimineum* (Nepalese browntop) or a tangle of *Smilax rotundifolia* (roundleaf greenbrier) and *Rubus* sp. (a blackberry). The herbaceous layer may include *Chasmanthium laxum* (slender woodoats), *Carex* spp. (sedges), *Boehmeria cylindrica* (smallspike false nettle), and *Botrychium biternatum* (sparselobe grapefern), sometimes growing on hummocks in standing water. Various *Carex* (Sedge) species may be present.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Liquidambar styraciflua</i> (sweetgum)

Characteristic Species: Information not available.

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This association is known from the Piedmont, Interior Low Plateau, Inner South Atlantic Coastal Plain, and possibly other provinces.

States/Provinces: AL, GA?, KY, MS, NC, NJ, SC, TN, VA.

Federal Lands: DOD (Arnold, Fort Benning?); DOE (Savannah River Site); NPS (Big South Fork, Chickamauga-Chattanooga?, Cowpens, Fort Donelson, Fredericksburg-Spotsylvania, Kings Mountain, Little River Canyon, Mammoth Cave, Natchez Trace, Shiloh); USFS (Bankhead?, Bienville?, Daniel Boone, De Soto?, Delta?, Francis Marion?, Holly Springs?, Homochitto?, Oconee?, Sumter (Piedmont)?, Talladega (Oakmulgee)?, Talladega?, Tombigbee?, Tuskegee?).

CONSERVATION STATUS

Rank: GNA (ruderal) (8-Aug-2000).

Reasons: This is a successional community which develops following clearcutting or other disturbance along floodplains of major creeks and other temporarily flooded areas.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 – Moderate.

Comments: At Arnold Air Force Base (Tennessee), this community is found primarily in the vicinity of Hunt Creek, Heron Pond, and Sinking Pond in areas that have experienced logging. Prior to logging, these areas would probably have had canopies dominated by *Quercus phellos* (willow oak) or *Quercus alba* (white oak), with the overall community structure being that of *Quercus alba* - *Carya (alba, ovata)* - *Liriodendron tulipifera* - (*Quercus phellos*) / *Cornus florida* Forest (CEGL007709) or possibly *Quercus phellos* - *Quercus alba* / *Vaccinium fuscum* - (*Viburnum nudum*) / *Carex (barrattii, intumescens)* Forest (CEGL007364). The sweet gum-red maple-red bay community of Jones et al. 1981 (2 stands sampled) is included here.

Similar Associations:

- *Liquidambar styraciflua* - *Liriodendron tulipifera* / *Lindera benzoin* / *Arisaema triphyllum* Forest (CEGL004418)--may be difficult to distinguish from older versions of this community; trees will be older, uneven-aged, and the herbaceous layer more diverse in this association.
- *Quercus alba* - *Carya (alba, ovata)* - *Liriodendron tulipifera* - (*Quercus phellos*) / *Cornus florida* Forest (CEGL007709).
- *Quercus phellos* - *Quercus alba* / *Vaccinium fuscum* - (*Viburnum nudum*) / *Carex (barrattii, intumescens)* Forest (CEGL007364).

Related Concepts:

- Sweet gum-red maple-red bay community (Jones et al. 1981) ?

SOURCES

Description Authors: mod. R. White.

References: Jones et al. 1981, NatureServe Ecology - Southeastern U.S. unpubl. data, Schotz pers. comm., Southeastern Ecology Working Group n.d., TDNH unpubl. data, TNC 1998a.

**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: CEG004418

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. The soils are typically acidic with a mean pH value of 4.5.

Vegetation Description: In mature examples of this association, the vegetation layers often are well-developed, with *Liriodendron tulipifera* (tuliptree), *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), and *Quercus alba* (white oak) usually the most abundant overstory trees. A number of other trees can occur as inconsistent, low-cover associates, including *Quercus phellos* (willow oak), *Platanus occidentalis* (American sycamore), *Ulmus americana* (American elm), *Nyssa sylvatica* (blackgum), *Celtis occidentalis* (common hackberry), *Fraxinus americana* (white ash), and *Carya* spp. (hickories). *Lindera benzoin* (northern spicebush) often dominates the shrub layer with *Ilex opaca* var. *opaca* (American holly), *Carpinus caroliniana* (American hornbeam), *Cornus florida* (flowering dogwood), *Viburnum acerifolium* (mapleleaf viburnum), *Cercis canadensis* var. *canadensis* (eastern redbud), and *Viburnum nudum* (possumhaw). The vines *Smilax rotundifolia* (roundleaf greenbrier), *Lonicera japonica* (Japanese honeysuckle), and *Toxicodendron radicans* (eastern poison ivy) are often present in the low-shrub layer and can climb into the canopy. The herb stratum is species-rich and composed of both mesophytic and hydrophytic species; it often has high cover of *Carex* spp. (sedges). Characteristic species include *Thelypteris noveboracensis* (New York fern), *Arisaema triphyllum* (Jack in the pulpit), *Amphicarpaea bracteata* (American hogpeanut), *Dichanthelium boscii* (Bosc's panicgrass), *Dichanthelium dichotomum* (cypress panicgrass), *Symphotrichum lateriflorum* (calico aster), *Osmunda regalis* (royal fern), *Boehmeria cylindrica* (smallspike false nettle), *Festuca subverticillata* (nodding fescue), *Polystichum acrostichoides* (Christmas fern), and *Brachyelytrum erectum* (bearded shorthusk), among others.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	<i>Liquidambar styraciflua</i> (sweetgum)
Tree canopy	Broad-leaved deciduous tree	<i>Liriodendron tulipifera</i> (tuliptree)

Characteristic Species: *Arisaema triphyllum* (Jack in the pulpit), *Carpinus caroliniana* (American hornbeam), *Lindera benzoin* (northern spicebush), *Liquidambar styraciflua* (sweetgum), *Liriodendron tulipifera* (tuliptree), *Thelypteris noveboracensis* (New York fern).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	plant	invasive nonnative
<i>Microstegium vimineum</i> (Nepalese browntop)	-	plant	invasive nonnative

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNR*	B	C	Coastal Plain / Piedmont Floodplain Forest	Fleming et al. 2006

Local Range: Coastal Plain / Piedmont Small-Stream Floodplain Forest is part of the map class Coastal Plain / Piedmont Floodplain Forest, which includes three associations and is mapped as 56 polygons, covering a total of 188.1 hectares (464.8 acres) occurring throughout Fredericksburg & Spotsylvania National Military Park.

Classification Comments: Coastal Plain / Piedmont Small-Stream Floodplain Forest often occurs adjacent to Coastal Plain / Piedmont Acidic Seepage Swamp, which has a longer hydroperiod and a seasonally flooded to seasonally saturated hydrology. Acidic Seepage Swamps tend to be located at the headwaters of small streams and transition into Coastal Plain / Piedmont Small Stream Floodplain Forest. In ecotonal areas, Coastal Plain / Piedmont Small-Stream Floodplain Forest may be distinguished by having well-drained substrates adjacent to defined streams, whereas Acidic Seepage Swamps tend to have poorly drained, mucky soils with areas of standing water.

Other Comments: Coastal Plain / Piedmont Small-Stream Floodplain Forest may be difficult to distinguish from Successional Tuliptree Floodplain Forest and Successional River Birch - Red Maple Floodplain Forest, and therefore these three associations were combined into one map class: Coastal Plain / Piedmont Floodplain Forest.

The structure and composition of Coastal Plain / Piedmont Small-Stream Floodplain Forest varies depending on disturbance history and topographic position. Floodplain width can vary from narrow zones in small ravines to wide areas in lower stream reaches. In some cases, narrow occurrences were not mapped separately from the upland forest if very narrow and below minimum mapping unit (0.5 ha).

Local Description Authors: K. Taverna.

Plots: FRSP.13.

Fredericksburg & Spotsylvania National Military 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	<i>Liquidambar styraciflua</i> - (<i>Liriodendron tulipifera</i> , <i>Acer rubrum</i>) Temporarily Flooded Forest Alliance (A.287)
Alliance (English name)	Sweetgum - (Tuliptree, Red Maple) Temporarily Flooded Forest Alliance
Association	<i>Liquidambar styraciflua</i> - <i>Liriodendron tulipifera</i> / <i>Lindera benzoin</i> / <i>Arisaema triphyllum</i> 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) Southern Piedmont Small Floodplain and Riparian Forest (CES202.323)

GLOBAL DESCRIPTION

Concept Summary: These low-elevation forests develop along 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. Soils are relatively acidic. 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), *Galium circaeazans* (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: Information not available.

Characteristic Species: Information not available.

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Carex impressinervia</i> (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, Cowpens, Fredericksburg-Spotsylvania, Guilford Courthouse, Kings Mountain, National Capital-East, Prince William, 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 I14. Coastal Plain / Piedmont Small-Stream Floodplain Forest (plot FRSP.13) at Fredericksburg and Spotsylvania National Military Park. July 2004. NAD 1983 / UTM easting 259510, northing 4243822.

**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: CEG006110

LOCAL INFORMATION

Environmental Description: Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Forest) occurs as an isolated seasonally flooded deciduous forest in an otherwise upland landscape. These wetlands are often influenced by perched groundwater and have a nutrient-poor substrate of gleyed to mottled, sandy or clay loams. In Fredericksburg & Spotsylvania National Military Park, this association can vary from a closed forest to more open woodland with some standing water.

Vegetation Description: Characteristic tree species include *Acer rubrum* (red maple), *Quercus phellos* (willow oak), *Liquidambar styraciflua* (sweetgum), *Quercus palustris* (pin oak), and *Nyssa sylvatica* (blackgum). The shrub layer is characterized by *Leucothoe racemosa* (swamp doghobble), *Vaccinium corymbosum* (highbush blueberry), *Ilex verticillata* (common winterberry), and *Vaccinium formosum* (southern blueberry). *Smilax rotundifolia* (roundleaf greenbrier) is a particularly characteristic vine. The shrub layer can be absent in occurrences with more standing water. When drawn down, these communities tend to have a sparse herb stratum. 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 include *Carex debilis* (white edge sedge), *Chasmanthium laxum* (slender woodoats), *Carex albolutescens* (greenwhite sedge), *Eleocharis* sp. (a spikerush), *Juncus effusus* (common rush), and *Polygonum* spp. (knotweeds). Some examples may have cover by *Sphagnum* sp. (sphagnum mosses) among hummock-and-hollow microtopography.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Quercus phellos</i> (willow oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Leucothoe racemosa</i> (swamp doghobble)

Characteristic Species: *Acer rubrum* (red maple), *Chasmanthium laxum* (slender woodoats), *Leucothoe racemosa* (swamp doghobble), *Liquidambar styraciflua* (sweetgum), *Quercus phellos* (willow oak), *Vaccinium formosum* (southern blueberry), *Carex debilis* (white edge sedge).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	plant	invasive nonnative

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNR*	B	C	Coastal Plain Depression Wetlands	Fleming et al. 2006

Local Range: Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Forest) is only documented at a few sites in Fredericksburg & Spotsylvania National Military Park. It is mapped at two sites in Wilderness Battlefield, one site in Spotsylvania Court House Battlefield, and one site in Fredericksburg Battlefield for a total of 8 hectares.

Classification Comments: This association is primarily distinguished from other wetland forests in Fredericksburg & Spotsylvania National Military Park by occurring as small, isolated wetlands in an otherwise upland landscape. The composition of Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Forest) could be confused with Coastal Plain / Piedmont Acidic Seepage Swamp, Coastal Plain / Piedmont Small Stream Floodplain Forest or Non-Riverine Saturated Forest. It can be distinguished from Coastal Plain / Piedmont Acidic Seepage Swamp by the presence of *Quercus palustris* (pin oak) and/or by not having common seepage swamp species such as *Magnolia virginiana* (sweetbay), *Viburnum nudum* var. *nudum* (possumhaw), and *Clethra alnifolia* (coastal sweetpepperbush). It can be distinguished from Coastal Plain / Piedmont Small Stream Floodplain Forest by not being located near active floodplains and by lacking species typical of floodplains, such as *Carpinus caroliniana* (American hornbeam), *Betula nigra* (river birch), and *Cinna arundinacea* (sweet woodreed). It can be distinguished from Non-Riverine Saturated Forests by its location on small, isolated upland depressions rather than occurring as large expansive wetlands on broad flats.

Other Comments: Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Forest) occurs in small patches in the park and can vary from a closed forest to more open woodland with standing water (water levels fluctuate with the seasons). Disturbed examples may have *Pinus* sp. (a pine) as a component and less diverse vegetation with canopy damage.

Local Description Authors: K. Taverna.

Plots: FRSP.5, FRSP.11, FRSP.26.

Fredericksburg & Spotsylvania National Military 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	<i>Liquidambar styraciflua</i> - (<i>Acer rubrum</i>) Seasonally Flooded Forest Alliance (A.321)
Alliance (English name)	Sweetgum - (Red Maple) Seasonally Flooded Forest Alliance
Association	<i>Liquidambar styraciflua</i> - <i>Acer rubrum</i> - <i>Quercus phellos</i> / <i>Leucothoe racemosa</i> 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 jorii* (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 fuscum* (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 jorii* (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 phellos* / *Carex (albolutescens, intumescens, jorii)* / *Climacium americanum* Forest (CEGL007403)--of the Virginia Piedmont and more southerly areas, dominated by *Quercus phellos*.

Related Concepts:

- *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 I15. Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type) (plot FRSP.26) at Fredericksburg and Spotsylvania National Military Park. May 2005. NAD 1983 / UTM easting 286074, northing 4236030.

**COMMON NAME (PARK-SPECIFIC): COASTAL PLAIN / PIEDMONT FLOODPLAIN
SWAMP FOREST (MIXED OAK - RED MAPLE
TYPE)**

SYNONYMS

USNVC English Name: (Willow Oak, Pin Oak, Swamp Chestnut Oak) - Sweetgum / Sweet Woodreed Forest
USNVC Scientific Name: *Quercus (phellos, palustris, michauxii)* - *Liquidambar styraciflua* / *Cinna arundinacea* Forest
USNVC Identifier: CEGLO06605

LOCAL INFORMATION

Environmental Description: Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type) is a floodplain swamp forest occurring in depressions and backswamps of broad alluvial floodplains. This association is poorly drained and often has standing water and saturated soil conditions. Soils are mainly poorly drained loams or clay loams.

Vegetation Description: The tree canopy is dominated by *Quercus palustris* (pin oak), *Quercus phellos* (willow oak), *Acer rubrum* (red maple), and *Liquidambar styraciflua* (sweetgum), with *Nyssa sylvatica* (blackgum), *Liriodendron tulipifera* (tuliptree), and *Betula nigra* (river birch) frequent subcanopy species. *Quercus alba* (white oak) can occur as a canopy associate on well-drained hummocks of this association. The shrub layer varies in cover and is typically comprised of *Carpinus caroliniana* (American hornbeam), *Viburnum dentatum* (southern arrowwood), *Ilex verticillata* (common winterberry), and *Vaccinium corymbosum* (highbush blueberry). Typical vines include *Smilax rotundifolia* (roundleaf greenbrier) (often dominant in the low-shrub layer), *Toxicodendron radicans* (eastern poison ivy), and *Parthenocissus quinquefolia* (Virginia creeper). The herb layer is often dense and is characterized by *Cinna arundinacea* (sweet woodreed), *Chasmanthium laxum* (slender woodoats), *Carex* spp. (sedges), *Lycopus virginicus* (Virginia water horehound), *Thelypteris noveboracensis* (New York fern), *Symphytotrichum lateriflorum* (calico aster), *Arisaema triphyllum* (Jack in the pulpit), and *Glyceria striata* (fowl mannagrass). *Sphagnum* spp. (sphagnum mosses) cover is often abundant on hummocks. More disturbed areas typically have cover of exotic species such as *Lonicera japonica* (Japanese honeysuckle) and *Microstegium vimineum* (Nepalese browntop).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple)
Herb (field)	Graminoid	<i>Carex</i> spp. (sedges)

Characteristic Species: *Acer rubrum* (red maple), *Carpinus caroliniana* (American hornbeam), *Quercus palustris* (pin oak), *Quercus phellos* (willow oak), *Thelypteris noveboracensis* (New York fern), *Carex* spp. (sedges).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	plant	invasive nonnative
<i>Microstegium vimineum</i> (Nepalese browntop)	-	plant	invasive nonnative

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNR*	B	C	Coastal Plain / Piedmont Swamp Forest	Fleming et al. 2006

Local Range: Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type) only occurs along the upper reaches of the Ni River in Chancellorsville where soil drainage is impeded and the floodplain is wide enough to support the association. It covers a total of 73 hectares and is mapped as 3 polygons.

Classification Comments: Information not available.

Other Comments: Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type) occurs adjacent to and grades into Successional River Birch - Red Maple Floodplain Forest, which is an early-successional temporary flooded forest with little to no oaks in the canopy. In ecotonal areas these two forests may be difficult to distinguish, however, Successional River Birch - Red Maple Floodplain Forest has higher cover of *Betula nigra* (river birch) and *Acer rubrum* (red maple) and is typically on well-drained alluvial soil.

Local Description Authors: K. Taverna.

Plots: FRSP.9, FRSP.12.

Fredericksburg & Spotsylvania National Military 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	<i>Quercus (phellos, laurifolia)</i> Seasonally Flooded Forest Alliance (A.327)
Alliance (English name)	(Willow Oak, Diamondleaf Oak) Seasonally Flooded Forest Alliance
Association	<i>Quercus (phellos, palustris, michauxii)</i> - <i>Liquidambar styraciflua</i> / <i>Cinna arundinacea</i> Forest
Association (English name)	(Willow Oak, Pin Oak, Swamp Chestnut Oak) - Sweetgum / Sweet Woodreed Forest
Ecological System(s):	Central Appalachian Stream and Riparian (CES202.609) Central Appalachian River Floodplain (CES202.608) Atlantic Coastal Plain Small Brownwater River Floodplain Forest (CES203.250) Atlantic Coastal Plain Brownwater Stream Floodplain Forest (CES203.248) Northern Atlantic Coastal Plain Stream and River (CES203.070)

GLOBAL DESCRIPTION

Concept Summary: This floodplain swamp forest occurs in backswamps and topographic depressions within alluvial floodplains of large streams and small rivers. Along smaller headwater streams, it may occur in low, poorly drained floodplains with braided channels and depressions. The overstory is dominated by variable mixtures of *Quercus phellos* (willow oak), *Quercus palustris* (pin oak), *Quercus michauxii* (swamp chestnut oak), *Liquidambar styraciflua* (sweetgum), and *Acer rubrum* (red maple). The proportion of the latter two species typically increases with disturbance. The understory is commonly quite open and contains young *Acer rubrum* (red maple), several climbing vines, *Carpinus caroliniana* (American hornbeam), *Ilex opaca* var. *opaca* (American holly), *Asimina triloba* (pawpaw), *Viburnum dentatum* (southern arrowwood), *Ilex verticillata* (common winterberry), and other species. The herb layer is usually well-developed, with a prominent graminoid component. Common herbaceous patch-dominants include *Cinna arundinacea* (sweet woodreed), *Carex debilis* var. *debilis* (white edge sedge),

Carex intumescens (greater bladder sedge), *Glyceria striata* (fowl mannagrass), and *Carex tribuloides* (blunt broom sedge).

Environmental Description: This floodplain swamp forest occurs in backswamps and topographic depressions within alluvial floodplains of large streams and small rivers. Along smaller headwater streams, it may occur in low, poorly drained floodplains with braided channels and depressions. Sites are probably overflowed annually, and depressions retain standing water well into the growing season. Soils are somewhat to very poorly drained loams or clay loams that are strongly to extremely acidic and infertile.

Vegetation Description: The overstory is dominated by variable mixtures of *Quercus phellos* (willow oak), *Quercus palustris* (pin oak), *Quercus michauxii* (swamp chestnut oak), *Liquidambar styraciflua* (sweetgum), and *Acer rubrum* (red maple). The proportion of the latter two species typically increases with disturbance. Other canopy associates include *Fraxinus pennsylvanica* (green ash), *Nyssa sylvatica* (blackgum), *Ulmus americana* (American elm), *Quercus pagoda* (cherrybark oak), *Quercus lyrata* (overcup oak), and *Betula nigra* (river birch). Climbing vines of *Smilax rotundifolia* (roundleaf greenbrier), *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), and *Campsis radicans* (trumpet creeper) are common and characteristic. The subcanopy and shrub layers tend to be open and composed of young recruitment of *Acer rubrum* (red maple), along with *Carpinus caroliniana* (American hornbeam) (usually dominant), *Ilex opaca* var. *opaca* (American holly), *Asimina triloba* (pawpaw), *Euonymus americanus* (strawberry bush), *Viburnum dentatum* (southern arrowwood), *Ilex verticillata* (common winterberry), and *Lindera benzoin* (northern spicebush). The herb layer is usually well-developed, with a prominent graminoid component. Common herbaceous patch-dominants include *Cinna arundinacea* (sweet woodreed), *Carex debilis* var. *debilis* (white edge sedge), *Carex intumescens* (greater bladder sedge), *Glyceria striata* (fowl mannagrass), and *Carex tribuloides* (blunt broom sedge). Additional characteristic herbs include *Boehmeria cylindrica* (smallspike false nettle), *Arisaema triphyllum* (Jack in the pulpit), *Lycopus virginicus* (Virginia water horehound), *Athyrium filix-femina* ssp. *asplenioides* (asplenium ladyfern), *Impatiens capensis* (jewelweed), *Leersia virginica* (whitegrass), *Onoclea sensibilis* (sensitive fern), *Symphyotrichum lateriflorum* (calico aster), and *Rubus hispidus* (bristly dewberry). Many other species occur at low constancy and cover. Mean species richness of 47 Maryland and Virginia plot samples was 38 taxa per 400 square meters.

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 found in the Chesapeake Bay region. It is most characteristic of the Coastal Plain but also extends into the extreme eastern part of the Piedmont.

States/Provinces: DE?, MD, NJ?, PA, VA.

Federal Lands: DOD (Fort Belvoir); NPS (Fredericksburg-Spotsylvania, National Capital-East, Petersburg, Prince William).

CONSERVATION STATUS

Rank: G3G4 (23-Feb-2007).

Reasons: This is a moderately-well-distributed forest type. Some examples are at least partly protected in national parks. More information on threats is needed.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 – Moderate.

Comments: This association 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 type was represented by a group of 37 Maryland and 10 northern Virginia plots.

Similar Associations: Information not available.

Related Concepts:

- *Acer rubrum* - *Liquidambar styraciflua* - *Quercus* (*palustris*, *phellos*) Seasonally Flooded Forest (Patterson pers. comm.) ?

SOURCES

Description Authors: D. Thompson and L. A. Sneddon, mod. G. P. Fleming.

References: Eastern Ecology Working Group n.d., Fleming et al. 2001, Harrison 2004, Harrison and Stango 2003, Patterson pers. comm., Thomson et al. 1999.



Figure I16. Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type) photographed at Petersburg National Battlefield. May 2006.

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: CEG004644

LOCAL INFORMATION

Environmental Description: Non-Riverine Saturated Forest is a deciduous, seasonally to permanently saturated forest occupying nearly flat, broad terraces, as well as old, very broad stream terraces that are no longer subject to overland flooding. The natural hydrology of this association has been impacted by historic anthropogenic activities and historic berms and ditches are often evident. Habitats are nearly flat with seasonally perched water tables. Some sites experience periodic sheetflows of seepage from adjacent slope-base springs. Shallow, braided channels and depressions which pond water intermittently are frequent habitat features.

Vegetation Description: The canopy and subcanopy contain mixtures of *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), with scattered hydric oaks, including *Quercus phellos* (willow oak), *Quercus michauxii* (swamp chestnut oak), and *Quercus palustris* (pin oak). *Quercus alba* (white oak) is common on drier hummocks. More mature, less disturbed areas are often dominated by these oak species. Typical shrubs include species from the canopy as well as *Magnolia virginiana* (sweetbay), *Vaccinium formosum* (southern blueberry), *Vaccinium corymbosum* (highbush blueberry), *Ilex opaca* var. *opaca* (American holly), *Viburnum nudum* (possumhaw), *Leucothoe racemosa* (swamp doghobble), *Ilex verticillata* (common winterberry), and *Smilax rotundifolia* (roundleaf greenbrier). *Carex* spp. (sedges) can have high cover or even be locally dominant. Some characteristic and common herb species include *Carex debilis* (white edge sedge), *Carex intumescens* (greater bladder sedge), *Carex seorsa* (weak stellate sedge), *Carex abscondita* (thicket sedge), *Chasmanthium laxum* (slender woodoats), *Osmunda regalis* (royal fern), *Osmunda cinnamomea* (cinnamon fern), *Woodwardia* sp. (a chainfern), *Cinna arundinacea* (sweet woodreed), and *Dichanthelium* spp. (rosette grasses).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Quercus phellos</i> (willow oak)
Herb (field)	Graminoid	<i>Carex</i> spp. (sedges)

Characteristic Species: *Liquidambar styraciflua* (sweetgum), *Magnolia virginiana* (sweetbay), *Quercus michauxii* (swamp chestnut oak), *Quercus phellos* (willow oak), *Carex* spp. (sedges).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	plant	invasive nonnative

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNR*	B	C	Non-Riverine Saturated Forest	Fleming et al. 2006

Local Range: Non-Riverine Saturated Forest only occurs in the Fredericksburg area of Fredericksburg & Spotsylvania National Military Park on broad terraces of the Coastal Plain. It covers a total of 125 hectares and is mapped as 12 polygons ranging in size from 0.4 to 78 hectares.

Classification Comments: This forest is distinguished from small-patch, isolated wetlands such as Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type) and Coastal Plain / Piedmont Acidic Seepage Swamp by its occurrence as large expansive wetlands on poorly drained flats. It can be distinguished from associations in the map class Coastal Plain / Piedmont Floodplain Forest by not being located in active floodplains and by lacking high cover of species typical of floodplains, such as *Carpinus caroliniana* (American hornbeam), *Betula nigra* (river birch), and *Platanus occidentalis* (sycamore). It also often has a number of species not common along floodplains, including *Quercus michauxii* (swamp chestnut oak), highbush blueberries like *Vaccinium fuscum* (black highbush blueberry), *Vaccinium formosum* (southern blueberry), and *Vaccinium corymbosum* (highbush blueberry), as well as *Woodwardia virginica* (Virginia chainfern).

Other Comments: Non-Riverine Saturated Forest only occurs in Fredericksburg Battlefield on broad terraces of the Coastal Plain that are no longer subject to overland flooding. More disturbed examples of this association occur near roadways and railroads and tend to have higher cover of *Acer rubrum* (red maple) with *Quercus phellos* (willow oak), *Liquidambar styraciflua* (sweetgum), and *Nyssa sylvatica* (blackgum). Several high mature, high-quality stands are strongly dominated by *Quercus michauxii* (swamp chestnut oak). There are also inclusions of drier forest scattered among larger occurrences of this association (below minimum mapping unit) dominated by *Quercus alba* (white oak) and often with a sparse herb layer.

Local Description Authors: K. Taverna and K. D. Patterson.

Plots: FRSP.18, FRSP.28.

Fredericksburg & Spotsylvania National Military 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	<i>Quercus phellos</i> Seasonally Flooded Forest Alliance (A.330)
Alliance (English name)	Willow Oak Seasonally Flooded Forest Alliance
Association	<i>Quercus (phellos, pagoda, michauxii) / Ilex opaca</i> var. <i>opaca</i> / <i>Clethra alnifolia</i> / <i>Woodwardia areolata</i> 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 fuscum* (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. 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 fuscum* (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: Information not available.

Characteristic Species: Information not available.

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:S2?

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: Information not available.

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 FRSP.18) in Fredericksburg and Spotsylvania National Military Park. June 2004. NAD 1983 / UTM easting 285223, northing 4237139.

**COMMON NAME (PARK-SPECIFIC): COASTAL PLAIN / PIEDMONT ACIDIC
SEEPAGE SWAMP**

SYNONYMS

USNVC English Name: Red Maple - Blackgum - Sweetbay / Southern Wild Raisin / Cinnamon Fern - Netted Chainfern Forest
USNVC Scientific Name: *Acer rubrum* - *Nyssa sylvatica* - *Magnolia virginiana* / *Viburnum nudum* var. *nudum* / *Osmunda cinnamomea* - *Woodwardia areolata* Forest
USNVC Identifier: CEGLO06238

LOCAL INFORMATION

Environmental Description: Coastal Plain / Piedmont Acidic Seepage Swamps occurs throughout Fredericksburg & Spotsylvania National Military Park and are generally restricted to groundwater-saturated stream bottoms (often at headwaters) and seeping toeslopes. Acidic water originates from groundwater seepage, with little to no overland seasonal flooding. Sites typically have hummock-and-hollow microtopography with braided channels, *Sphagnum* (sphagnum)-covered hummocks, mucky depressions, and areas of standing water.

Vegetation Description: This association is characterized by *Acer rubrum* (red maple) and *Nyssa sylvatica* (blackgum) in the canopy, which may be quite open in some examples. Canopy associates include *Liquidambar styraciflua* (sweetgum), *Quercus phellos* (willow oak), and *Magnolia virginiana* (sweetbay), plus occasional incidental *Liriodendron tulipifera* (tuliptree) or *Quercus alba* (white oak). Upland trees may occur on drier hummocks. The shrub layer is characterized by blueberry species like *Vaccinium formosum* (southern blueberry), *Vaccinium fuscum* (black highbush blueberry), and *Vaccinium corymbosum* (highbush blueberry), as well as *Viburnum nudum* var. *nudum* (possumhaw), *Ilex verticillata* (common winterberry), *Ilex opaca* var. *opaca* (American holly), *Leucothoe racemosa* (swamp doghobble), *Clethra alnifolia* (coastal sweetpepperbush), *Photinia pyrifolia* (red chokeberry), and *Lindera benzoin* (northern spicebush). The herbaceous layer varies from dense to sparse and often includes *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* (royal fern), *Chasmanthium laxum* (slender woodoats), *Carex debilis* (white edge sedge), *Carex intumescens* (greater bladder sedge), *Lycopus virginicus* (Virginia water horehound), *Dichanthelium* sp. (a rosette grass), *Leersia virginica* (whitegrass), *Woodwardia areolata* (netted chainfern), and *Symplocarpus foetidus* (skunk cabbage). *Sphagnum* spp. (sphagnum mosses) and other mosses are common.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple)
Herb (field)	Fern or fern ally	<i>Osmunda cinnamomea</i> (cinnamon fern)

Characteristic Species: *Acer rubrum* (red maple), *Magnolia virginiana* (sweetbay), *Nyssa sylvatica* (blackgum), *Osmunda cinnamomea* (cinnamon fern), *Viburnum nudum* var. *nudum* (possumhaw).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNR*	B	C	Coastal Plain / Piedmont Acidic Seepage Swamp	Fleming et al. 2006

Local Range: Coastal Plain / Piedmont Acidic Seepage Swamp covers a total of 27 hectares and is mapped as 15 polygons ranging in size from 0.3 to 5.5 hectares.

Classification Comments: Coastal Plain / Piedmont Acidic Seepage Swamp could be confused with Non-Riverine Saturated Forest since they can have similar canopy composition and herbaceous flora with wet soil conditions. They can be distinguished based on size and topographic position. Non-Riverine Saturated Forest only occurs in the Fredericksburg section of the park on nearly flat, broad, old stream terraces that are no longer subject to overland flooding. It generally covers a much wider area than Coastal Plain / Piedmont Acidic Seepage Swamps, which are typically <2.5 ha and occur at the headwaters of small streams and sideslopes. Non-Riverine Saturated Forest also often has additional hydric oak species, such as *Quercus michauxii* (swamp chestnut oak) and *Quercus palustris* (pin oak).

Other Comments: The canopy of Coastal Plain / Piedmont Acidic Seepage Swamp can vary in composition and structure. Some occurrences may have *Liquidambar styraciflua* (sweetgum) and *Quercus phellos* (willow oak) as dominant canopy species, with *Acer rubrum* (red maple) and *Nyssa sylvatica* (blackgum) as subcanopy associates. Disturbed stands of this association may have *Pinus virginiana* (Virginia pine) in the canopy. Overall size of this association can vary, but most are <2.5 ha. Larger stands occur in areas with broader upstream ravines.

Local Description Authors: K. Taverna.

Plots: FRSP.7, FRSP.14, FRSP.17, FRSP.22, FRSP.27.

Fredericksburg & Spotsylvania National Military 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	<i>Acer rubrum</i> - <i>Nyssa sylvatica</i> Saturated Forest Alliance (A.348)
Alliance (English name)	Red Maple - Blackgum Saturated Forest Alliance
Association	<i>Acer rubrum</i> - <i>Nyssa sylvatica</i> - <i>Magnolia virginiana</i> / <i>Viburnum nudum</i> var. <i>nudum</i> / <i>Osmunda cinnamomea</i> - <i>Woodwardia areolata</i> Forest
Association (English name)	Red Maple - Blackgum - Sweetbay / Southern Wild Raisin / Cinnamon Fern - Netted Chainfern Forest
Ecological System(s):	Northern Atlantic Coastal Plain Basin Peat Swamp (CES203.522) Northern Atlantic Coastal Plain Pitch Pine Lowland (CES203.374) Northern Atlantic Coastal Plain Stream and River (CES203.070)

GLOBAL DESCRIPTION

Concept Summary: This acidic swamp forest of the eastern middle-latitude states is a nutrient-poor wetland forest occurring in groundwater-saturated stream bottoms and poorly drained depressions. Soils are typically moderately deep to deep muck over mineral soil, with pools of standing water at the surface. Acidic waters originate from groundwater seepage, with little to no overland seasonal flooding. Most sites can be characterized as "groundwater slope wetlands" (*sensu* Golet et al. 1993) with a flow-through hydrology. This community is characterized by *Acer rubrum* (red maple) and *Nyssa sylvatica* (blackgum) in the canopy, which may be quite open in some examples. Canopy associates include *Magnolia virginiana* (sweetbay), *Liquidambar styraciflua* (sweetgum), and *Persea palustris* (swamp bay), plus occasional

incidental *Liriodendron tulipifera* (tuliptree) or *Pinus taeda* (loblolly pine). Upland trees may occur on drier hummocks. The shrub layer is characterized by *Vaccinium corymbosum* (highbush blueberry), as well as *Clethra alnifolia* (coastal sweetpepperbush), *Ilex verticillata* (common winterberry), *Ilex opaca* var. *opaca* (American holly), *Viburnum nudum* var. *nudum* (possumhaw), *Lindera benzoin* (northern spicebush), and *Rhododendron viscosum* (swamp azalea). The herbaceous layer varies from dense to sparse and may include *Symplocarpus foetidus* (skunk cabbage), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Osmunda regalis* var. *spectabilis* (royal fern), *Woodwardia areolata* (netted chainfern), *Carex folliculata* (northern long sedge), *Carex lonchocarpa* (southern long sedge), *Carex collinsii* (Collins' sedge), *Carex atlantica* (prickly bog sedge), *Bartonia paniculata* (twining screwstem), *Parnassia asarifolia* (kidneyleaf grass of Parnassus), *Helonias bullata* (swamppink), *Chelone glabra* (white turtlehead), *Oxypolis rigidior* (stiff cowbane), and *Osmunda cinnamomea* (cinnamon fern). *Sphagnum* spp. (sphagnum mosses) and other mosses are common.

Environmental Description: This association is generally restricted to groundwater-saturated stream bottoms, seeping toeslopes, and poorly drained depressions with seepage inputs. Most sites can be characterized as "groundwater slope wetlands" (*sensu* Golet et al. 1993) with a flow-through hydrology. Sites typically have hummock-and-hollow microtopography with braided channels, *Sphagnum* (sphagnum)-covered hummocks, mucky depressions, and areas of exposed sand and gravel. Soils are extremely acidic and low in base status.

Vegetation Description: Canopy closure ranges from closed to quite open. Plot data from 38 Virginia and Maryland stands indicate that *Acer rubrum* (red maple) and *Nyssa sylvatica* (blackgum) are consistently dominant overstory species. *Magnolia virginiana* (sweetbay) is a frequent overstory associate and usually dominant in a subcanopy layer or codominant with *Ilex opaca* var. *opaca* (American holly). *Liriodendron tulipifera* (tuliptree) is a frequent but minor overstory associate, and *Pinus taeda* (loblolly pine) is occasional in the canopy. Trees tend to be slow-growing and of less than optimal stature in the wet, unstable habitats. Shrub layers tend to be dense and diverse, characteristically containing *Viburnum nudum* var. *nudum* (possumhaw), *Vaccinium corymbosum* (highbush blueberry), *Smilax rotundifolia* (roundleaf greenbrier), *Ilex verticillata* (common winterberry), and *Lindera benzoin* (northern spicebush). In parts of the range, *Clethra alnifolia* (coastal sweetpepperbush) is a dominant shrub, while in New Jersey, *Chamaedaphne calyculata* (leatherleaf) and *Gaylussacia frondosa* (blue huckleberry) are present. Additional, less constant shrub associates are *Rhododendron viscosum* (swamp azalea), *Leucothoe racemosa* (swamp doghobble), *Chionanthus virginicus* (white fringetree), *Viburnum dentatum* (southern arrowwood), *Toxicodendron vernix* (poison sumac), and *Carpinus caroliniana* (American hornbeam). The herb layer varies from dense to sparse. *Osmunda cinnamomea* (cinnamon fern) and *Woodwardia areolata* (netted chainfern) are generally the most constant and abundant herbs, but *Symplocarpus foetidus* (skunk cabbage) is a patch-dominant in approximately two-thirds of the Virginia and Maryland stands. Additional characteristic herbs occurring at low cover include *Arisaema triphyllum* ssp. *pusillum* (Jack in the pulpit), *Carex atlantica* (prickly bog sedge), *Carex debilis* var. *debilis* (white edge sedge), *Carex folliculata* (northern long sedge), *Carex intumescens* (greater bladder sedge), *Carex lonchocarpa* (southern long sedge), *Carex seorsa* (weak stellate sedge), *Carex styloflexa* (bent sedge), *Chelone glabra* (white turtlehead), *Impatiens capensis* (jewelweed), *Lycopus virginicus* (Virginia water horehound), *Mitchella repens* (partridgeberry), *Osmunda regalis* var. *spectabilis* (royal fern), *Platanthera clavellata* (small green wood orchid), *Viola cucullata* (marsh blue violet), and *Viola X primulifolia* (primroseleaf violet). Regionally uncommon or rare species that

may be locally abundant in this type include *Helonias bullata* (swamppink), *Parnassia asarifolia* (kidneyleaf grass of Parnassus), *Carex collinsii* (Collins' sedge), and *Bartonia paniculata* (twining screwstem).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple), <i>Liquidambar styraciflua</i> (sweetgum), <i>Nyssa sylvatica</i> (blackgum)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Clethra alnifolia</i> (coastal sweetpepperbush), <i>Vaccinium corymbosum</i> (highbush blueberry)
Herb (field)	Fern or fern ally	<i>Osmunda cinnamomea</i> (cinnamon fern), <i>Osmunda regalis</i> (royal fern), <i>Woodwardia areolata</i> (netted chainfern)

Characteristic Species: *Acer rubrum* (red maple), *Magnolia virginiana* (sweetbay), *Nyssa sylvatica* (blackgum), *Osmunda cinnamomea* (cinnamon fern).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Helonias bullata</i> (swamppink)	G3	plant	

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This community ranges from southeastern New York and New Jersey to southeastern Virginia on the Coastal Plain. In Virginia, it extends into the extreme eastern portion of the Piedmont.

States/Provinces: DC, DE, MD, NJ:S4S5, PA, VA:S3?.

Federal Lands: DOD (Fort A.P. Hill, Fort Belvoir); NPS (Assateague Island, Fredericksburg-Spotsylvania, National Capital-East, Petersburg, Prince William, Richmond, Thomas Stone).

CONSERVATION STATUS

Rank: G3? (30-Mar-2004).

Reasons: The type is restricted to an uncommon wetland habitat in a limited region. It is vulnerable to alteration or destruction by beavers and various anthropogenic activities, including hydrologic modifications.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 – Moderate.

Comments: Information not available.

Similar Associations:

- *Acer rubrum* - *Nyssa sylvatica* - *Betula alleghaniensis* / *Sphagnum* spp. Forest (CEGL006014).
- *Acer rubrum* - *Nyssa sylvatica* / *Ilex verticillata* - *Vaccinium fuscum* / *Osmunda cinnamomea* Forest (CEGL007853).
- *Pinus taeda* / *Morella cerifera* / *Osmunda regalis* var. *spectabilis* Forest (CEGL006137).

Related Concepts:

- *Acer rubrum* - *Nyssa sylvatica* - *Magnolia virginiana* / *Viburnum nudum* var. *nudum* / *Osmunda cinnamomea* - *Woodwardia areolata* Forest (Fleming pers. comm.) =
- *Acer rubrum* - *Nyssa sylvatica* / *Magnolia virginiana* / *Woodwardia areolata* - *Symplocarpus foetidus* Saturated Forest (Patterson pers. comm.) ?
- *Acer rubrum* - *Quercus nigra* - *Nyssa sylvatica* swamp (Harvill 1967) ?
- Broadleaf swamp forest (Heckscher 1994) ?
- Cape May lowland swamp (Breden 1989) B
- Inland red maple swamp (Breden 1989) ?
- Pine barrens hardwood swamp (Breden 1989) B
- Woodland fresh marsh community (Hill 1986) ?

SOURCES

Description Authors: G. Fleming.

References: Breden 1989, Breden et al. 2001, Eastern Ecology Working Group n.d., Ehrenfeld and Gulick 1981, Fike 1999, Fleming et al. 2001, Fleming pers. comm., Golet et al. 1993, Harrison 2004, Harrison and Stango 2003, Harvill 1967, Heckscher 1994, Hill 1986, McCormick 1979, Patterson pers. comm., Robichaud and Buell 1973, Sipple and Klockner 1984, VDNH 2003, Windisch 1995.



Figure I18. Coastal Plain / Piedmont Acidic Seepage Swamp (plot FRSP.17) at Fredericksburg and Spotsylvania National Military Park. June 2004. NAD1983 / UTM easting 284052, northing 4239301.

COMMON NAME (PARK-SPECIFIC): BEAVER WETLAND COMPLEX

SYNONYMS

USNVC English Name: Smooth Alder Swamp Shrubland
USNVC Scientific Name: *Alnus serrulata* Swamp Shrubland
USNVC Identifier: CEGLO05082

LOCAL INFORMATION

Environmental Description: Beaver Wetland Complex includes disturbed vegetation associated with beaver activities along stream channels and usually has open standing water due to hydrologic alterations. Areas without open water have saturated soil conditions.

Vegetation Description: Beaver Wetland Complex includes a physiognomic complex of semipermanently flooded habitat with areas variously dominated by trees, shrubs, herbs, or water. Forested areas are typically dominated by *Acer rubrum* (red maple), with *Carpinus caroliniana* (American hornbeam) and *Quercus phellos* (willow oak) common associates. There are also frequently dead overstory trees as a result of saturated soil conditions. The shrubland areas are typically dominated by *Alnus serrulata* (hazel alder), although other species may occur, such as *Ilex verticillata* (common winterberry) and *Smilax rotundifolia* (roundleaf greenbrier). Typical herbaceous species include *Leersia virginica* (whitegrass), *Impatiens capensis* (jewelweed), *Juncus effusus* (common rush), *Carex intumescens* (greater bladder sedge), *Polygonum sagittatum* (arrowleaf tearthumb), *Boehmeria cylindrica* (smallspike false nettle), *Dichanthelium* spp. (rosette grasses), *Arisaema triphyllum* (Jack in the pulpit), *Peltandra virginica* (green arrow arum), and *Erechtites hieraciifolia* var. *hieraciifolia* (American burnweed).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Alnus serrulata</i> (hazel alder)

Characteristic Species: *Acer rubrum* (red maple), *Alnus serrulata* (hazel alder), *Impatiens capensis* (jewelweed), *Juncus effusus* (common rush).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	plant	invasive nonnative
<i>Microstegium vimineum</i> (Nepalese browntop)	-	plant	invasive nonnative

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNR	.	.	[not crosswalked]	.

Local Range: Beaver Wetland Complex occurs in areas with beaver activity along stream channels. It covers a total of 7 hectares and is mapped as 2 polygons.

Classification Comments: Information not available.

Other Comments: Information not available.

Local Description Authors: K. Taverna.

Plots: None.

Fredericksburg & Spotsylvania National Military 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.e.)
Formation	Seasonally flooded cold-deciduous shrubland (III.B.2.N.e.)
Alliance	<i>Alnus serrulata</i> Seasonally Flooded Shrubland Alliance (A.994)
Alliance (English name)	Smooth Alder Seasonally Flooded Shrubland Alliance
Association	<i>Alnus serrulata</i> Swamp Shrubland
Association (English name)	Smooth Alder Swamp Shrubland
Ecological System(s):	Central Appalachian River Floodplain (CES202.608) Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)

GLOBAL DESCRIPTION

Concept Summary: This alder swamp is found widely throughout the northeastern United States south of near-boreal regions. These shrublands are found on muck overlying mineral soils (peat deposits are not typical) of upland marsh borders, at the edges of red maple swamps, or in acidic colluvium at bases of slopes. The pH of these systems is broadly circumneutral to somewhat calcareous. The vegetation is dominated by tall shrubs, characterized and usually dominated by *Alnus serrulata* (hazel alder), sometimes in a mixture with (or rarely replaced by) *Alnus incana* (gray alder). Associate shrubs vary somewhat with geography and include *Cornus sericea* (redosier dogwood), *Rosa palustris* (swamp rose), *Physocarpus opulifolius* (common ninebark), *Viburnum recognitum* (southern arrowwood), and *Salix* spp. (willows). Saplings of *Acer rubrum* (red maple) are typical. Short shrubs include *Spiraea alba* var. *latifolia* (white meadowsweet) and *Lindera benzoin* (northern spicebush). Less frequent shrubs include *Cephalanthus occidentalis* (common buttonbush), *Decodon verticillatus* (swamp loosestrife), *Ilex verticillata* (common winterberry), *Rhododendron viscosum* (swamp azalea), and *Sambucus canadensis* (= *Sambucus nigra* ssp. *canadensis*) (common elderberry). Herbaceous associates include *Calamagrostis canadensis* (bluejoint), *Osmunda regalis* (royal fern), *Glyceria striata* (fowl mannagrass), *Thelypteris palustris* (eastern marsh fern), *Galium* spp. (bedstraws), *Typha latifolia* (broadleaf cattail), *Polygonum hydropiper* (marshpepper knotweed), *Bidens cernua* (nodding beggartick), *Galium tinctorium* (stiff marsh bedstraw), *Cicuta maculata* (spotted water hemlock), *Peltandra virginica* (green arrow arum), and *Carex stricta* (upright sedge).

Environmental Description: These shrublands are found on muck overlying mineral soils (peat deposits are not typical) of upland marsh borders, small upland depressions, at the edges of red maple swamps or other ponded drainages, or in colluvium at bases of slopes. The pH of these systems is broadly circumneutral to somewhat calcareous (Fike 1999).

Vegetation Description: The vegetation is dominated by tall shrubs and characterized by *Alnus serrulata* (hazel alder), *Alnus incana* (gray alder), *Physocarpus opulifolius* (common ninebark), *Viburnum recognitum* (southern arrowwood), *Cornus amomum* (silky dogwood), and *Salix* spp. (willows). Saplings of *Acer rubrum* (red maple) are typical. Short shrubs include *Spiraea alba* var. *latifolia* (white meadowsweet) and *Lindera benzoin* (northern spicebush). Other shrubs present include *Cephalanthus occidentalis* (common buttonbush), *Decodon verticillatus* (swamp loosestrife), *Ilex verticillata* (common winterberry), *Rhododendron viscosum* (swamp azalea), and *Sambucus canadensis* (= *Sambucus nigra* ssp. *canadensis*) (common elderberry) (Anderson 1996, Fike 1999). Herbaceous associates include *Calamagrostis canadensis* (bluejoint), *Osmunda regalis* (royal fern), *Glyceria striata* (fowl mannagrass), *Thelypteris palustris* (eastern

marsh fern), *Galium* spp. (bedstraws), *Typha latifolia* (broadleaf cattail), *Polygonum hydropiper* (marshpepper knotweed), *Bidens cernua* (nodding beggartick), *Galium tinctorium* (stiff marsh bedstraw), *Cicuta maculata* (spotted water hemlock), *Peltandra virginica* (green arrow arum), and *Carex stricta* (upright sedge).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Alnus incana</i> (gray alder)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Alnus serrulata</i> (hazel alder), <i>Physocarpus opulifolius</i> (common ninebark), <i>Viburnum recognitum</i> (southern arrowwood)
Herb (field)	Forb	<i>Peltandra virginica</i> (green arrow arum)
Herb (field)	Graminoid	<i>Calamagrostis canadensis</i> (bluejoint)
Herb (field)	Fern or fern ally	<i>Osmunda regalis</i> (royal fern)

Characteristic Species: *Alnus serrulata* (hazel alder), *Cornus amomum* (silky dogwood), *Physocarpus opulifolius* (common ninebark), *Viburnum recognitum* (southern arrowwood).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This alder swamp is found widely throughout the northeastern United States, ranging from central New England south to New Jersey, and west to Ohio and Pennsylvania.

States/Provinces: CT, DE?, MA, MD?, ME, NH, NJ, NY, OH, PA, QC?, RI, VA, VT.

Federal Lands: NPS (Delaware Water Gap, Fredericksburg-Spotsylvania, Minute Man).

CONSERVATION STATUS

Rank: G4G5 (22-Mar-1999).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 – Weak.

Comments: This type overlaps with *Alnus incana* Swamp Shrubland (CEGL002381) where the ranges abut in Ohio, Pennsylvania, southern New England, and southern New York. Where both alder species are present, this type is distinguished from the *Alnus incana* (gray alder) nominal type by the presence of species with a somewhat more Central Appalachian / Alleghenian affinity such as *Physocarpus opulifolius* (common ninebark), *Rhododendron viscosum* (swamp azalea), *Peltandra virginica* (green arrow arum), compared to CEGL002381 which is characterized by somewhat more northern species such as *Nemopanthus mucronatus* (catberry) and *Myrica gale* (sweetgale). Where they overlap, the relative dominance of the two alder species should be expected to vary. If *Alnus serrulata* (hazel alder) is present in more than token amounts, consider this type as opposed to CEGL002381.

Similar Associations:

- *Alnus incana* Swamp Shrubland (CEGL002381).
- *Alnus serrulata* Southeastern Seasonally Flooded Shrubland (CEGL008474).

Related Concepts:

- Smooth alder shrub thicket (CAP 1998) ?

SOURCES

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

References: Anderson 1996, CAP 1998, Eastern Ecology Working Group n.d., Fike 1999, Swain and Kearsley 2001.



Figure I19. Beaver Wetland Complex at Fredericksburg and Spotsylvania National Military Park. August 2004. Locational coordinates are unknown.

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: CEG006107

LOCAL INFORMATION

Environmental Description: This association includes herbaceous-dominated vegetation that is maintained as fields, agricultural leases, lawns, and mowed roadsides. Fields in Fredericksburg & Spotsylvania National Military Park are maintained to keep an open landscape similar to the open farmland and battlefield conditions found during the 18th century. Vegetation is often allowed to grow to a height of 50-75 cm before being mowed and can include scattered woody shrubs.

Vegetation Description: Cultural Meadows are typically composed of a mix of native and exotic grasses and forbs with scattered shrubs. Fields tend to be dense stands of cool-season, sod-forming grasses such as *Lolium pratense* (meadow ryegrass), *Andropogon virginicus* (broomsedge bluestem), and *Dactylis glomerata* (orchard grass). Planted crops in fields with agricultural leases may vary from season to season.

This association also includes meadow areas established by park Natural Resource staff through planting of native warm-season grasses and maintained with prescribed burning. It consists of very dense graminoid vegetation; the dominant species are tall (1-2 m) warm-season grasses, primarily *Panicum virgatum* (switchgrass), *Tridens flavus* (purpletop tridens), *Andropogon gerardii* (big bluestem), and *Sorghastrum nutans* (Indiangrass). *Panicum anceps* (beaked panicgrass) is also present along with various non-graminoid herbaceous species.

Most Abundant Species: Information not available.

Characteristic Species: Information not available.

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	SNA	.	.	[not crosswalked]	.

Local Range: Cultural Meadow occurs throughout Fredericksburg & Spotsylvania National Military Park and cover a total of 517 hectares. Sites are mapped as 50 polygons ranging in size from 0.5 to 132 hectares.

Classification Comments: Cultural Meadow is distinguished from other map classes by being an herbaceous-dominated association composed primarily of native and exotic grasses and forbs. It also includes areas dominated by native warm-season grasses that are maintained as open grassland with periodic controlled burns. There is only one documented occurrence of warm-season grass meadow located in the park in Spotsylvania Court House Battlefield. This occurrence is tagged as "Native Grassland" in the comments field of the attribute table in the park vegetation map. Additional sites could be established in the future by Fredericksburg & Spotsylvania National Military Park Natural Resource staff.

Other Comments: Areas mapped as Cultural Meadow may have below minimum mapping unit inclusions of tree-dominated windrows or shrub-dominated ditches or small, disturbed seepages. It may also include minor roads and scattered trees and shrubs.

Local Description Authors: K. D. Patterson and K. Taverna.

Plots: None.

Fredericksburg & Spotsylvania National Military 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	<i>Dactylis glomerata</i> - <i>Rumex acetosella</i> Herbaceous Alliance (A.1190)
Alliance (English name)	Orchard Grass - Common Sheep Sorrel Herbaceous Alliance
Association	<i>Dactylis glomerata</i> - <i>Phleum pratense</i> - <i>Festuca</i> spp. - <i>Solidago</i> 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:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Forb	<i>Rumex acetosella</i> (common sheep sorrel)
Herb (field)	Graminoid	<i>Dactylis glomerata</i> (orchardgrass), <i>Festuca rubra</i> (red fescue), <i>Phleum pratense</i> (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, Booker T. Washington, Cape Cod, Delaware Water Gap, Fire Island, Fort Necessity, Fredericksburg-Spotsylvania, Friendship Hill, Gateway, Gettysburg, Johnstown Flood, Marsh-Billings-Rockefeller, Minute Man, Morristown, Saint-Gaudens, 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* - *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* - *Solidago* spp. Herbaceous Vegetation (CEGL006333).

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, Keever 1979, 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 I20. Cultural Meadow at Fredericksburg and Spotsylvania National Military Park. August 2002. NAD 1983 / UTM easting 258995, northing 4244692.

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 is documented at one site in Fredericksburg Battlefield where an old man-made impoundment has created an area of open water surrounded by shrubby and coarse herbaceous vegetation. Over time, this wetland will fill with sediment and undergo invasion by emergent and woody vegetation. The site currently has an area of open water; the depth fluctuates throughout the year.

Vegetation Description: The vegetation of the Semipermanent Impoundment includes both low pond edges immediately adjacent to open water and shrubby woodland vegetation surrounding the pond edges. At lower depths near the pond edge is emergent vegetation dominated by *Juncus effusus* (common rush). The vegetation transitions from the pond edge into a shrubby area dominated by *Betula nigra* (river birch), *Alnus serrulata* (hazel alder), *Salix nigra* (black willow), and *Acer rubrum* (red maple) farther out from the pond.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Betula nigra</i> (river birch)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Alnus serrulata</i> (hazel alder), <i>Salix nigra</i> (black willow)
Herb (field)	Graminoid	<i>Juncus effusus</i> (common rush)

Characteristic Species: *Agalinis purpurea* (purple false foxglove), *Alnus serrulata* (hazel alder), *Betula nigra* (river birch), *Juncus effusus* (common rush), *Salix nigra* (black willow).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Daucus carota</i> (Queen Anne's lace)	-	plant	nonnative

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	NA	.	.	[not crosswalked, not ranked]	.

Local Range: Semipermanent Impoundment is only documented from south of Lee Drive in Fredericksburg Battlefield. It is mapped as 1 polygon covering a total of 2 hectares.

Classification Comments: Semipermanent Impoundment is distinguished from Beaver Wetland Complex by the man-made impoundment (old farm pond) dominated by *Juncus effusus* (common rush).

Other Comments: Information not available.

Local Description Authors: K. Taverna.

Plots: None.

Fredericksburg & Spotsylvania National Military Park Inventory Notes: Information not available.

GLOBAL INFORMATION

Semipermanent Impoundment is a park-specific, nonstandard type and has no global information.

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: Successional Mixed Scrub includes sparse to dense, shrubby regeneration of hardwood and/or evergreen species on areas that have been cleared in the recent past (< 20 years). The map class varies from open weedy herbaceous areas with patches of young evergreens and hardwoods to thick stands of young deciduous and evergreen sprouts (6-10 m tall) with little canopy stratification and no clear dominant.

Vegetation Description: Species composition varies from stand to stand, but typical young tree species include *Juniperus virginiana* var. *virginiana* (eastern redcedar) (often a dominant in small patches), *Pinus virginiana* (Virginia pine), *Acer rubrum* (red maple), *Liquidambar styraciflua* (sweetgum), *Liriodendron tulipifera* (tuliptree), *Quercus alba* (white oak), *Carya alba* (mockernut hickory), *Cornus florida* (flowering dogwood), *Nyssa sylvatica* (blackgum), and *Robinia pseudoacacia* (black locust). Common low shrubs and vines include *Smilax rotundifolia* (roundleaf greenbrier), *Lespedeza* spp. (lespedeza species), *Rubus* spp. (blackberry species), *Lonicera japonica* (Japanese honeysuckle), and *Toxicodendron radicans* (eastern poison ivy). The herb layer can vary from a dense graminoid-dominated layer with small forbs to a very sparse layer in stands with higher tree density. Common grasses include *Andropogon virginicus* (broomsedge bluestem) and *Lolium pratense* (meadow ryegrass).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree (canopy & subcanopy)	Needle-leaved tree	<i>Juniperus virginiana</i> var. <i>virginiana</i> (eastern redcedar)
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	<i>Liquidambar styraciflua</i> (sweetgum)

Characteristic Species: *Andropogon virginicus* (broomsedge bluestem), *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Lespedeza cuneata* (Chinese lespedeza), *Liquidambar styraciflua* (sweetgum), *Pinus virginiana* (Virginia pine), *Rubus* spp. (blackberry species).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Lespedeza cuneata</i> (Chinese lespedeza)	-	plant	invasive nonnative
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	plant	invasive nonnative

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VA	NA	.	.	[not crosswalked, not ranked]	.

Local Range: Successional Mixed Scrub occurs throughout Fredericksburg & Spotsylvania National Military Park and covers a total of 72 hectares and is mapped as 16 polygons ranging in size from 0.5 to 28 hectares.

Classification Comments: This map class can be distinguished from Successional Red-cedar Forest by the occurrence of *Juniperus virginiana* var. *virginiana* (eastern redcedar) as scattered tall shrubs (short-statured) along with other hardwood and evergreen species in the context of open meadows dominated by graminoids and small forbs. Successional Red-cedar Forest is typically a dense stand of *Juniperus virginiana* var. *virginiana* (eastern redcedar) trees. The denser tree variant of Successional Mixed Scrub differs from Successional Tuliptree Forest and

Successional Virginia Pine Forest in that it is dominated by young, relatively short sprouts with many coppiced trees and no clear dominant. These stands are also not dominated by *Liriodendron tulipifera* (tuliptree) or *Pinus virginiana* (Virginia pine), but rather have a mixed composition of a number of different hardwoods and evergreens.

Other Comments: Species composition varies depending on the original forest on the site and composition of the surrounding forest. This map class varies from open weedy herbaceous areas with patches of young evergreens and hardwoods to thick stands of young deciduous and evergreen sprouts (6-10 m tall) with little canopy stratification.

Local Description Authors: K. Taverna.

Plots: None.

Fredericksburg & Spotsylvania National Military Park Inventory Notes: Information not available.

GLOBAL INFORMATION

Successional Mixed Scrub is a park-specific, nonstandard type and has no global information.



Figure I21. Successional Mixed Scrub at Fredericksburg and Spotsylvania National Military Park. September 2003. NAD 1983 / UTM easting 271266, northing 4242429. Photo by NCSU-CEO.

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

Classification Comments: This map class includes areas associated with park maintenance, recreation, and historic interpretation. It includes all buildings, and their associated lawns and vegetation, as well as picnic areas, cemeteries, and other structures. This map class also includes any private buildings within the park boundary (such as residential homes). This map class is equal to the Anderson (Anderson et al. 1976) Level II unit 17 - Other Urban or Built-up Land.

Local Range: Other Urban or Built-up Land is mapped throughout the park as 27 polygons, covering a total of 37.0 ha.

Other Comments: Information not available.

Local Description Authors: K. Taverna.

Plots: None.

References: 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 DESCRIPTION

Classification Comments: This map class includes major paved roads and the associated maintained roadsides, park roads, large parking areas, and utility line corridors. This map class is equal to the Anderson (Anderson et al. 1976) Level II unit 14 - Transportation, Communications, and Utilities.

Local Range: Transportation, Communications, and Utilities is mapped throughout the Park.

Other Comments: The 'Comments' field in the vegetation map attribute table indicates if a polygon represents transportation, mowed roadside, parking area or utilities (pipeline/powerline).

Local Description Authors: K. Taverna.

Plots: None.

References: 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 DESCRIPTION

Classification Comments: This map class includes areas of open water, primarily small ponds and other artificial impoundments. This map class is equal to the Anderson (Anderson et al. 1976) Level II unit 53 - Reservoirs.

Local Range: Water is mapped in the park as 6 polygons, covering a total of 1.8 ha.

Local Description Authors: K. Taverna.

Plots: None.

References: Anderson et al. 1976.

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Appendix J. Field definitions for local and global descriptions of vegetation associations and other 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 sclerophyllous 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. Field key to the vegetation classes² at Fredericksburg and Spotsylvania National Military Park.

- 1a Forested vegetation: vegetation dominated by trees with canopy coverage of at least 25%. 2
- 1b Non-forested vegetation: vegetation dominated by shrubs and/or herbs with less than 25% tree cover. 23

FORESTED VEGETATION

- 2a Deciduous forested vegetation: vegetation dominated by deciduous trees with canopy coverage of at least 25%; evergreens can be scattered. 3
- 2b Evergreen forested vegetation: vegetation dominated by evergreen trees with canopy coverage of at least 25%; hardwoods can be scattered. 19
- 3a Upland forests; lacking wetland plants and soils. 4
- 3b Wetland forests: vegetation influenced by groundwater or surface flooding from rivers and streams. 11

DECIDUOUS UPLAND FORESTS

- 4a White oak (*Quercus alba*), northern red oak (*Quercus rubra*), and/or chestnut oak (*Quercus prinus*) strongly dominant in canopy; hickories (*Carya* spp.) can be present in varying proportions. 5
- 4b Oaks not strongly dominant; other deciduous species such as tuliptree (*Liriodendron tulipifera*) and American beech (*Fagus grandifolia*) dominant or co-dominant. White oak and northern red oak often present in canopy as co-dominants. 8
- 5a Forests of drier side slopes, crests and upland flats; oaks dominant in the canopy; heaths present; American beech (*Fagus grandifolia*) absent or restricted to shrub layer. 6
- 5b Forests of mesic lower slopes and ravines; white oak (*Quercus alba*) and/or northern red oak (*Quercus rubra*) dominant, or co-dominant with American beech in canopy; American beech always present in canopy and/or subcanopy. **Mesic Mixed Hardwood Forest**
- 6a Forest primarily of drier side slopes; chestnut oak (*Quercus prinus*) absent or of low cover; hickories (*Carya* spp.) and tuliptree (*Liriodendron tulipifera*) often present; heaths often patchy, but not forming a dense shrub layer; maple-leaf viburnum (*Viburnum acerifolium*) common; can have a well-developed or sparse herb layer. **Acidic Oak – Hickory Forest**
- 6b Forest of crests and upland flats; white oak, scarlet oak (*Quercus coccinea*), northern red oak (*Quercus rubra*) and chestnut oak (*Quercus prinus*) (if present) dominant in various combinations; prominent low shrub layer dominated by heaths; sparse to no herb cover. 7

² If a map class name differs from the vegetation class common name (i.e. Common Name (Park-specific) used in Appendix I), the map class name follows in brackets.

- 7a Widespread in park; blue huckleberry (*Gaylussacia frondosa*) absent or unimportant; chesnut oak (*Quercus prinus*) often present. **Piedmont / Low Elevation Mixed Oak / Heath Forest [Oak / Heath Forest]**
- 7b Confined to Coastal Plain portion of park; blue huckleberry (*Gaylussacia frondosa*) dominant in low heath complex; chestnut oak absent. **Coastal Plain Mixed Oak / Heath Forest [Oak/ Heath Forest]**
- 8a Canopy dominated by variable combinations of American beech (*Fagus grandifolia*), tuliptree (*Liriodendron tulipifera*), and white oak (*Quercus alba*); American beech often dominant only in subcanopy; forests of mesic lower slopes and ravines. **Mesic Mixed Hardwood Forest**
- 8b Canopy dominated by successional species (single species or mixed) such as tuliptree, red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), eastern redcedar (*Juniperus virginiana* var. *virginiana*) and/or Virginia pine (*Pinus virginiana*). 9
- 9a Successional forests with one species, typically tuliptree (*Liriodendron tulipifera*) or Virginia pine (*Pinus virginiana*), dominating the canopy; white oak (*Quercus alba*) sometimes scattered in canopy. 10
- 9b Dense stands of young successional trees of variable composition, including tuliptree, Virginia pine, red maple (*Acer rubrum*), white oak (*Quercus alba*), eastern redcedar (*Juniperus virginiana* var. *virginiana*), sweetgum (*Liquidambar styraciflua*), black gum (*Nyssa sylvatica*), hickories (*Carya* spp.), flowering dogwood (*Cornus florida*) and others; coppiced trees and stumps evident. **Successional Mixed Scrub**
- 10a Tuliptree (*Liriodendron tulipifera*) strongly dominant or co-dominant with other deciduous trees (often white oak); stands usually even-aged; Virginia pine (*Pinus virginiana*), if present, a minor component. **Successional Tuliptree Forest**
- 10b Virginia pine forming an emergent canopy above tuliptree and other deciduous trees, but pines not all vigorous, some dying. **Successional Virginia Pine Forest**

DECIDUOUS WETLAND FORESTS

- 11a Small patch, forested isolated wetlands of headwaters and upland depressions; primary hydrology not influenced by rivers or streams..... 12
- 11b Broad, large patch wetlands associated with river floodplains or broad poorly drained flats 13
- 12a Wetland forest of headwaters and ravine bottoms; groundwater seepage usually evident; substrate very mucky, with hummock and hollow microtopography; canopy characterized by red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), willow oak (*Quercus phellos*), and black gum (*Nyssa sylvatica*); shrub layer often includes possumhaw (*Viburnum nudum*), sweetbay (*Magnolia virginiana*), and coastal sweet pepperbush (*Clethra alnifolia*). **Coastal Plain / Piedmont Acidic Seepage Swamp**
- 12b Small isolated forested depression wetlands in an otherwise upland landscape; seepage absent, soils saturated or flooded by perched water table. Canopy often dominated by hydric oak species [willow oak and pin oak (*Quercus phellos* and *Quercus palustris*)], with red maple, sweetgum and blackgum common associates. ... **Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type)**

- 13a Wetlands with hydrophytic oaks such as willow oak (*Quercus phellos*), pin oak (*Quercus palustris*) and swamp chestnut oak (*Quercus michauxii*) in the canopy; often occurring with other species such as sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*) and black gum (*Nyssa sylvatica*). 14
- 13b Wetlands associated with alluvial forests that are not dominated by hydrophytic oak species; willow oak occasionally present as scattered individuals. 15
- 14a Large non-alluvial wetland forests occurring on broad, flat terraces in Fredericksburg; sweet gum (*Liquidambar styraciflua*), red maple (*Acer rubrum*) and blackgum (*Nyssa sylvatica*) present in combination with hydrophytic oaks: swamp chestnut oak (*Quercus michauxii*), willow oak (*Quercus phellos*), or pin oak (*Quercus palustris*); seasonally fluctuating groundwater hydrology often with standing water. **Non-Riverine Saturated Forest**
- 14b Large alluvial wetlands occurring on broad floodplains of the Ni River; poorly drained saturated soils prevalent; canopy a mix of willow oak, pin oak, red maple and sweetgum. Often includes typical floodplain species such as American hornbeam (*Carpinus carolinana*), river birch (*Betula nigra*) and sweet woodreed (*Cinna arundinacea*). **Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak – Red Maple Type)**
- 15a Alluvial forest of large rivers dominated by silver maple (*Acer saccharinum*) with American sycamore (*Platanus occidentalis*), boxelder (*Acer negundo*), common hackberry (*Celtis occidentalis*) and sweetgum (*Liquidambar styraciflua*); exotic herbs may be common. **Piedmont / Mountain Floodplain Forest**
- 15b Alluvial forests of small streams, silver maple absent. 16
- 16a Community influenced by beaver activity; variable mix of red maple (*Acer rubrum*) swamp, alder (*Alnus* sp.) shrublands, herbaceous vegetation and open water formed by beaver activity on small stream floodplains; may have standing dead trees. **Beaver Wetland Complex**
- 16b Floodplain forests where beaver activity is not evident; includes early successional and more mature floodplain forests. 17
- 17a Mature floodplain forest of small streams; soils well-drained; diverse canopy characterized by tuliptree (*Liriodendron tulipifera*), sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), and white oak (*Quercus alba*); willow oak (*Quercus phellos*) not dominant, if present. Examples often include typical floodplain species such as American holly (*Ilex opaca* var. *opaca*), American hornbeam (*Carpinus caroliniana*) and northern spicebush (*Lindera benzoin*) in shrub layer; diverse herbs and exotic species can be prevalent. **Coastal Plain / Piedmont Small-Stream Floodplain Forest [Coastal Plain / Piedmont Floodplain Forest]**
- 17b Early successional floodplain forest dominated by tuliptree and/or river birch with varying canopy cover; exotic species may be abundant. 18

- 18a Early successional floodplain forest dominated by river birch (*Betula nigra*) and red maple (*Acer rubrum*) with varying canopy cover; herb layer often dense and dominated by graminoids and forbs.
.. **Successional River Birch – Red Maple Floodplain Forest [Coastal Plain / Piedmont Floodplain Forest]**
- 18b Early successional floodplain forest dominated by tuliptree (*Liriodendron tulipifera*), with sweetgum (*Liquidambar styraciflua*) and red maple common associates; shrub and ground layer varies and in highly disturbed examples can be dense tangles of vines; exotic species often present.
..... **Successional Tuliptree Floodplain Forest [Coastal Plain / Piedmont Floodplain Forest]**

EVERGREEN OR MIXED FORESTS

- 19a Evergreen (or mixed) forest dominated by eastern white pine (*Pinus strobus*) or with high understory cover of eastern white pine with high cover of white oak (*Quercus alba*) and northern red oak (*Quercus rubra*). **Eastern White Pine-Hardwood Forest**
- 19b Successional evergreen forest dominated by eastern redcedar (*Juniperus virginiana* var. *virginiana*), loblolly pine (*Pinus taeda*) and/or Virginia pine (*Pinus virginiana*); hardwoods can be prevalent in the understory. 20
- 20a Virginia pine (*Pinus virginiana*) dominant evergreen forests, often occurring with a variety of deciduous trees; older stands may exhibit an emergent canopy of senescent pines with a main canopy of deciduous trees; herb layer poorly developed or often dominated by fan clubmoss (*Lycopodium digitatum*). **Successional Virginia Pine Forest**
- 20b Evergreen forests dominated by loblolly pine (*Pinus taeda*) or eastern redcedar (*Juniperus virginiana* var. *virginiana*); eastern redcedar can occur as closed canopy stands or scattered in open meadows. 21
- 21a Evergreen forests dominated by loblolly pine (*Pinus taeda*). Loblolly pines in dense, even-aged stands, or occurring with scattered deciduous trees and Virginia pine (*Pinus virginiana*). Often with shrub and herbaceous layers essentially lacking. **Loblolly Pine Plantation**
- 21b Evergreen forests dominated by eastern redcedar (*Juniperus virginiana* var. *virginiana*); eastern redcedar can occur as closed canopy stands or scattered in open meadows. 22
- 22a Eastern redcedar (*Juniperus virginiana* var. *virginiana*) dominant and in dense closed canopy stands; other successional trees such as Virginia pine (*Pinus virginiana*), black cherry (*Prunus serotina* var. *serotina*), or sweetgum (*Liquidambar styraciflua*) may be present; often sparse herb cover. **Successional Red-cedar Forest**
- 22b Eastern redcedar present as tall shrubs with other young regenerating trees such as Virginia pine, red maple (*Acer rubrum*), sweetgum and tuliptree (*Liriodendron tulipifera*); canopy may be closed to scattered, over an herbaceous layer of grasses or forbs. Nonnative herbs may be common. **Successional Mixed Scrub**

NON-FORESTED VEGETATION

23a	Vegetation dominated by herbs; trees and shrubs, if present, occur at less than 25% cover.	24
23b	Vegetation woody; shrubs, vines and scattered trees characteristic.	27
24a	Wetland herbaceous vegetation.	25
24b	Upland herbaceous vegetation.	26

HERBACEOUS WETLAND VEGETATION

25a	Wetlands associated with beaver activity on small streams; variable mix of red maple (<i>Acer rubrum</i>) swamp, alder (<i>Alnus</i> sp.) shrublands, herbaceous vegetation and open water; herbaceous areas dominated by hydrophytic herbs such as whitegrass (<i>Leersia virginica</i>), common rush (<i>Juncus effuses</i>), arrowleaf tearthumb (<i>Polygonum sagittatum</i>), smallspike false nettle (<i>Boehmeria cylindrica</i>), and green arrow arum (<i>Peltandra virginica</i>); may have standing dead trees.	Beaver Wetland Complex
25b	Wetlands associated with anthropogenic impoundments; areas of open water and herbaceous vegetation dominated by common rush.	Semipermanent Impoundment

HERBACEOUS UPLAND VEGETATION

26a	Planted and maintained grassland meadows and/or agricultural land dominated by native and/or exotic grasses; may include scattered trees and shrubs, windrows, ditches, and small isolated wetland areas.	Cultural Meadow
26b	Small (<0.5 ha) open herbaceous areas dominated by weedy grasses and forbs; herbaceous areas directly adjacent to or among young regenerating trees such as eastern redcedar (<i>Juniperus virginiana</i> var. <i>virginiana</i>), Virginia pine (<i>Pinus virginiana</i>), red maple (<i>Acer rubrum</i>), sweetgum (<i>Liquidambar styraciflua</i>) and tuliptree (<i>Liriodendron tulipifera</i>); nonnative herbs common.	Successional Mixed Scrub

SHRUBLAND VEGETATION

27a	Young regenerating upland vegetation dominated by shrubs and small trees such as eastern redcedar (<i>Juniperus virginiana</i> var. <i>virginiana</i>), Virginia pine (<i>Pinus virginiana</i>), red maple (<i>Acer rubrum</i>), sweetgum (<i>Liquidambar styraciflua</i>) and tuliptree (<i>Liriodendron tulipifera</i>); often with open herbaceous areas.	Successional Mixed Scrub
27b	Wetland vegetation dominated by shrubs and small trees and associated with beaver activity on small streams; typical dominants are alder (<i>Alnus</i> sp.) and red maple (<i>Acer rubrum</i>).	Beaver Wetland Complex

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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National Park Service
U.S. Department of the Interior



Northeast Region
Natural Resource Stewardship and Science
200 Chestnut Street
Philadelphia, Pennsylvania 19106-2878

<http://www.nps.gov/nero/science/>