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Northeast Region
Philadelphia, Pennsylvania



Vegetation Classification and Mapping at Booker T. Washington National Monument, Virginia

Technical Report NPS/NER/NRTR—2008/100



ON THE COVER

Left inset: Basic Mesic Forest; Right inset: Booker T. Washington bust at park visitor center; Center: Garden area at park;
Bottom inset: Acidic Oak-Hickory Forest. Photographs by: Gary P. Fleming

Vegetation Classification and Mapping at Booker T. Washington National Monument, Virginia

Technical Report NPS/NER/NRTR—2008/100

Karen D. Patterson
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

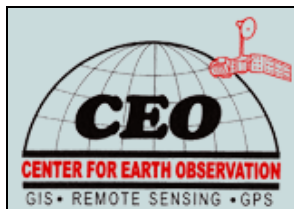


Virginia Department of Conservation and Recreation
Division of Natural Heritage
Governor Street, 3rd Floor
Richmond, VA 23219
www.dcr.virginia.gov/dnh/index.html

Karen D. Patterson
Vegetation Ecologist, Principal Investigator
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, Kristin Taverna, John Townsend, Philip Coulling, 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

Booker T Washington National Monument

Timbo Sims, Park Ranger
540 721-2094
Timbo_Sims@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 and the U.S. Geological Survey (USGS) have put forth standards and protocols for classification and mapping of vegetation communities on NPS lands. The USGS-NPS Vegetation Mapping Program recognizes the United States National Vegetation Classification (USNVC) as the standard vegetation classification to be used in these mapping projects.

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

This report documents the classification and mapping of vegetation at Booker T. Washington National Monument. Ten map classes, representing seven USNVC associations, one nonstandard park-specific vegetation class, and two Anderson Level II land-use categories were used to map the 97-ha (239-ac) park. Vegetation map classes were determined through extensive field reconnaissance and data collection and analysis. The vegetation map classes were based on 2002 aerial photography and 2002 field sampling. Spatial data was 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.

Four cultural map classes covered 35% (32 ha [79 ac]) of the park: Cultural Meadow; Other Urban or Built-Up Land; Transportation, Communications, and Utilities; and White Pine Plantation. Early successional or transitional vegetation covers approximately 31% (28 ha [69 ac]) of park land: Successional Virginia Pine Forest; Successional Tuliptree Forest; and Dense Hardwood Regeneration. The remaining 34% (31 ha [77 ac]) of the park are later successional forests: Acidic Oak - Hickory Forest; Basic Mesic Forest; and Piedmont / Mountain Floodplain Forest.

A vegetation map of Booker T. Washington National Monument was created following the USGS-NPS Vegetation Mapping Program protocols. These vegetation associations 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. A field key to the map classes and detailed descriptions for each 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 and plot sample points with associated Federal Geographic Data Committee (FGDC)-compliant metadata.

Products for Booker T. Washington National Monument 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, Booker T. Washington National Monument

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 on the map or 12.2 m (40 ft) on the ground.

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

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

The USNVC is a hierarchical system that classifies vegetation using physiognomic (structural) features at the highest levels of the hierarchy and floristic features at the lower levels. The physiognomic units have a broad geographic perspective and the floristic units have local and site-specific perspectives (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 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 Booker T. Washington National Monument was to produce an up-to-date digital geospatial vegetation database for the park and to provide a plant species list, a dichotomous key for map 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, and writing the final reports. The Northeast Region of the NPS funded the project and provided technical specifications and guidance.

Park-specific Information

Booker T. Washington National Monument is a 97-ha (239-ac) unit of the National Park Service located in Franklin County, Virginia near the community of Hardy, about 40 km (25 mi) southeast of Roanoke (Figure 1). The site was formerly known as the Burroughs Plantation; where John and Elizabeth Burroughs moved with their family and slaves in 1850. It was established as a national park in 1956 to preserve and protect the birth site and childhood home of educator and activist Booker T. Washington, who was born into slavery in 1856. Booker T. Washington went on to become one of the most influential African Americans of the late 19th and early 20th centuries, founding Tuskegee Institute in Alabama in 1881. The park provides a resource for public education and historic interpretation of the life of Booker T. Washington. It also preserves a piece of the region's rural character in the midst of increasing modern development along the Route 122 corridor (NPS 2000). Facilities at the park include a visitor center, administrative offices located within a former school building, an 1850s tobacco barn, reconstructed plantation outbuildings, two marked archeological sites, three small cemeteries, and 2.8 km (1.75 mi) of walking trails that meander through the historic areas and many forested acres of the Burroughs Plantation. Twentieth century reconstructions of nineteenth century farm buildings include a slave cabin, smoke house, blacksmith shop, privy, hog pen, duck lot, and a chicken house (NPS 2000). Nearly 18,000 people visit the park annually.

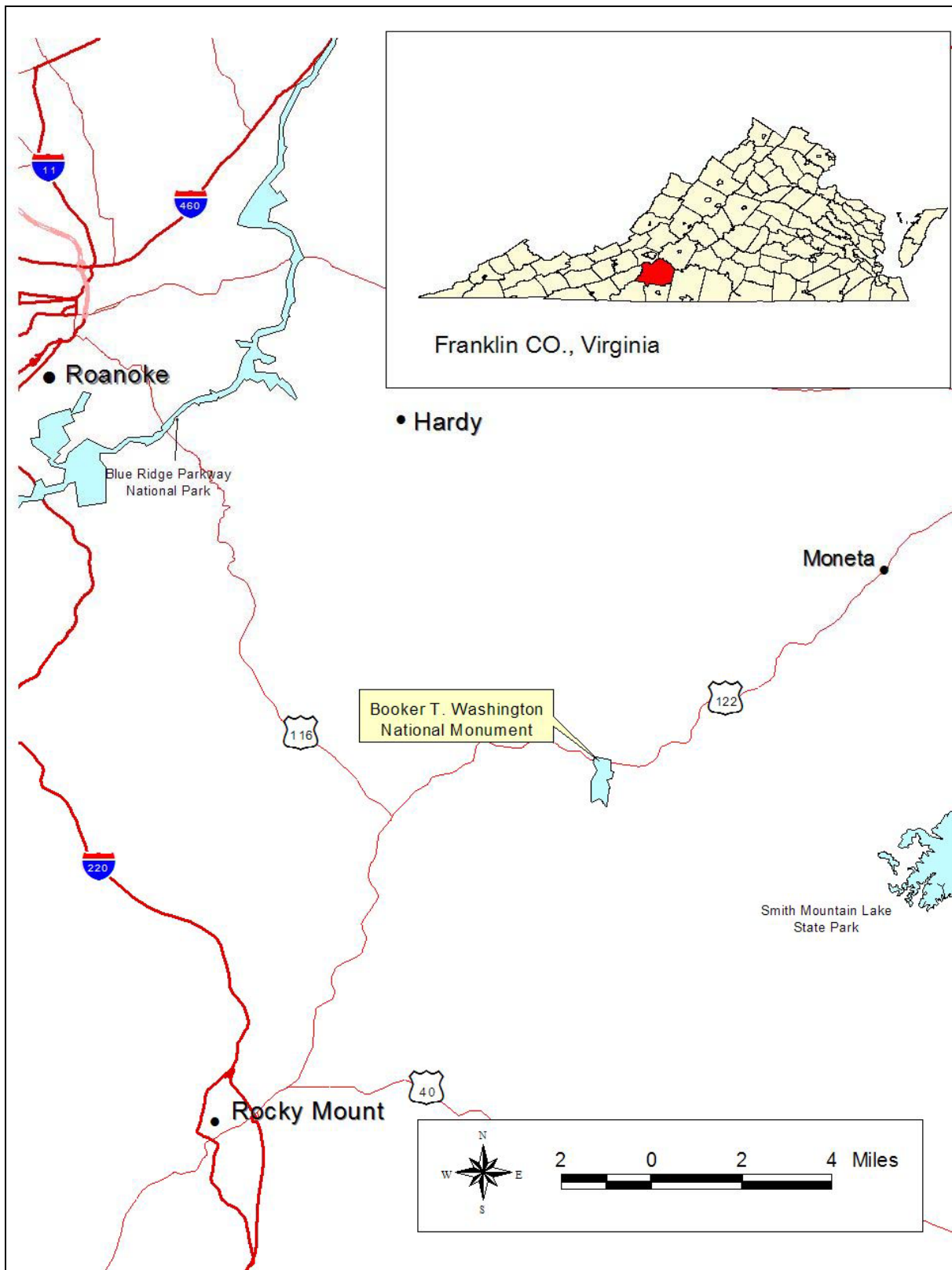


Figure 1. General location of Booker T. Washington National Monument, Virginia.

Project Area

Location and Regional Setting

Booker T. Washington National Monument is located within the southern Piedmont of Virginia, near its boundary with the Blue Ridge Province (Figure 2). The park boundary falls within the Moneta SW, Virginia USGS quadrangle map (Figure 3). This portion of the southern Piedmont is known as the Lynchburg Belt subsection (Keys et al. 1995) and consists of irregular plains with elevations ranging from 30–396 m (100–1,300 ft). Soils are Kanhapludults, Hapludults, and Dystrochrepts of kaolinitic and mixed mineralogy with a thermic temperature and udic moisture regimes. The mean annual precipitation across the region ranges from 114–140 cm (45–55 in), and the mean annual temperature across the region ranges from 14–18°C (57–64°F) (McNab and Avers 1994; Keys et al. 1995).

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. More local are rich mesophytic forests, which are generally confined to ravines and river slopes underlain by mafic rocks such as amphibolite, diabase, or gabbro. Upland forests of the western monadnocks resemble those of the Blue Ridge. Forests of silver maple (*Acer saccharinum*), American sycamore (*Platanus occidentalis*), American elm (*Ulmus americana*), boxelder (*Acer negundo*), and other flood-tolerant trees are well developed along the larger rivers that cross the Piedmont, particularly the Potomac, the Rappahannock, the James, and the Roanoke (Fleming et al. 2006).

Park Environmental Attributes

Many environmental factors, such as geology, topography, soils, and hydrology, affect the types and distribution of vegetation within Booker T. Washington National Monument. The bedrock geology over 90% of the park is mapped as the Ashe Formation (VADMR 1993), which can include both mafic / ultramafic rocks (e.g. amphibolite), that weather to soils rich in calcium and magnesium, and more acidic rocks (e.g. biotite gneiss), that weather to the acidic soils more typical of the Piedmont region. In Booker T. Washington National Monument most of the area is biotite gneiss, but there are local inclusions of dark, mafic rocks. Field samples of these mafic rocks collected in the park were identified as amphibolite (USGS, Scott Southworth, Geologist, pers. comm., 2004).

The soils in the park are classed as Ultisols, Alfisols, and Inceptisols. The majority of the park's upland soils are mapped as Clifford fine sandy loam, a fine, kaolinitic, mesic Typic Kanhapludults (USDA, NRCS 2006). Small upland areas in the southern portion of the park are mapped as Minnieville-Orenda-Redbrush complex and Bluemount-Spriggs complex which include soils classed as Hapludults and Hapludalfs. The drainageways of the park have soils mapped as Clifford-Hickoryknob complex and Comus-Maggodee-Elsinboro complex, soils complexes classed as Dystrudepts and Hapludults.

Within the boundary of Booker T. Washington National Monument are numerous small streams, including Gill's Creek and its three tributaries, Jack-O-Lantern Branch and two unnamed streams. Additionally, there are five cold springs located in the park. Three of the springs form the headwaters of Jack-O-Lantern Branch and the fourth forms the headwaters of an unnamed stream. The fifth spring flows into Gill's Creek. There are at least two streams that enter the

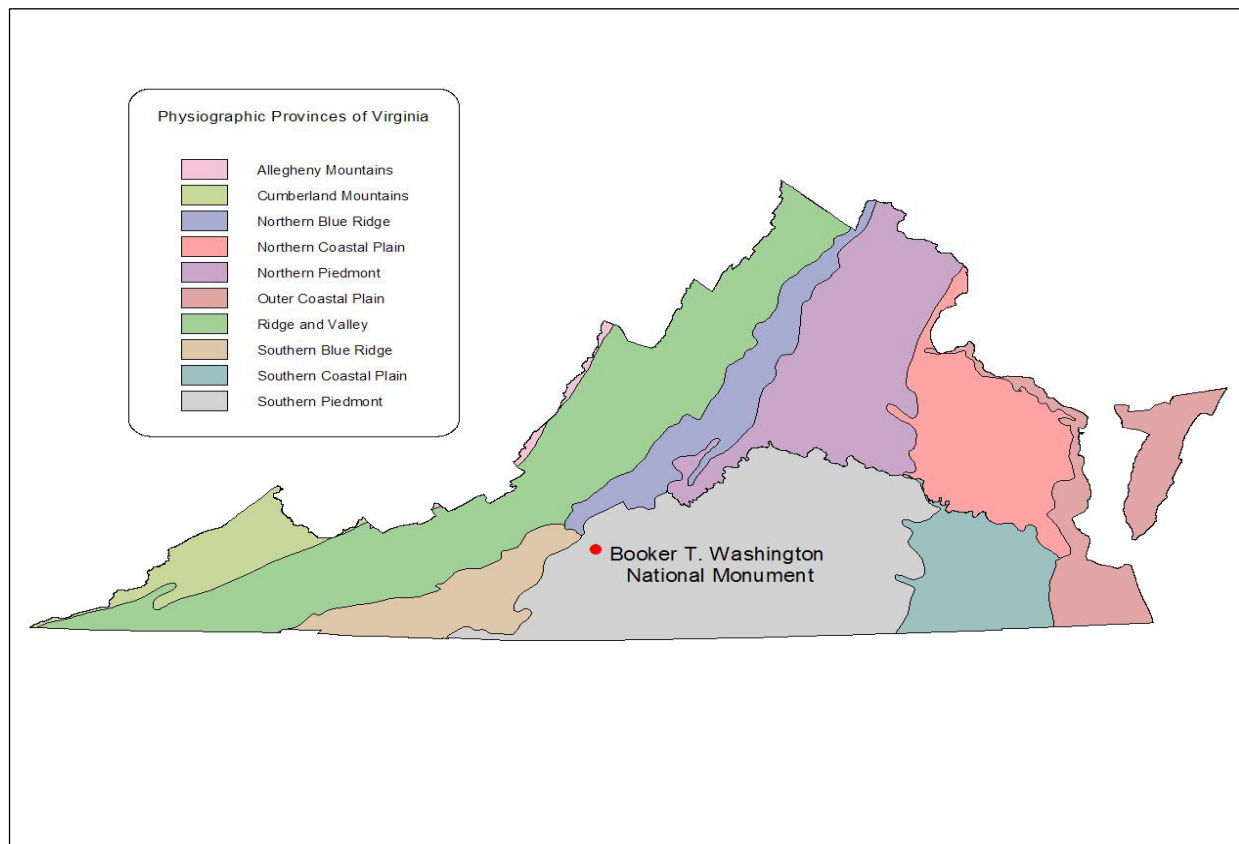


Figure 2. Physiographic provinces of Virginia showing the location of Booker T. Washington National Monument in the southern Piedmont.

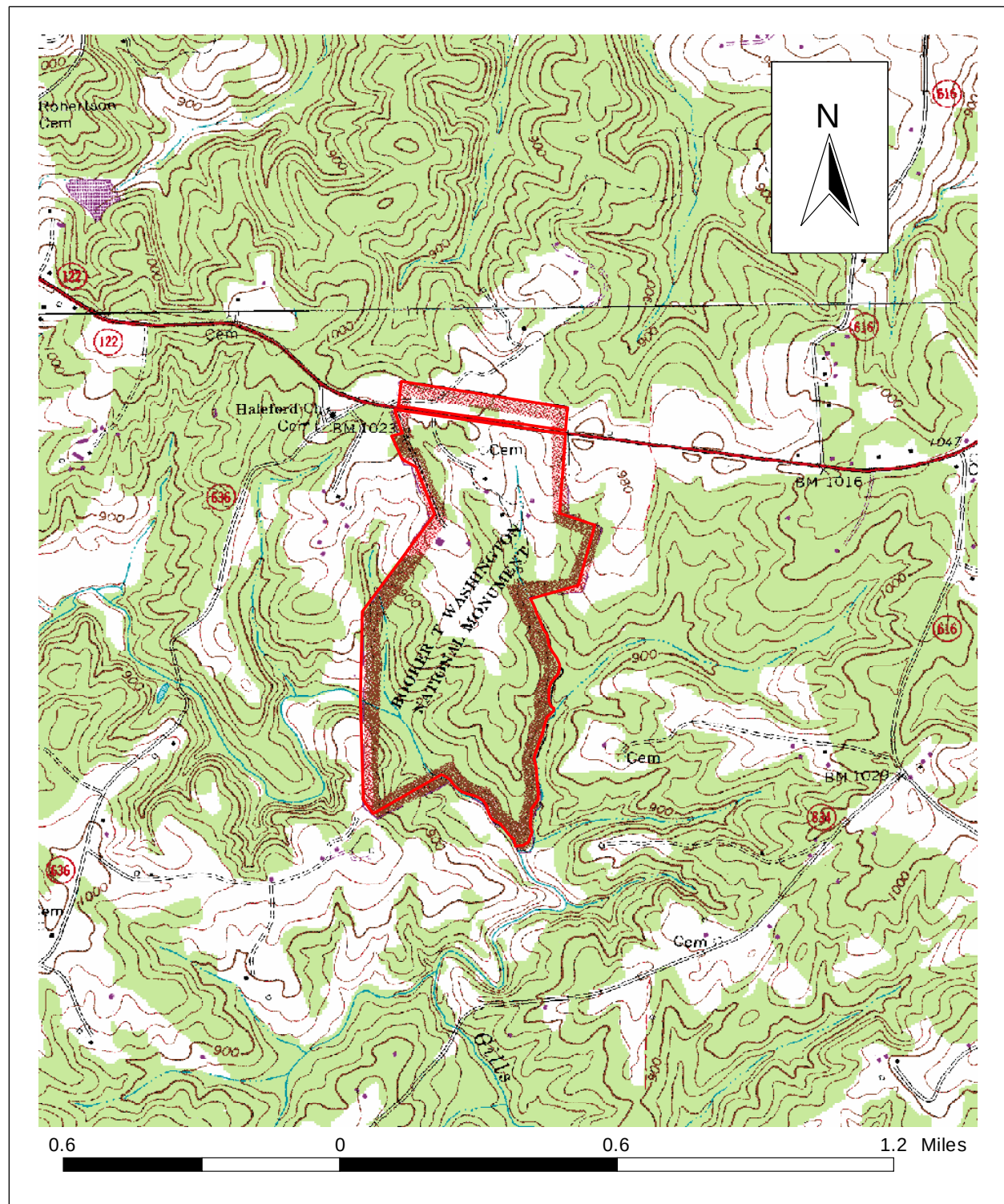


Figure 3. Location of Booker T. Washington National Monument on the Moneta SW, VA 1:24000 USGS topographic quadrangle map.

park from outside sources and one joins Jack-O-Lantern Branch on the park's south boundary. The other enters the park in a forested area along the north boundary and flows into Gill's Creek. Gill's Creek, the largest surface water resource in the park, is a non-navigable stream that enters the park from the north, comprises the park's western boundary, and exits the park through the southwestern corner of the park's boundary. Gill's Creek traverses approximately 1.1 km (0.7 mi) through the park with an average width of 8.73 m (28.6 ft) and an average depth of 3.85 m (12.6 ft). Likewise, a 1.1 km (0.7 mi) section of Jack-O-Lantern Branch is within the park (Davis et al. 2006). There is little elevation change in the park, with the lowest points along Gill's Creek bottom at approximately 253 m (830 ft) to just over 305 m (1000 ft) elevation at the park's northern boundary along Route 122.

Methods

Project Scoping and Planning

In early 2001, the Northeast Region of the National Park Service approached VADNH to help develop a vegetation classification and maps for seven NPS units in the Piedmont and Coastal Plain of Virginia (Appomattox Court House National Historical Park, Booker T. Washington National Monument, Colonial National Historic Park, Fredericksburg and Spotsylvania National Military Park, George Washington Birthplace National Monument, Petersburg National Battlefield, and Richmond National Battlefield Park). Later that year a meeting was convened with representatives from 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, 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, preliminary photo interpretation, and compiling edits to the vegetation line work. They also wrote the corresponding sections of the final reports.

Preliminary Data Collection and Review of Existing Information

Previous studies conducted at Booker T. Washington National Monument were reviewed for information pertinent to the park's vegetation. These included species lists compiled by various researchers (Critz 1986; Mengak and Mengak 1989; McCormick 2001; Powers 1999) and previous inventories by VADNH (Wright and Burton 1990; Ludwig 1991; Ludwig and Pague 1993). Existing aerial photography (VAGIN 2002), topographic maps and digital raster graphics (DRGs), National Wetland Inventory maps, the soil survey for Franklin County, Virginia, 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.

Aerial Photography Acquisition and Processing

Two digital orthophoto mosaics, leaf-on (fall) and leaf-off (spring), were created for Booker T. Washington National Monument. Kucera International acquired color infrared, stereo pair 1:6,000 scale aerial photography for the leaf-on mosaic on October 22, 2001 and for the leaf-off mosaic on February 19, 2002. The photography was delivered to the NPS, quality checked,

accepted as provided, and sent to NCSU-CEO. Upon receipt at NCSU-CEO, the air photos were counted to make sure that none were missing, scanned, saved in .tif format, and placed in the data archive maintained at North Carolina State University 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 13 and 10 color infrared air photos, respectively, scanned at 600 dpi with 24-bit color depth. For each mosaic, 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-CEO data archive.

Preliminary Photointerpretation

A preliminary vegetation map for Booker T. Washington National Monument was created by interpreting the digital orthophoto mosaics to delineate vegetation polygons to the formation level defined in the USNVC (FGDC 1997; Grossman et al. 1998). To create the formation-level vegetation map, 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 USGS-NPS VMP protocols (USGS 1994), the Level II land-use and land-cover classification scheme developed by Anderson et al. (1976) was used to attribute non-vegetated land cover. In addition, user-defined codes were used to attribute agricultural areas and roads. 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-CEO data archive.

Field Data Collection

Leaf-on and leaf-off photomosaics and the formation-level line work were obtained from NCSU-CEO in May 2002. Ecologists from VADNH conducted field data collection in Booker T. Washington National Monument in June, July, and September 2002. 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.

Since the park is small and easily accessible, a census sampling approach was followed for all vegetation polygons within the park. Polygons representing cultural / anthropogenic land use (i.e. agricultural fields, roads, built-up areas) were eliminated from the census. For the remaining polygons, the centroid was calculated using Arcview 3.3 (Environmental Systems Research Institute, Inc. [ESRI] 1992–2002) and uploaded into a GarminMap76s global positioning system (GPS) unit using the DNRGarmin Arcview extension developed by the Minnesota Department of Natural Resources.

Using a GarminMap76 GPS, an ecologist navigated to the center of each vegetation polygon represented on the formation-level map. 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 the ecologist was certain she was 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.

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

In order to be maximally compatible with existing regional plot data, plots were sampled using the relevé method (*sensu* Peet et al. 1998), following standard procedures employed by VADNH and modified slightly to accommodate entry into the PLOTS database (NatureServe 2004). As a

rule, 100 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.

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%

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.

A standard set of environmental data were 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 such information as landscape context, estimated size of stand, hydrologic evidence, 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).

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)	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) subhydric (water table at or near surface for most of the year) hydric (water table at or above surface year round)
Measured Slope (degrees)	
Slope shape: vertical concave convex straight horizontal concave convex straight hummock and hollow microtopography irregular craggy / bouldery microtopography	
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	

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.

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

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	

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°) 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 ($[\text{cation exchange capacity} \times \text{total base saturation}]/100$) 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 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 units 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 Booker T. Washington National Monument were drafted using data from field observation points and quantitative plots. A dichotomous key to the vegetation classes occurring in Booker T. Washington National Monument 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 class. The dichotomous key should be used in conjunction with the detailed vegetation class descriptions to confirm that the class selected with the key is appropriate.

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 observation points and quantitative plots were used to edit the formation-level map of Booker T. Washington National Monument 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 Booker T. Washington National Monument vegetation map was assigned to one of 11 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.

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 horizontal positional accuracy of the leaf-on and leaf-off mosaics was assessed using guidelines of the USGS/NPS Vegetation Mapping Program (TNC and ESRI 1994c). Well-defined positional accuracy ground control points were placed throughout all quadrants of each mosaic 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 22 ground control points for the leaf-on mosaic and 19 ground control points for the leaf-off mosaic. 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 mosaic and one ground control point for the leaf-off mosaic were identified as outliers with SAS's JMP program and removed. The field-collected GPS coordinates for the remaining 20 points for the leaf-on mosaic and 18 points for the leaf-off mosaic were compared to the coordinates obtained from each mosaic viewed in ArcMap. Both pairs of coordinates for each point were entered into a spreadsheet in order to calculate horizontal accuracy (in meters). The accuracy calculation formula is based on root mean square error (FGDC 1998b; Minnesota Governor's Council on Geographic Information and Minnesota Land Management Information Center 1999). Figures 4 and 5 show the distribution of the ground control points for the leaf-on and leaf-off mosaics, respectively.

A complete census of all vegetation polygons was carried out during the field-data collection phase of the project. The vegetation classification attribute of all polygons (except those representing cultural / anthropogenic land use; i.e., agricultural fields, roads, built-up areas) was validated in the field by a VADNH ecologist. At least 80% of each polygon was observed in the field and a classification was assigned. Since all vegetation polygons were confirmed during this exercise, a formal thematic accuracy assessment was not carried out.

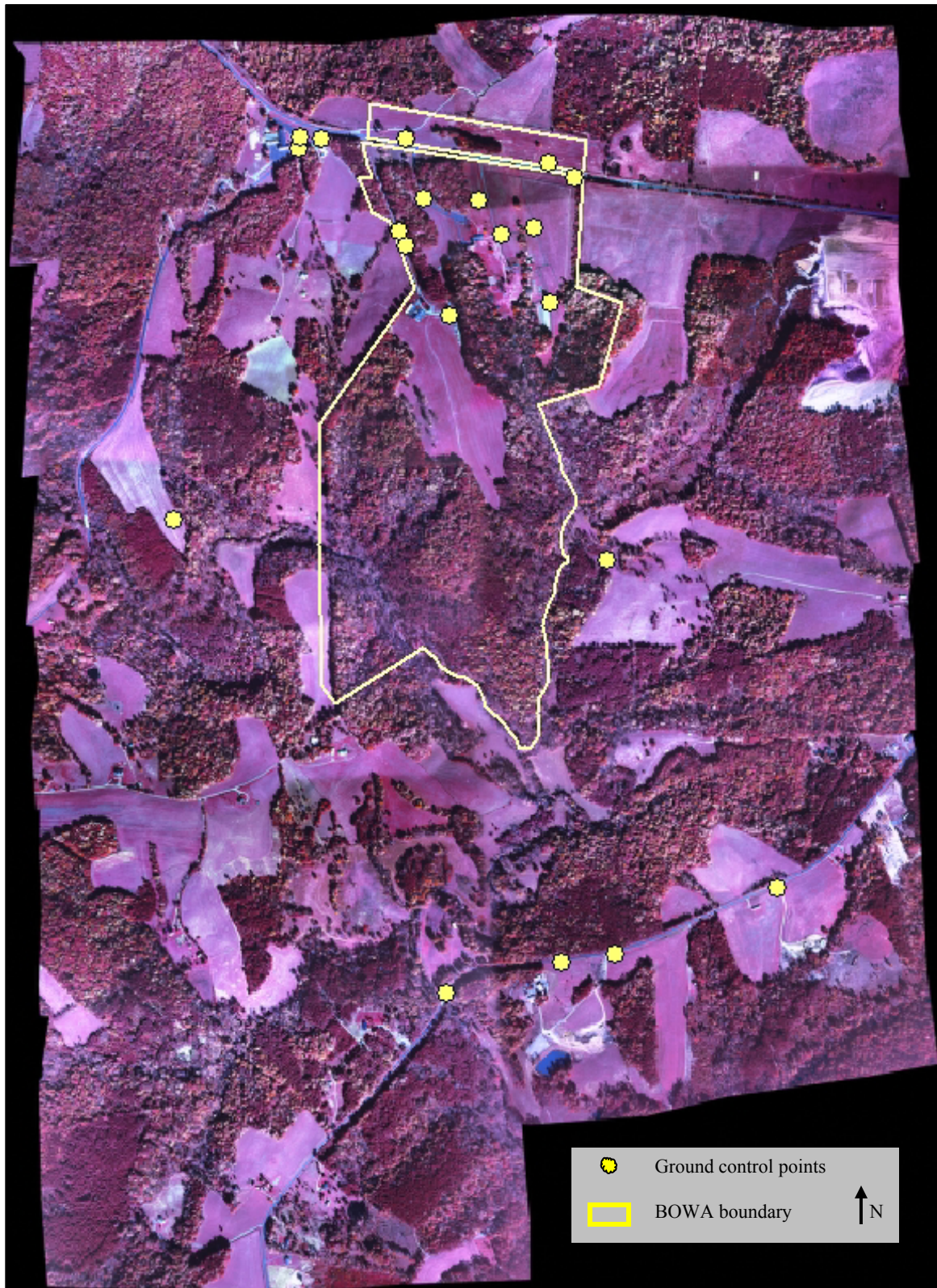


Figure 4. Ground control points used to calculate horizontal positional accuracy of the Booker T. Washington National Monument (BOWA) leaf-on (fall) mosaic.

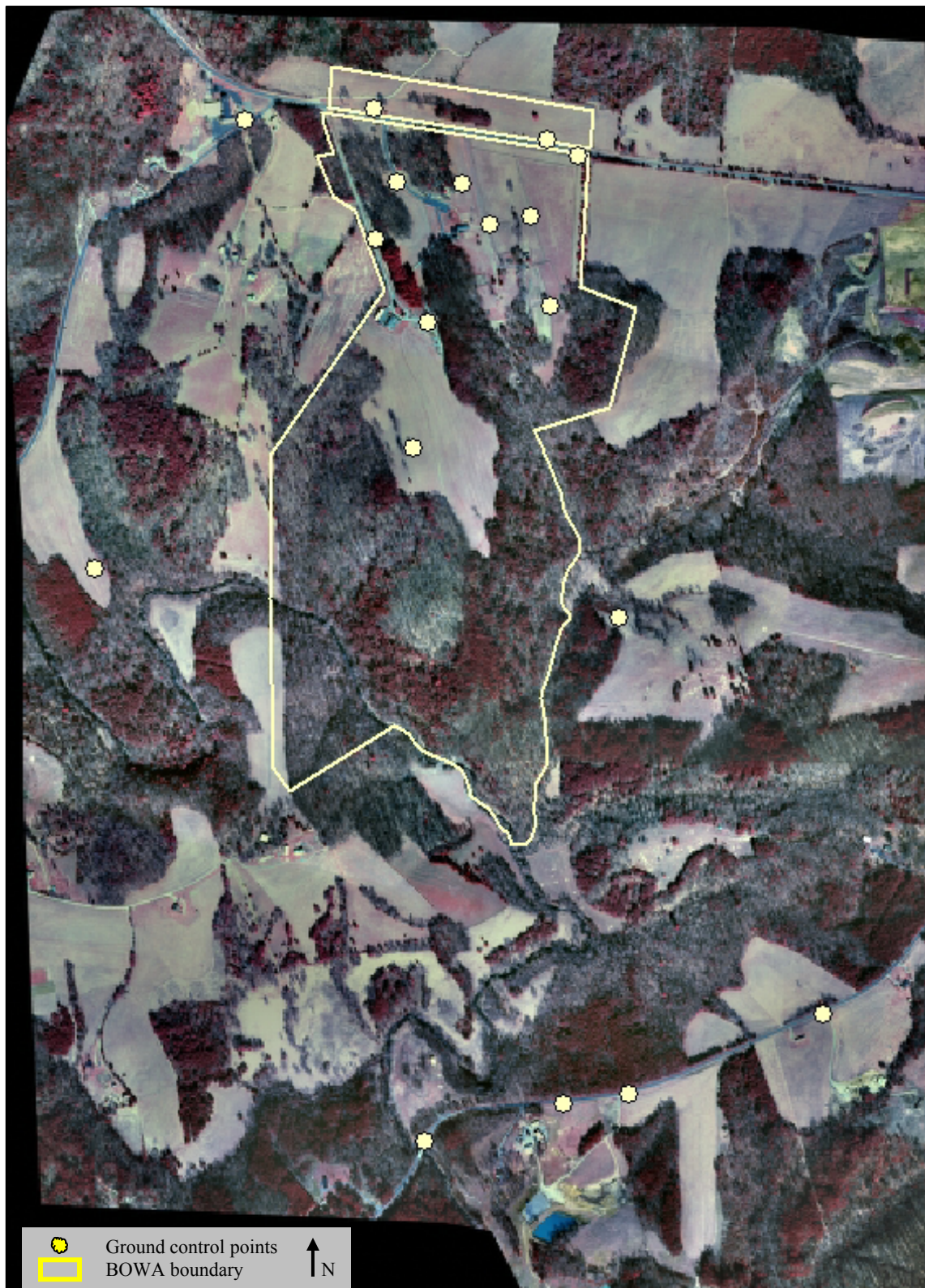


Figure 5. Ground control points used to calculate horizontal positional accuracy of the Booker T. Washington National Monument (BOWA) leaf-off (spring) mosaic.

Metadata Preparation

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

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 6, and 7, respectively.

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

Table 6. Summary of key information for Booker T. Washington National Monument leaf-on (fall) mosaic.

Title of metadata record:	Booker T. Washington National Monument Color Infrared Orthorectified Photomosaic - Leaf-on (ERDAS IMAGINE .img and MrSID formats)
Publication date of mosaic (from metadata):	March 1, 2003
Date aerial photography was acquired:	October 22, 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:	13
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 mosaic:	1.483 meters, meets Class 1 National Map Accuracy Standard
Number of ground control points upon which estimated accuracy is based:	20
Method of calculating positional accuracy:	Root mean square error
Archive location of mosaic and metadata:	North Carolina State University, Center for Earth Observation
Formats of archived mosaic:	.img (uncompressed) and MrSID (20:1 compression)

Table 7. Summary of key information for Booker T. Washington National Monument leaf-off (spring) mosaic.

Title of metadata record:	Booker T. Washington National Monument Color Infrared Orthorectified Photomosaic -Leaf-off (ERDAS IMAGINE .img and MrSID formats)
Publication date of mosaic (from metadata):	March 1, 2003
Date aerial photography was acquired:	February 19, 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:	10
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 mosaic:	1.746 meters, meets Class 2 National Map Accuracy Standard
Number of ground control points upon which estimated accuracy is based:	18
Method of calculating positional accuracy:	Root mean square error
Archive location of mosaic and metadata:	North Carolina State University, Center for Earth Observation
Formats of archived mosaic:	.img (uncompressed) and MrSID (20:1 compression)

Results

Field Surveys

Field work was completed in Booker T. Washington National Monument in 2002. Data were collected from six quantitative vegetation plots and 51 qualitative observation points. Figure 6 shows the locations of the vegetation plots and observation points distributed across the draft formation-level vegetation map. Species observed during 2002 fieldwork are listed in Appendix B. This list should not be considered a comprehensive flora for the park, but could be used to add to existing vascular plant lists for the area.

Six vascular plant species were determined to be county distributional records for Franklin, County, Virginia, according to the Digital Atlas of the Virginia Flora (Wieboldt et al. 2005). These species include green dragon (*Arisaema dracontium*), bitternut hickory (*Carya cordiformis*), wahoo (*Euonymus atropurpureus*), goldenseal (*Hydrastis canadensis*), October ladies' tresses (*Spiranthes ovalis* var. *erostellata*), and smooth carrionflower (*Smilax herbacea*). Voucher specimens of these species have been submitted to the herbarium at Virginia Polytechnic and State University, as per the research permit for the project (BOWA-2002-SCI-0002). One of these species, *Hydrastis canadensis*, is included on the Vascular Plant Watchlist of the Virginia Department of Conservation and Recreation (VADCR), Division of Natural Heritage (DNH) (Townsend 2007). Taxa on this list are decidedly uncommon in Virginia, but not scarce enough to merit inclusion on the Rare Vascular Plant List, but are monitored to determine general population trends. Of the 202 vascular plant species noted during fieldwork in Booker T. Washington National Monument, 10 were nonnative species, and of those, 7 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 cluster 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 Booker T. Washington National Monument, is presented in Appendix C. Quantitative analysis classified 35 associations occurring in the seven national parks in Virginia. An additional 19 associations and 12 nonstandard park-specific vegetation classes representing disturbed, cultural, or exotic vegetation were also recognized from the seven parks, but were not represented by quantitative plot data, and thus not included in the quantitative analyses. Global and subnational (state)

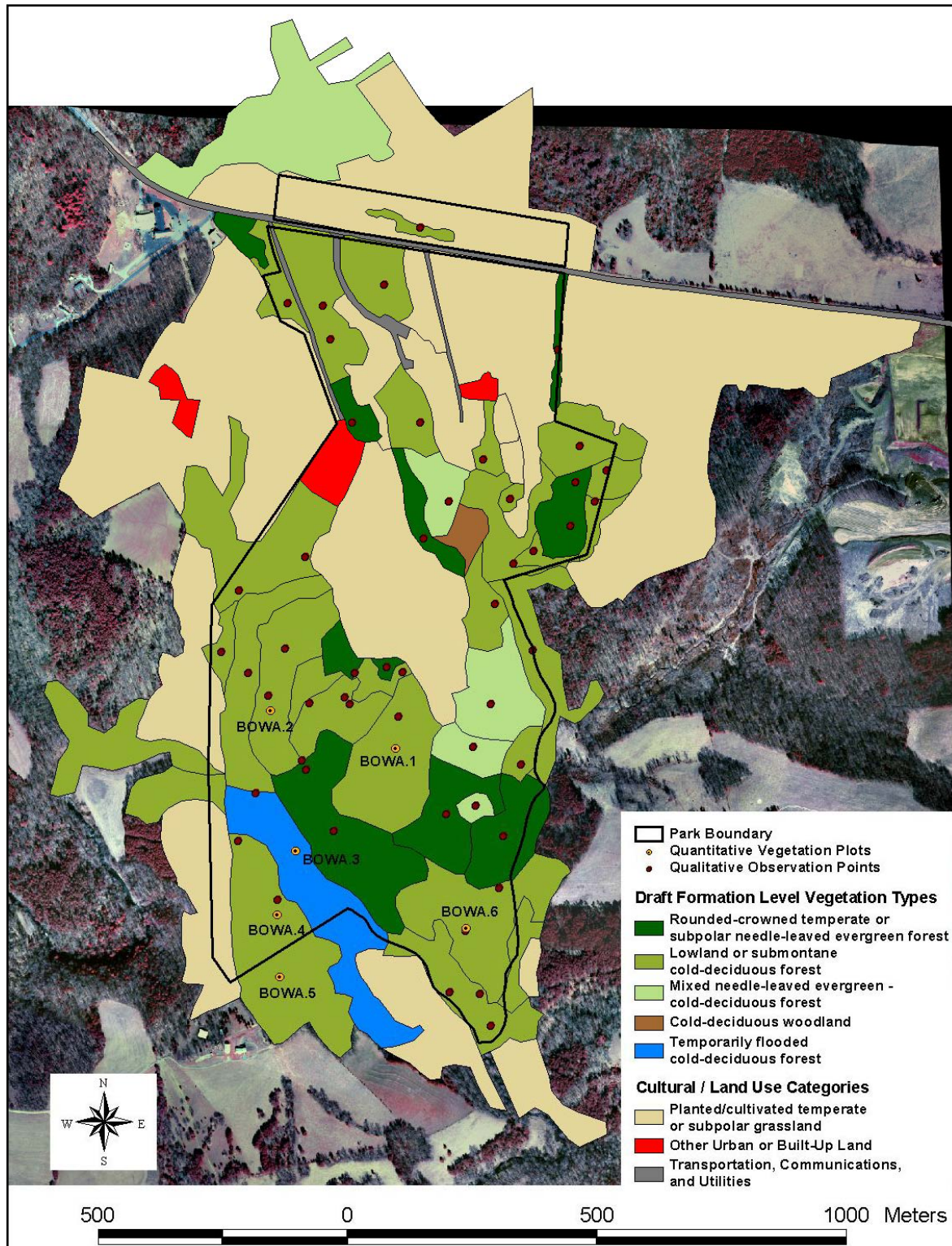


Figure 6. Locations of quantitative vegetation plots and qualitative observation points over the draft formation-level vegetation map of Booker T. Washington National Monument.

conservation ranks used in Appendix C are defined in Appendix D, and a summary of select environmental variables by association is presented in Appendix E.

The three major vegetation groupings represented at Booker T. Washington National Monument are 1) oak-hickory forests, 2) basic mesic and calcareous forests, and 3) alluvial forests. Cluster dendrograms, ordination scatterplots, and joint plots resulting from quantitative analysis of plots from these groups are presented in Appendix F. Compositional summary statistics for each association derived from quantitative analysis and present in Booker T. Washington National Monument are presented in Appendix G.

The analysis results presented in Appendix F support the classification of plot samples into the three major vegetation groups represented at Booker T. Washington National Monument. 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 proportion of the variance represented by each ordination axis for the major vegetation groups in Booker T. Washington National Monument is presented in Table 8. 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 Booker T. Washington National Monument. In this way, species and environmental relationships among associations can be examined in a regional context.

The results of the regional analysis of the oak - hickory forest group are illustrated in Figures F1–F3 of Appendix F. Plot samples cluster into two compositionally similar groups in both the dendrogram and the three-dimensional ordination. Strong correlations of soil fertility variables with axis 3 of the ordination suggest that soil nutrients have an important influence on vegetation patterns within this group (Appendix F, Figure F3). The two associations illustrated can occur in the same landscape, but only Acidic Oak - Hickory Forest (CEGL008475) was documented at Booker T. Washington National Monument. In the larger regional analysis, this group was composed of 120 sample plots representing dry-mesic oak-hickory forests of the Piedmont, occasionally ranging into the inner Coastal Plain. There is much variation within this group of plot samples along a gradual cline of site conditions, soil chemistry, and floristic composition. Nonetheless, homogeneity is high for such a large group (Appendix G, Table G1). This variability is illustrated in the three Acidic Oak - Hickory Forest plot samples from Booker T. Washington National Monument, which are distributed across the group representing Acidic Oak - Hickory Forest in the oak - hickory forest joint plot (Appendix F, Figure F3). The plot labeled BOWA.2 is located toward the higher end of the fertility gradient represented by axis 3 and is, in fact, compositionally transitional to Inner Piedmont / Lower Blue Ridge Basic Mesic Forest (see below). For the most part, Acidic Oak - Hickory Forests at Booker T. Washington National Monument are compositionally typical of the association (Appendix G, Table G1), although the stands at the park have greater cover by southern red oak (*Quercus falcata*) and tuliptree (*Liriodendron tulipifera*), probably due to past forest disturbances at the site. This association occurs in six of the seven national parks included in this study (Appendix C).

The other association classified within the oak - hickory forest group, Basic Oak - Hickory Forest (CEGL007232), is not present at Booker T. Washington National Monument. Compared

Table 8. 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 Booker T. Washington National Monument. Two-dimensional ordinations have “n/a” listed in Axis 3 column.

Vegetation Group	Increment			Cumulative
	Axis 1	Axis 2	Axis 3	
oak - hickory forests	0.083	0.155	0.543	0.781
basic mesic and calcareous forests	0.341	0.272	0.215	0.828
alluvial forests	0.094	0.767	n/a	0.862

to Acidic Oak - Hickory Forest, Basic Oak - Hickory Forest is associated with soils that are more alkaline and characterized by high cation levels (Appendix E). This forest is the typical basic oak-hickory forest of the southern Virginia Piedmont and, although it is widely distributed in the Piedmont from Virginia to Alabama, it is an uncommon community type that is strongly restricted to mafic substrates and subject to ongoing threats from cutting and conversion of hardwood stands to pine silvicultures.

The classification of 77 basic mesic and calcareous forest sample plots is illustrated in Figures F4–F6 of Appendix F. Plot samples cluster into three compositionally similar groups in both the dendrogram and the three-dimensional ordination (Appendix F, Figures F4 and F5). The association Inner Piedmont / Lower Blue Ridge Basic Mesic Forest (CEGL006186) is represented by 31 sample plots, including two from from Booker T. Washington National Monument. The other two associations are restricted to the Coastal Plain, occurring over Tertiary shell deposits, and are compositionally and environmentally distinct. All associations in this group have high soil fertility relative to all other upland forest types (Appendix E), but even within this group, soil nutrients have a strong influence on vegetation pattern. Axis 1 of the joint plot (Appendix F, Figure F6) is highly correlated with the joint plot vectors representing pH, calcium / magnesium ratio, and fertility index. In the context of this ordination, plot samples representing the forest present at Booker T. Washington National Monument are not correlated with high soil fertility variables, but instead are associated with high values of TRMI and percent cover by boulders. Inner Piedmont / Lower Blue Ridge Basic Mesic Forest (CEGL006186) is known from steep, rocky sites of sub-montane landscapes in the western and northern Piedmont and on lower slopes of the Blue Ridge. This association occurs almost exclusively on clay-rich soils weathered from mafic rocks, often on very rocky sites. The two plot samples from Booker T. Washington National Monument are compositionally very typical of the association (Appendix G, Table G1), containing all the nominal species and having high species richness values. This association is also found at Appomattox Court House National Historic Park, but not at any of the other parks included in this study (Appendix C).

The regional analysis of alluvial forest sample plots is illustrated in Figures F7–F9 of Appendix F. Plot samples cluster into three compositionally similar groups in both the dendrogram and the two-dimensional ordination (Figures F7 and F8 of Appendix F). The joint plot (Appendix F, Figure F9) shows the correlation of soil fertility variables with axis 2 of the ordination,

suggesting that soil nutrients have an important influence on vegetation patterns within this group. The 14 plot samples representing the alluvial forest association found at Booker T. Washington National Monument, Piedmont / Mountain Alluvial Forest (CEGL006492), are at intermediate positions along the soil fertility gradient (Appendix F, Figure F9). This particular association is found on small-stream floodplains of the northern and western Piedmont of Virginia, ranging north into Maryland. Piedmont / Mountain Alluvial Forest is found on more fertile alluvium than Coastal Plain / Piedmont Small-Stream Floodplain Forest (CEGL004418), while Piedmont / Mountain Floodplain Forest (CEGL006217) is found on the large floodplains of major mid-Atlantic rivers over the most fertile alluvium (Appendix E). The single plot sample from Booker T. Washington National Monument is compositionally typical of the Piedmont / Mountain Alluvial Forest association (Appendix G, Table G1). This association is also found at Appomattox Court House National Historical Park, but not at any of the other parks included in this study (Appendix C).

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. Booker T. Washington National Monument had five of these cultural, disturbed, or exotic vegetation classes. Four of these vegetation classes were crosswalked to the association level of the USNVC and one represented vegetation that had no defined classification in the USNVC and was given a nonstandard, park-specific name. 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 C.

Vegetation Community Descriptions and Map Classes

Ten map classes were used in the vegetation map for Booker T. Washington National Monument. 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 9 lists the ten 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. Seven of the 10 map classes were crosswalked to the finest level of the USNVC (association). One of the ten map classes was described a nonstandard, park-specific vegetation class and two 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 Booker T. Washington National Monument were written based on information collected within the park boundary. 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 H. Local descriptions for other map classes (nonstandard vegetation classes and land-use classes)

Table 9. Vegetation-map classes and corresponding USNVC associations (NatureServe 2007) or other classification for Booker T. Washington National Monument.

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)
Inner Piedmont / Lower Blue Ridge Basic Mesic Forest	<i>Liriodendron tulipifera</i> - <i>Quercus rubra</i> - <i>Fraxinus americana</i> / <i>Asimina triloba</i> / <i>Actaea</i> <i>racemosa</i> - <i>Uvularia perfoliata</i> Forest (CEGL006186)	Inner Piedmont / Lower Blue Ridge Basic Mesic Forest (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)
Dense Hardwood Regeneration	Not defined - nonstandard, park-specific vegetation class	Dense Hardwood Regeneration (park-specific name)
Other Urban or Built-Up Land	None - Anderson Level II class	Other Urban or Built-up Land (17) (Anderson et al. 1976)
Piedmont / Mountain Alluvial Forest	<i>Liriodendron tulipifera</i> - <i>Acer (rubrum, negundo)</i> - (<i>Platanus occidentalis</i>) / <i>Carpinus</i> <i>caroliniana</i> / <i>Polygonum virginianum</i> Forest (CEGL006492)	Piedmont / Mountain Alluvial Forest (Fleming et al. 2006)
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)
White Pine Plantation	<i>Pinus strobus</i> Planted Forest (CEGL007178)	White Pine Plantation (NatureServe 2007)

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

are also provided. The descriptions are indexed by the regional vegetation class or land-use class name. Representative photographs of the vegetation types are provided after the descriptions, except for Dense Hardwood Regeneration, where an acceptable photograph was not obtained. 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 H.

Fields used in the local and global descriptions are defined in Appendix I. Each association is also crosswalked to the state classification for Virginia (Fleming et. al 2006). The state/subnational 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 and classification confidence codes are shown in Appendix H.

The dichotomous key to the Booker T. Washington National Monument map classes is presented in Appendix J. The dichotomous key should be used in conjunction with the detailed descriptions.

Vegetation Map Production

The draft formation-level vegetation map (Figure 6) was edited based on information gathered from field reconnaissance and data collected from quantitative vegetation plots and qualitative observation points. The vegetation classification attribute of all polygons, except those representing cultural / anthropogenic land use (i.e. agricultural fields, roads, built-up areas), was validated in the field by a VADNH ecologist. At least 80% of each polygon was observed in the field and a classification was assigned.

The final vegetation map for Booker T. Washington National Monument is shown in Figure 7 and a summary of the map class distribution and abundance is provided in Table 10. The number of total mapped hectares listed in Table 10 is larger than the number of hectares in the park because some mapped polygons extend beyond the park boundary.

The map classes Inner Piedmont / Lower Blue Ridge Basic Mesic Forest and Piedmont / Mountain Alluvial Forest included stands that were significantly disturbed with high cover by nonnative invasive plants, and without the characteristic structure and species of less disturbed examples of these natural communities. 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 Inner Piedmont / Lower Blue Ridge Basic Mesic Forest and Piedmont / Mountain Alluvial Forest are indicated in the comment field of the map attribute table. The map class Successional Virginia Pine Forest is a relatively short-lived vegetation type and contains polygons at different stages of succession. Those stands that are transitional to Successional Tuliptree Forest, with significant succession by deciduous trees, are indicated in the comment field of the map attribute table. These transitional stands had at least 25% Virginia pine component at the time of the mapping and were included in the Successional Virginia Pine map class. Polygons that were attributed with Anderson Level II class 14 (Transportation, Communication, and Utilities) are further attributed in the comment field to identify what finer feature they represent (road, utility line, etc). A field was included in the map attribute table to

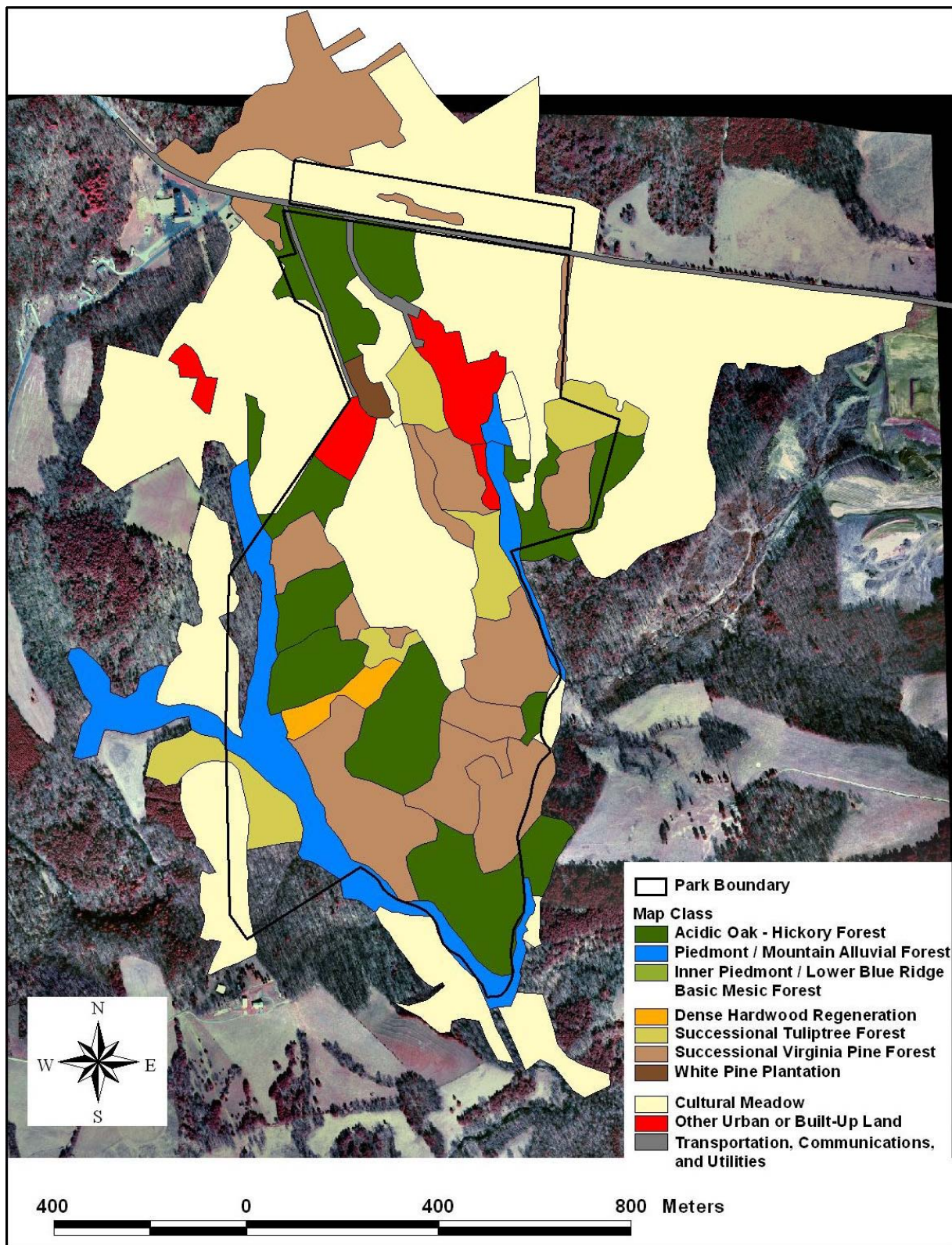


Figure 7. Vegetation and Anderson Level II map classes for Booker T. Washington National Monument.

Table 10. Number of polygons, total mapped hectares, mapped hectares within the park boundary, and number of quantitative plots sampled and observations for 10 vegetation-map classes at Booker T. Washington National Monument.

Map Class - Local Name	Number of total polygons	Total mapped hectares	Mapped hectares within park boundary	Number of plots sampled	Number of observations
Acidic Oak - Hickory Forest	12	24.12	20.69	3	16
Inner Piedmont / Lower Blue Ridge					
Basic Mesic Forest	2	9.99	3.40	2	2
Cultural Meadow	14	84.09	26.46	0	0
Dense Hardwood Regeneration	1	1.25	1.25	0	2
Other Urban or Built-Up Land	4	4.74	4.13	0	0
Piedmont / Mountain Alluvial Forest	3	11.97	6.74	1	8
Successional Tuliptree Forest	3	8.29	6.26	0	6
Successional Virginia Pine Forest	15	29.31	20.95	0	16
Transportation, Communications, and Utilities	3	2.99	0.91	0	0
White Pine Plantation	1	0.63	0.63	0	1
TOTAL	58	177.39	91.43	6	51

indicate which United States Fish and Wildlife Service (USFWS) wetland system (*sensu* Cowardin et al. 1979) associations represent. Polygons representing wetland formations (i.e. those with hydrologic modifiers in the formation name of temporarily flooded, seasonally flooded, saturated, semipermanently flooded, or tidally flooded) 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 the single wetland map class is shown in Figure 8. This is not a map of jurisdiction wetlands, but rather a map of the distribution of wetland map classes with the USNVC formations of temporarily flooded cold-deciduous forest, seasonally flooded cold-deciduous forest, seasonally flooded cold-deciduous shrubland, or saturated cold-deciduous forest. Only one wetland map class was mapped in Booker T. Washington National Monument, Piedmont / Mountain Alluvial Forest, which falls into the Palustrine System of the USFWS wetland classification.

Accuracy Assessment

The final horizontal positional accuracy of the leaf-on mosaic is 1.483 meters, which meets the Class 1 National Map Accuracy Standard (FGDC 1998b). The final horizontal positional accuracy of the leaf-off mosaic is 1.746 meters, which meets the Class 2 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.

A complete census of all vegetation polygons was carried out during the field data collection phase of the project. The vegetation classification attribute of all polygons, except those representing cultural / anthropogenic land use (i.e. agricultural fields, roads, built-up areas), was validated in the field by a VADNH ecologist. At least 80% of each polygon was observed in the

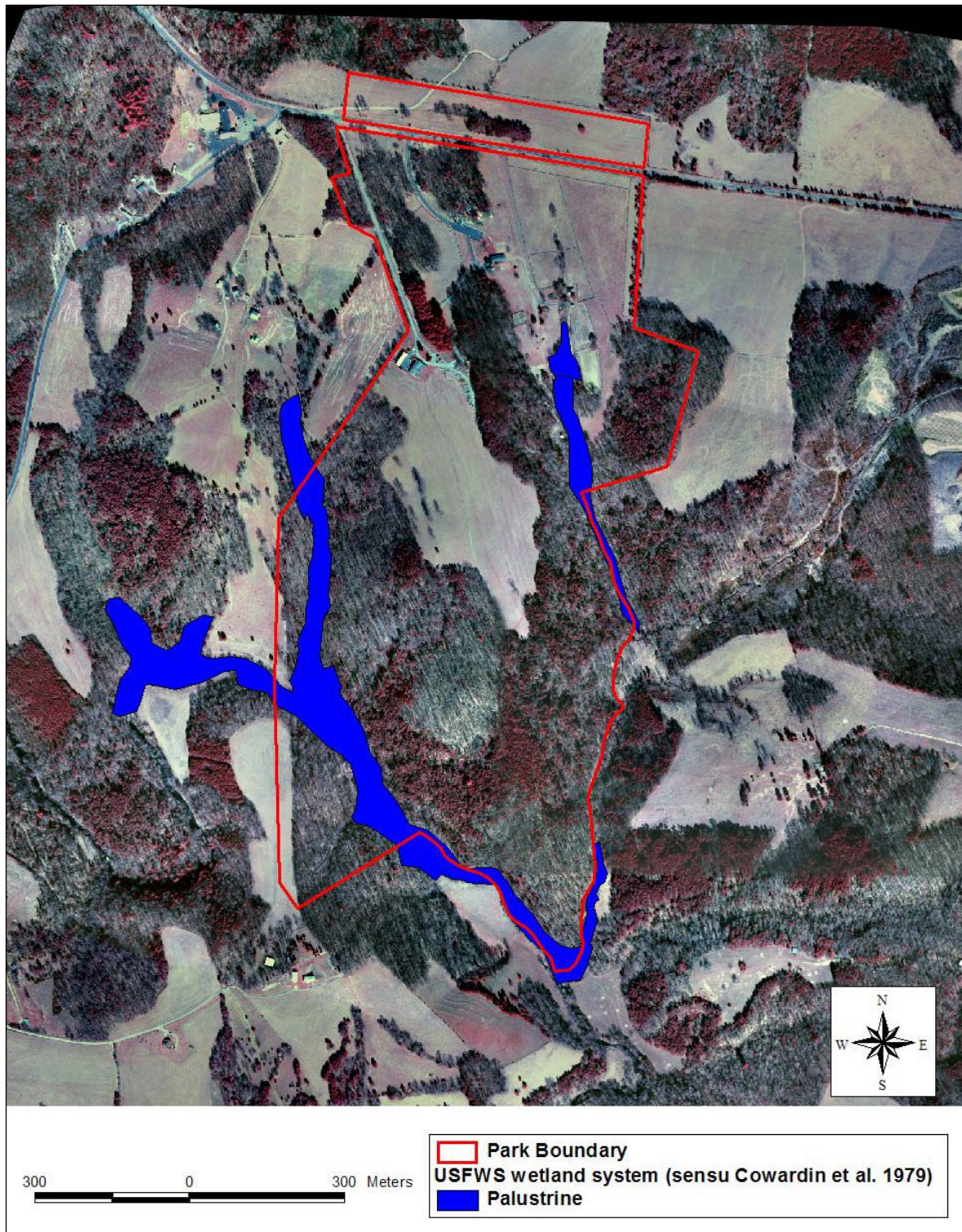


Figure 8. Distribution of wetland vegetation-map classes in Booker T. Washington National Monument.

field and a classification was assigned. Since all vegetation polygons were confirmed during this exercise, a formal thematic accuracy assessment was not carried out.

Project Deliverables

Final products of the vegetation mapping project are shown in Table 11. All products have been delivered to the National Park Service by either the VADCR, DNH with this report or at an earlier date by NCSU-CEO.

Table 11. Summary of products resulting from the classification and mapping of vegetation at Booker T. Washington National Monument.

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
Association-level vegetation polygon map	Yes
Digital photos representative of vegetation type	Not applicable
Final report with vegetation keys and descriptions in digital and hardcopy format	Not applicable

Discussion

Vegetation Classification and Characterization

A regional analysis resulted in the classification of over 100 USNVC associations, 35 of which are represented in the seven national parks included in this study. An additional 19 associations and 12 nonstandard park-specific vegetation classes representing disturbed, cultural, or exotic vegetation were also recognized from the seven parks. This study at Booker T. Washington National Monument identified and characterized 10 map classes, representing seven USNVC associations, two Anderson land-use classes (Anderson et al. 1976), and one nonstandard park-specific vegetation class representing disturbed or cultural vegetation (Table 9).

The ongoing management to maintain the historic and cultural landscape of an 1850s rural plantation has the greatest influence on the vegetation present in the park. Maintained cultural map classes represent 35% of the park's acreage. Cultural Meadow is the most common map class in the park, covering 26.46 ha (65.38 acs). Other cultural map classes include White Pine Plantation, Other Urban or Built-Up Land, and Transportation, Communications, and Utilities.

Early successional or transitional vegetation covers over 31% of the land in the park. This vegetation is the result of relatively recent (20–60 years) abandonment of fields or tree canopy removal by disturbances such as pine bark beetle infestation, wind disturbance, or silvicultural practices. These 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. These map classes are rapidly changing in species composition and vegetation structure and, provided that invasive species can be kept in check, will succeed into one of the later successional upland forest types mapped in Booker T. Washington National Monument. Map classes representing early successional or transitional vegetation include Successional Virginia Pine Forest, Successional Tuliptree Forest, and Dense Hardwood Regeneration.

Three map classes represent later successional vegetation and cover almost 34% of the land in the park. These map classes include Acidic Oak - Hickory Forest, Basic Mesic Forest, and Piedmont / Mountain Alluvial Forest. These later successional forest types have the most stable species composition and support a greater diversity of native flora than other map classes in the park. These forests represent vegetation defined in the Natural Communities of Virginia (http://www.dcr.virginia.gov/natural_heritage/nchome.shtml), and exemplary occurrences are tracked by the VADNH. In order to be considered an exemplary occurrence, stands have to meet strict type-specific criteria of size, condition, and landscape context. The stands of these forests at Booker T. Washington National Monument are quite small and most have invasive, nonnative plant species and do not meet the criteria to be considered Natural Heritage exemplary natural community occurrences. Nonetheless, these native plant associations are an important part of the park's natural resources and should be targets for conservation and management.

The occurrence and distribution of the later successional forest types in the park can be related to specific environmental settings. The least disturbed upland forests tend to occur over rocky soils or on steep slopes, areas inhospitable to agriculture. Geology, as it relates to soil fertility, also influences vegetation patterns. Acidic Oak - Hickory Forest covers 23% of the park's land and is

on rocky, eroded soils or steep slopes. Soils, weathered from biotite gneiss, tend to be acidic and low in fertility. Typical expressions of this association are dominated by oaks and hickories with flowering dogwood (*Cornus florida*) and a large number of low-cover, dry-mesophytic herbs. Species-richness can exceed 80 taxa per 400 m² on undisturbed sites where deer are not problematic. In Booker T. Washington National Monument, species richness ranged from 28–48 species per 400 m² plot. Throughout the mid-Atlantic region, American beech (*Fagus grandifolia*), American holly (*Ilex opaca* var. *opaca*), and red maple (*Acer rubrum*) are heavily invading the understories of some stands of this type, likely due to the exclusion in recent decades of fires, logging, and other disturbances that favor oak regeneration (Orwig and Abrams 1994; Abrams and Copenheaver 1999). As a result, these stands appear to be succeeding to a more mesic forest composition, as is the case in some portions of Booker T. Washington National Monument. Acidic Oak - Hickory Forest ranges through the Piedmont of the Carolinas and Virginia, north into south-central Maryland. It is not a rare community type (G4G5), but stands older than about 80 years old are uncommon, since most of the rolling upland landscape of the Piedmont have been logged more than once since European settlement. The association is one of the most common forest types in the Piedmont, occurring as a matrix forest in the southern portion of its range, and a matrix or large-patch forest northward into Virginia.

The more fertile, upland soils in the park are weathered from dark, mafic rocks of metabasalt. These rocks were originally basaltic lavas intruded into the sediments that formed the biotite gneiss now covering much of Booker T. Washington National Monument. Soils weathered from these rocks are rich in calcium and magnesium and support Inner Piedmont / Lower Blue Ridge Basic Mesic Forest on protected, low slope locations above Gill's Creek. This map class covers less than four percent (3.4 ha [8.4 ac]) of the park. Undisturbed examples of Inner Piedmont / Lower Blue Ridge Basic Mesic Forest are characterized by a lush and diverse herbaceous stratum dominated by coarse forbs and ferns. The association Inner Piedmont / Lower Blue Ridge Basic Mesic Forest (CEGL006186), is scattered in small to large patches throughout the lower Blue Ridge and northern and western Piedmont of Virginia, and much of the Maryland Piedmont and Blue Ridge. This association occurs almost exclusively on clay-rich soils weathered from mafic rocks, often on very rocky sites. While not a naturally rare type (G4), this community has a restricted geographic distribution, mature examples are uncommon, and all stands are vulnerable to logging and degradation by introduced invasive weeds. Many examples are poorly buffered because of upslope land-use change and timber removal, or conversion of upslope forests to managed forest types. The stands at Booker T. Washington National Monument are particularly vulnerable to nonnative plant invasion; high recruitment of tree of heaven (*Ailanthus altissima*) in this community was noted during this study.

The narrow floodplains and terraces of Gill's Creek and Jack-O-Lantern Branch support Piedmont / Mountain Alluvial Forest, covering only seven percent (6.7 ha [9.1 ac]) of the park. Forests of this map class occur over deep, sandy alluvial soils that are subject to occasional flooding, typically once or twice a year. The deep, fertile soils are highly susceptible to nonnative species invasion; thus, it is important not to site trails and roads in the active floodplain and to mitigate impacts from surrounding development. The association Piedmont / Mountain Alluvial Forest (CEGL006492) was first defined through the regional analysis for this project. It is not an uncommon forest (G4), but high quality, undisturbed examples are rare. It is the principal small floodplain forest in the northern and western Piedmont of Virginia and extends into Maryland.

Invasive nonnative plant species are a significant threat to the native vegetation associations at Booker T. Washington National Monument. The nonnative invasive species tree of heaven (*Ailanthus altissima*), Russian olive (*Elaeagnus angustifolia*), Japanese honeysuckle (*Lonicera japonica*), and Nepalese browntop (*Microstegium vimineum*) were documented in the park during this study. Hemlock woolly adelgid (*Adelges tsugae*) was also observed on eastern hemlock (*Tsuga canadensis*) in the park. Park staff and the Mid-Atlantic Exotic Plant Management Team have been using chemical and mechanical controls on some of these invasive species. This management should continue in order to protect the native vegetation associations. In addition, many of these nonnative invasives are relatively recent introductions to North America and were not present during the historical period depicted by the park.

Vegetation Map Production

The original formation-level vegetation map identified seven vegetation formations and two Anderson Level II land-use categories. The formation-level map created during this study was developed solely to guide vegetation sampling and was not intended to identify specific USNVC formations for specific polygons. The final vegetation association map for Booker T. Washington National Monument includes seven USNVC vegetation associations, one nonstandard park-specific vegetation class, and two Anderson Level II land-use classes. Each polygon representing a USNVC association was attributed with the appropriate USNVC formation based on the hierarchy of the USNVC, rather than by on-the-ground interpretation. For example, polygons labeled as Successional Virginia Pine Forest, a relatively short-lived vegetation type, may contain up to a 75% deciduous canopy, even though this association is placed within an Evergreen Forest Class of the USNVC. Successional Virginia Pine Forest stands that are transitional to Successional Tuliptree Forest, with a mixed to mostly deciduous photo-signature, are indicated as “transitional” in the comment field of the attribute table. If left undisturbed, stands mapped as Successional Virginia Pine will eventually succeed to Successional Tuliptree Forest.

The map classes Inner Piedmont / Lower Blue Ridge Basic Mesic Forest and Piedmont / Mountain Alluvial Forest included stands that were significantly disturbed, with high cover by nonnative invasive plants and without the characteristic structure and species of less disturbed examples of these natural communities. 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 these forest types are identified with a note in the comment field of the map attribute table.

The final vegetation map is based on aerial photography that was flown in February 2002. Since that time, the vegetation in the park has continued to change. The temporal progression of early successional forest types will continue to alter the mapped vegetation, as will the park’s ongoing management of invasive species. Despite these changes, the vegetation map produced by this project provides crucial baseline data for the park resource managers.

Recommendations for Future Projects

Invasive nonnative plant species are the main threat to the native vegetation associations at Booker T. Washington National Monument and to an accurate presentation of the historical

landscape. The most common and problematic species are tree of heaven (*Ailanthus altissima*), Russian olive (*Elaeagnus angustifolia*), Japanese honeysuckle (*Lonicera japonica*), and Nepalese browntop (*Microstegium vimineum*). Tree of heaven (*Ailanthus altissima*) is a particular problem on the fertile soils of Basic Mesic Forest on the southwestern boundary of the park, where it occurs as abundant seedlings in the understory. Hemlock woolly adelgid (*Adelges tsugae*) may be able to be controlled on the few eastern hemlocks (*Tsuga canadensis*) in the southern portion of the park. Continued inventory, monitoring, and management of invasive species should be a priority for the park's resource managers.

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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

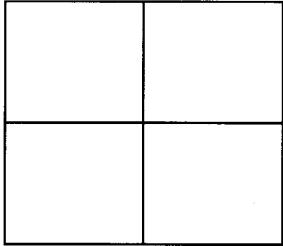
P.1

GENERAL INFORMATION PLOT: _____ Project: <u>Mid atlantic Veg mapping</u> Date: _____ Surveyors: _____ Plot dimensions: _____ by _____ m Sample area _____ sq. m		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: _____ Receiver status: 2D / 3D / 2D WAAS / 3D WAAS Field UTM X _____ E Y _____ N LAT _____ Long _____ Marked est. location on toposheet _____ yes	
PLOT DOCUMENTATION Source Code: _____ Film Roll: _____ Frames: _____ Description of pic(s): _____ Relative Stand Size A - extensive (> 100x plot size) B - large (10-100x plot size) C - small (3-10x plot size) D - very small (1-3x plot size) U - Unknown			
SITE CHARACTERISTICS compass: <u>magnetic</u> corrected _____			
Elevation _____ m/ft via GPS _____ map _____ altimeter _____			
Slope (o) _____ single measure. _____ avg of _____ or: A - 0-3% (level or nearly so) B - 3-8% (gentle/undulating) C - 8-16% (sloping/rolling) D - 16-30% (moderate/hilly) E - 30-65% (steep) F - 65-75% (very steep) G - 75+% (extremely steep)		Slope Shape (V w/ slope) VERTICALLY HORIZONTALLY C - concave C - concave X - convex X - convex S - straight S - straight H - hummock (____%) and hollow (____%) microtopography I - irregular craggy/ bouldery microtopography	
Aspect (N = 0o): _____ single measure. _____ avg of _____ F (flat) N 338-22 ° NE 23-67 ° V (variable) E 68-112 ° SE 113-157 ° S 158-202 ° SW 203-247 ° W 248-292 ° NW 293-337 °			
Topographic Position A - crest B - upper slope C - middle slope D - lower slope E - toe slope F - plain/level/bottom G - basin/depression		Landform IF - interfluvium 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: _____	
Surface Substrate bedrock boulders and stones gravel and cobbles litter / organic matter decaying wood water mineral soil / sand other (bryophytes and lichens) TOTAL 100%		% Cover _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	
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 neqia. time after ppt) B - xeric (moist for brief time) C - somewhat xeric (moist for short time) D - submesic (moist for moderately short time) E - mesic (moist for significant time) F - subhygric (wet for significant part of growing season: mottles <20cm) G - hygric (wet for most of growing season: permanent seepage/mottling) H - subhydryc (water table at or near surface for most of the year) I - hydryc (water table at or above surface year round) - ephemeral seepage/subsurface water present locally in plot	
Hydrologic Regime _____ Terrestrial (i.e. not a wetland) Tidal A - Irregularly exposed B - Regularly flooded C - Irregularly flooded D - Wind tidally flooded Non-Tidal A - Permanently flooded B - Semipermanently flooded C - Seasonally flooded D - Intermittently flooded E - Temporarily flooded F - Saturated Salinity/Halinity A - Saltwater B - Brackish C - Oligohaline D - Freshwater Refractometer Measurement: _____			
Cowardin System <u>Upland</u> <u>Riverine</u> <u>Lacustrine</u> <u>Estuarine</u> <u>Palustrine</u>			
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.

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

maximum CANOPY HEIGHT _____ m

COLUMN VALUES:

T>35 = tree canopy > 35m (T1) H = field layer (0 -0.5 m)

T20 = tree canopy 20-35m (T2) N = nonvascular

T10 = tree canopy 10-20m (T2) V = vines

T6 = tree canopy 6-10m (T3) E = epiphytes

S1 = tree or shrub 1-6m TC = total cover

S2 = woody sp. 0.5 - 1 m

C = collection

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

[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. Vascular plants observed in quantitative vegetation plots and qualitative observation points in Booker T. Washington National Monument during 2002.

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
Aceraceae	<i>Acer negundo</i>	boxelder
	<i>Acer rubrum</i>	red maple
	<i>Acer saccharum</i> var. <i>saccharum</i>	sugar maple
Anacardiaceae	<i>Toxicodendron radicans</i>	eastern poison ivy
Annonaceae	<i>Asimina triloba</i>	pawpaw
Apiaceae	<i>Cryptotaenia canadensis</i>	Canadian honewort
	<i>Sanicula canadensis</i>	Canadian blacksnakeroot
Aquifoliaceae	<i>Ilex opaca</i> var. <i>opaca</i>	American holly*
Araceae	<i>Arisaema dracontium</i>	green dragon
	<i>Arisaema triphyllum</i>	Jack in the pulpit
Aristolochiaceae	<i>Aristolochia serpentaria</i>	Virginia snakeroot
	<i>Asarum canadense</i>	Canadian wildginger
Aspleniaceae	<i>Asplenium platyneuron</i>	ebony spleenwort
Asteraceae	<i>Ageratina altissima</i>	white snakeroot*
	<i>Arctium minus</i>	lesser burdock* ^e
	<i>Bidens frondosa</i>	devil's beggartick*
	<i>Coreopsis major</i>	greater tickseed
	<i>Elephantopus carolinianus</i>	Carolina elephantsfoot*
	<i>Erigeron annuus</i>	eastern daisy fleabane
	<i>Hieracium venosum</i>	rattlesnakeweed
	<i>Packera anonyma</i>	Small's ragwort*
	<i>Packera aurea</i>	golden ragwort*
	<i>Rudbeckia laciniata</i>	cutleaf coneflower
	<i>Solidago bicolor</i>	white goldenrod*
	<i>Solidago caesia</i>	wreath goldenrod
	<i>Solidago speciosa</i> var. <i>erecta</i>	showy goldenrod*
	<i>Symphyotrichum cordifolium</i>	common blue wood aster
	<i>Symphyotrichum lateriflorum</i>	calico aster
	<i>Symphyotrichum patens</i> var. <i>patens</i>	late purple aster*
	<i>Symphyotrichum prenanthoides</i>	crookedstem 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 nigra</i>	river birch*
	<i>Carpinus caroliniana</i>	American hornbeam
	<i>Corylus americana</i>	American hazelnut*
Bignoniaceae	<i>Campsis radicans</i>	trumpet creeper*
Campanulaceae	<i>Lobelia inflata</i>	Indiantobacco*

Family	Scientific Name	Common name
Caprifoliaceae	<i>Lonicera japonica</i>	Japanese honeysuckle ^{c#}
	<i>Symphoricarpos orbiculatus</i>	coralberry
	<i>Viburnum acerifolium</i>	mapleleaf viburnum
	<i>Viburnum prunifolium</i>	blackhaw
Caryophyllaceae	<i>Stellaria pubera</i>	star chickweed
Celastraceae	<i>Euonymus americana</i>	strawberry bush
	<i>Euonymus atropurpurea</i>	eastern wahoo
Clusiaceae	<i>Hypericum punctatum</i>	spotted St. Johnswort
Convolvulaceae	<i>Ipomoea pandurata</i>	man of the earth
Cornaceae	<i>Cornus florida</i>	flowering dogwood
Cupressaceae	<i>Juniperus virginiana</i> var. <i>virginiana</i>	eastern redcedar
Cyperaceae	<i>Carex albicans</i> var. <i>australis</i>	stellate sedge
	<i>Carex amphibola</i>	eastern narrowleaf sedge
	<i>Carex appalachica</i>	Appalachian sedge
	<i>Carex blanda</i>	eastern woodland sedge
	<i>Carex cephalophora</i>	oval-leaf sedge
	<i>Carex complanata</i>	hirsute sedge*
	<i>Carex laxiculmis</i> var. <i>laxiculmis</i>	spreading sedge
	<i>Carex normalis</i>	greater straw sedge
	<i>Carex radiata</i>	eastern star sedge
	<i>Carex rosea</i>	rosy sedge
	<i>Carex striatula</i>	lined sedge
	<i>Cyperus strigosus</i>	strawcolored flatsedge*
Dioscoreaceae	<i>Dioscorea quaternata</i>	fourleaf yam*
Dryopteridaceae	<i>Athyrium filix-femina</i>	common ladyfern*
	<i>Deparia acrostichoides</i>	silver false spleenwort
	<i>Polystichum acrostichoides</i>	Christmas fern
Elaeagnaceae	<i>Elaeagnus angustifolia</i>	Russian olive ^{c#}
Ericaceae	<i>Gaylussacia baccata</i>	black huckleberry
	<i>Kalmia latifolia</i>	mountain laurel*
	<i>Oxydendrum arboreum</i>	sourwood
	<i>Rhododendron periclymenoides</i>	pink azalea
	<i>Vaccinium pallidum</i>	Blue Ridge blueberry
	<i>Vaccinium stamineum</i>	deerberry
Euphorbiaceae	<i>Euphorbia corollata</i>	flowering spurge*
Fabaceae	<i>Amphicarpaea bracteata</i>	American hogpeanut
	<i>Cercis canadensis</i> var. <i>canadensis</i>	eastern redbud
	<i>Desmodium glutinosum</i>	pointedleaf ticktrefoil*
	<i>Desmodium nudiflorum</i>	nakedflower ticktrefoil
	<i>Desmodium rotundifolium</i>	prostrate ticktrefoil*
	<i>Lespedeza procumbens</i>	trailing lespedeza*
	<i>Lespedeza virginica</i>	slender lespedeza*
	<i>Robinia pseudoacacia</i>	black locust
	<i>Castanea pumila</i> var. <i>pumila</i>	chinkapin
	<i>Fagus grandifolia</i>	American beech
Fagaceae	<i>Quercus alba</i>	white oak
	<i>Quercus coccinea</i>	scarlet oak

Family	Scientific Name	Common name
Fagaceae (cont.)	<i>Quercus falcata</i>	southern red oak
	<i>Quercus prinus</i>	chestnut oak*
	<i>Quercus rubra</i>	northern red oak
	<i>Quercus stellata</i>	post oak*
	<i>Quercus velutina</i>	black oak
Geraniaceae	<i>Geranium carolinianum</i>	Carolina geranium*
Hydrophyllaceae	<i>Hydrophyllum canadense</i>	bluntleaf waterleaf
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
Lamiaceae	<i>Cunila origanoides</i>	common dittany*
	<i>Scutellaria elliptica</i>	hairy skullcap
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>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
Magnoliaceae	<i>Liriodendron tulipifera</i>	tuliptree
	<i>Magnolia acuminata</i>	cucumber-tree
Nyssaceae	<i>Nyssa sylvatica</i>	blackgum
Oleaceae	<i>Fraxinus americana</i>	white ash
	<i>Fraxinus pennsylvanica</i>	green ash
Onagraceae	<i>Circaea lutetiana</i> ssp. <i>canadensis</i>	broadleaf enchanter's nightshade
Ophioglossaceae	<i>Botrychium virginianum</i>	rattlesnake fern
Orchidaceae	<i>Cypripedium acaule</i>	moccasin flower*
	<i>Galearis spectabilis</i>	showy orchid
	<i>Goodyera pubescens</i>	downy rattlesnake plantain
	<i>Liparis liliifolia</i>	brown widelip orchid*
	<i>Spiranthes ovalis</i> var. <i>erostellata</i>	October ladies' tresses*
Oxalidaceae	<i>Oxalis stricta</i>	common yellow oxalis
Papaveraceae	<i>Sanguinaria canadensis</i>	bloodroot
Passifloraceae	<i>Passiflora lutea</i>	yellow passionflower
Pinaceae	<i>Pinus pungens</i>	Table Mountain pine
	<i>Pinus rigida</i>	pitch pine*
	<i>Pinus strobus</i>	eastern white pine*
	<i>Pinus virginiana</i>	Virginia pine
	<i>Tsuga canadensis</i>	eastern hemlock
Platanaceae	<i>Platanus occidentalis</i>	American sycamore*
Poaceae	<i>Agrostis perennans</i>	upland bentgrass*
	<i>Andropogon virginicus</i>	broomsedge bluestem*
	<i>Brachyelytrum erectum</i>	bearded shorthusk

Family	Scientific Name	Common name
Poaceae (cont.)	<i>Bromus pubescens</i>	hairy woodland brome*
	<i>Chasmanthium laxum</i>	slender woodoats*
	<i>Cinna arundinacea</i>	sweet woodreed
	<i>Danthonia spicata</i>	poverty oatgrass*
	<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>Echinochloa crus-galli</i>	barnyardgrass* ^e
	<i>Elymus hystrix</i> var. <i>hystrix</i>	eastern bottlebrush grass
	<i>Elymus virginicus</i>	Virginia wildrye
	<i>Festuca subverticillata</i>	nodding fescue
	<i>Glyceria striata</i>	fowl mannagrass*
	<i>Leersia virginica</i>	whitegrass*
	<i>Lolium pratense</i>	meadow ryegrass* ^{e#}
	<i>Microstegium vimineum</i>	Nepalese browntop ^{e#}
	<i>Piptochaetium avenaceum</i>	blackseed speargrass*
Polygonaceae	<i>Polygonum caespitosum</i> var. <i>longisetum</i>	oriental ladythumb* ^{e#}
	<i>Polygonum sagittatum</i>	arrowleaf tearthumb*
	<i>Polygonum virginianum</i>	jumpseed
Primulaceae	<i>Lysimachia ciliata</i>	fringed loosestrife
Pteridaceae	<i>Adiantum pedatum</i>	northern maidenhair
Pyrolaceae	<i>Chimaphila maculata</i>	striped prince's pine
Ranunculaceae	<i>Cimicifuga racemosa</i> (= <i>Actaea racemosa</i>)	black bugbane
	<i>Clematis viorna</i>	vasevine
	<i>Hydrastis canadensis</i>	goldenseal
	<i>Thalictrum thalictroides</i>	rue anemone
Rosaceae	<i>Agrimonia rostellata</i>	beaked agrimony
	<i>Amelanchier arborea</i>	common serviceberry
	<i>Crataegus uniflora</i>	dwarf hawthorn
	<i>Duchesnea indica</i>	Indian strawberry ^e
	<i>Fragaria virginiana</i>	Virginia strawberry*
	<i>Geum canadense</i>	white avens
	<i>Potentilla canadensis</i>	dwarf cinquefoil
	<i>Potentilla simplex</i>	common cinquefoil
	<i>Prunus serotina</i> var. <i>serotina</i>	black cherry
	<i>Rubus argutus</i>	sawtooth blackberry
	<i>Rubus flagellaris</i>	northern dewberry
	<i>Rubus occidentalis</i>	black raspberry
	<i>Rubus pensilvanicus</i>	Pennsylvania blackberry
Rubiaceae	<i>Galium aparine</i>	stickywilly
	<i>Galium circaezans</i>	licorice bedstraw
	<i>Galium triflorum</i>	fragrant bedstraw
	<i>Houstonia longifolia</i>	longleaf summer bluet*
	<i>Mitchella repens</i>	partridgeberry
Saxifragaceae	<i>Tiarella cordifolia</i>	heartleaf foamflower
Scrophulariaceae	<i>Chelone glabra</i>	white turtlehead*

Family	Scientific Name	Common name
Simaroubaceae	<i>Ailanthus altissima</i>	tree of heaven ^{e#}
Smilacaceae	<i>Smilax glauca</i>	cat greenbrier
	<i>Smilax herbacea</i>	smooth carrionflower
	<i>Smilax rotundifolia</i>	roundleaf greenbrier
Staphyleaceae	<i>Staphylea trifolia</i>	American bladdernut
Thelypteridaceae	<i>Thelypteris noveboracensis</i>	New York fern*
Ulmaceae	<i>Celtis occidentalis</i>	common hackberry
	<i>Ulmus rubra</i>	slippery elm
Urticaceae	<i>Boehmeria cylindrica</i>	smallspike false nettle
	<i>Pilea pumila</i>	Canadian clearweed
Verbenaceae	<i>Phryma leptostachya</i>	American lopseed
Violaceae	<i>Viola cucullata</i>	marsh blue violet
	<i>Viola hastata</i>	halberdleaf yellow violet*
	<i>Viola hirsutula</i>	southern woodland violet
	<i>Viola palmata</i>	early blue violet
	<i>Viola sororia</i>	common blue violet
	<i>Viola striata</i>	striped cream violet
	<i>Parthenocissus quinquefolia</i>	Virginia creeper
Vitaceae	<i>Vitis cinerea</i>	graybark grape
	<i>Vitis rotundifolia</i>	muscadine
	<i>Vitis vulpina</i>	frost grape

*Species were not measured in quantitative plot sampling, but noted during polygon observations.

^eSpecies not native to Virginia.

[#]Species considered to be invasive nonnative species by the VADCR (VADCR 2003).

Appendix C. 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 Booker T. Washington National Monument can be found in Table 9 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 D.

Appendix C. 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
Booker T. Washington National Monument

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

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

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

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

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

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

Global Rank Codes and Definitions

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

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

GH - Historical - Presumed eliminated throughout its range, with no, or virtually no, likelihood that it will be rediscovered, but with potential for restoration (e.g., *Castanea dentata* Forest).

G1 - Critically Imperiled - Critically imperiled globally. Generally 5 or fewer occurrences and/or very few remaining acres or very vulnerable to elimination throughout its range due to other factor(s).

G2 - Imperiled - Imperiled globally. Generally 6–20 occurrences and/or few remaining acres or very vulnerable to elimination throughout its range due to other factor(s).

G3 - Vulnerable - Rare or uncommon. Generally 21–100 occurrences; either very rare and local throughout its range or found locally, even abundantly, within a restricted range or vulnerable to elimination throughout its range due to specific factor(s).

G4 - Apparently Secure - Uncommon but not rare. Apparently secure, but with cause for long-term concern. May be quite rare in parts of its range, especially at the periphery; apparently not vulnerable in most of its range

G5 - Secure - Demonstrably widespread, abundant, and secure. Common, widespread, and abundant, although it may be quite rare in parts of its range, especially at the periphery; not vulnerable in most of its range.

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

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

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

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

State Rank Codes and Definitions

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

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

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

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

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

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

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

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

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

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

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

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

Global and State Rank Qualifier Codes and Definitions

? - Inexact or Uncertain - A question mark added to a rank expresses an uncertainty about the rank in the range of 1 in either way on the 1–5 scale; for example, a G2? rank indicates that the rank is thought to be G2, but could be G1 or G3.

Q - Questionable taxonomy - A “Q” added to a rank denotes questionable taxonomy; it modifies the degree of imperilment and is only used in cases where the type would have a less imperiled rank if it were not recognized as a valid type (i.e., if it were combined with a more common type); a GUQ rank often indicates that the type is unrankable because of daunting taxonomic questions.

Appendix E. 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 Booker T. Washington National Monument are listed in bold font.

Table E1. 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	% Non Vasc
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

	USNVC code	Aspect	Slope Inclination	Topographic Position	TRMI	% Bedrock	% Large Rocks	% Small Rocks	% Min. Soil	% Litter& Duff	% Wood	% Water	% NonVasc
Nonriverine Forests													
Upland Depression Swamp	CEGL007403	flat	level to basin / depression	various	35.1	1	0	0	1	92	5	2	3
Coastal Plain Depression Wetland (Red Maple – Sweetgum – Willow Oak Type)	CEGL006110	flat	level to basin / depression	various	37.1	0	0	0	4	86	4	6	16
Coastal Plain Depression Wetland (Swamp Tupelo Type)	CEGL006223	flat	level to basin / depression	basin/depression	40.0	0	0	0	1	98	2	0	0
Non-Riverine Saturated Forest	CEGL004644	flat	level	plain/level/bottom	40.0	0	0	0	1	89	7	3	4
Tidal 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 E2. Environmental variable averages by association – soil chemistry variables.

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

USGS-NPS Vegetation Mapping Program
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	USNVC code	pH	N	P	S	Ca	Mg	K	Na	B	Fe	Mn	Cu	Zn	Al	CEC	TBS	OM	CaMgRatio	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 F. Cluster dendrograms, ordination scatterplots, and joint plots resulting from quantitative analysis of regional plot data for three major vegetation groups present at Booker T. Washington National Monument.

Major vegetation groups are presented as follows:

Oak - Hickory Forests (Figures F1–F3)

Basic Mesic and Calcareous Forests (Figures F4–F6)

Alluvial Forests (Figures F7–F9)

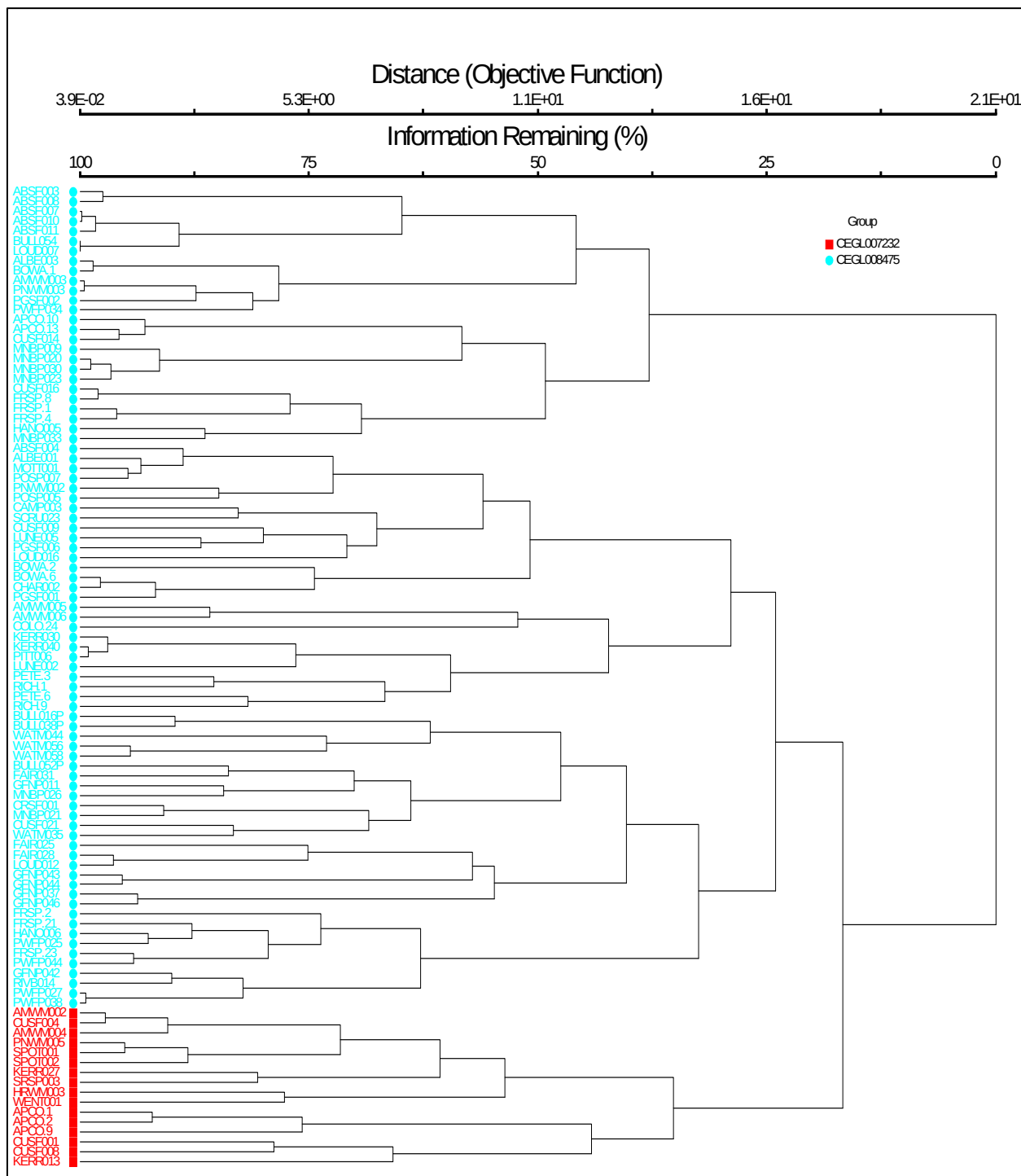


Figure F1. Dendrogram resulting from cluster analysis of species coverage data from 99 oak-hickory forest plots. Plot membership in two oak-hickory forest associations is shown. CEGL007232 = Basic Oak - Hickory Forest; CEGL008475 = Acidic Oak - Hickory Forest. Distance on the dendrogram scale is Wishart's 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.

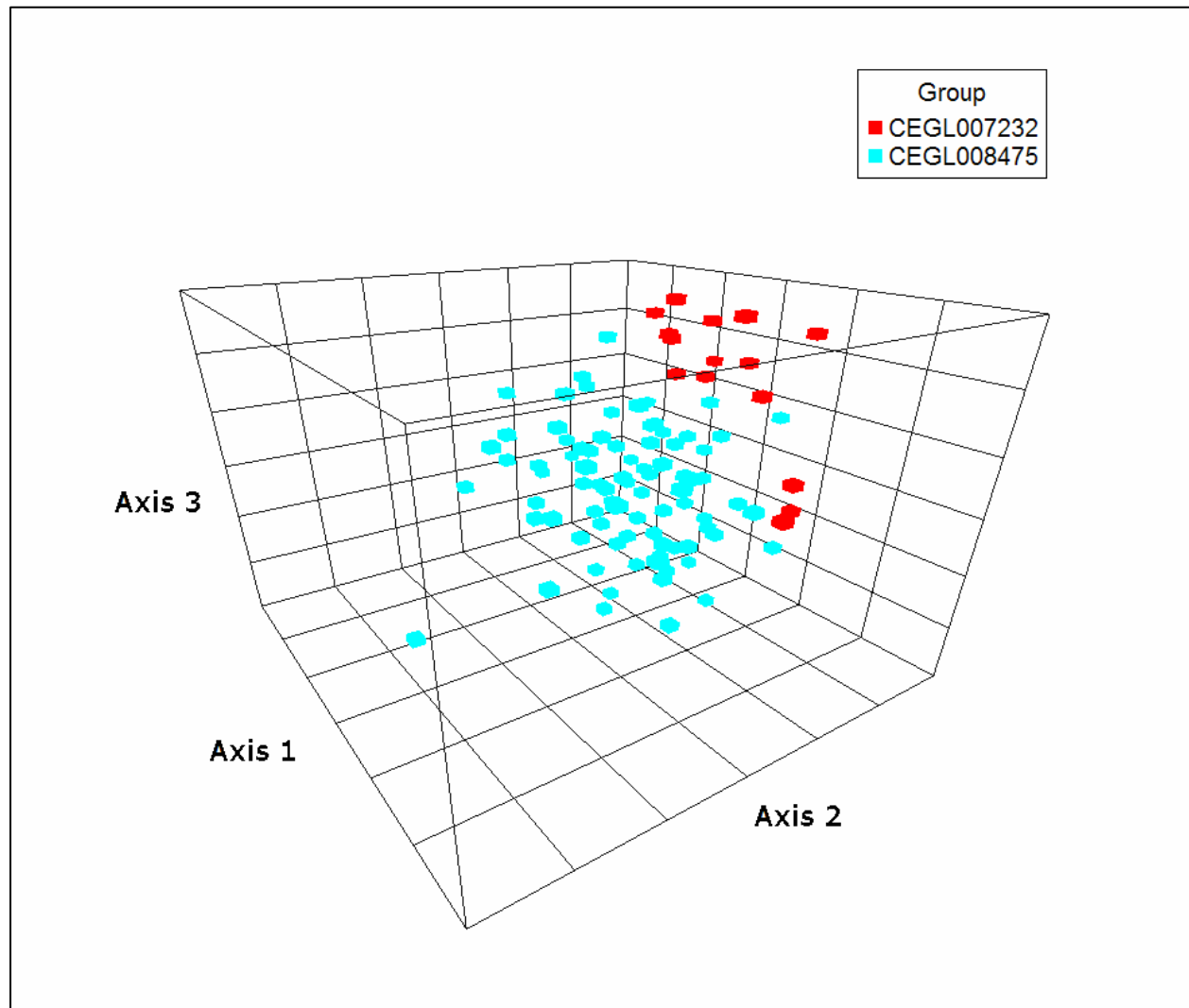


Figure F2. Scatterplot diagram for three-dimensional NMDS ordination of 98 oak-hickory forest plots. Plot membership in two oak-hickory forest associations is based on cluster analysis. CEGL007232 = Basic Oak - Hickory Forest; CEGL008475= Acidic Oak - Hickory Forest. One plot was determined to be an outlier and eliminated from the dataset prior to ordination.

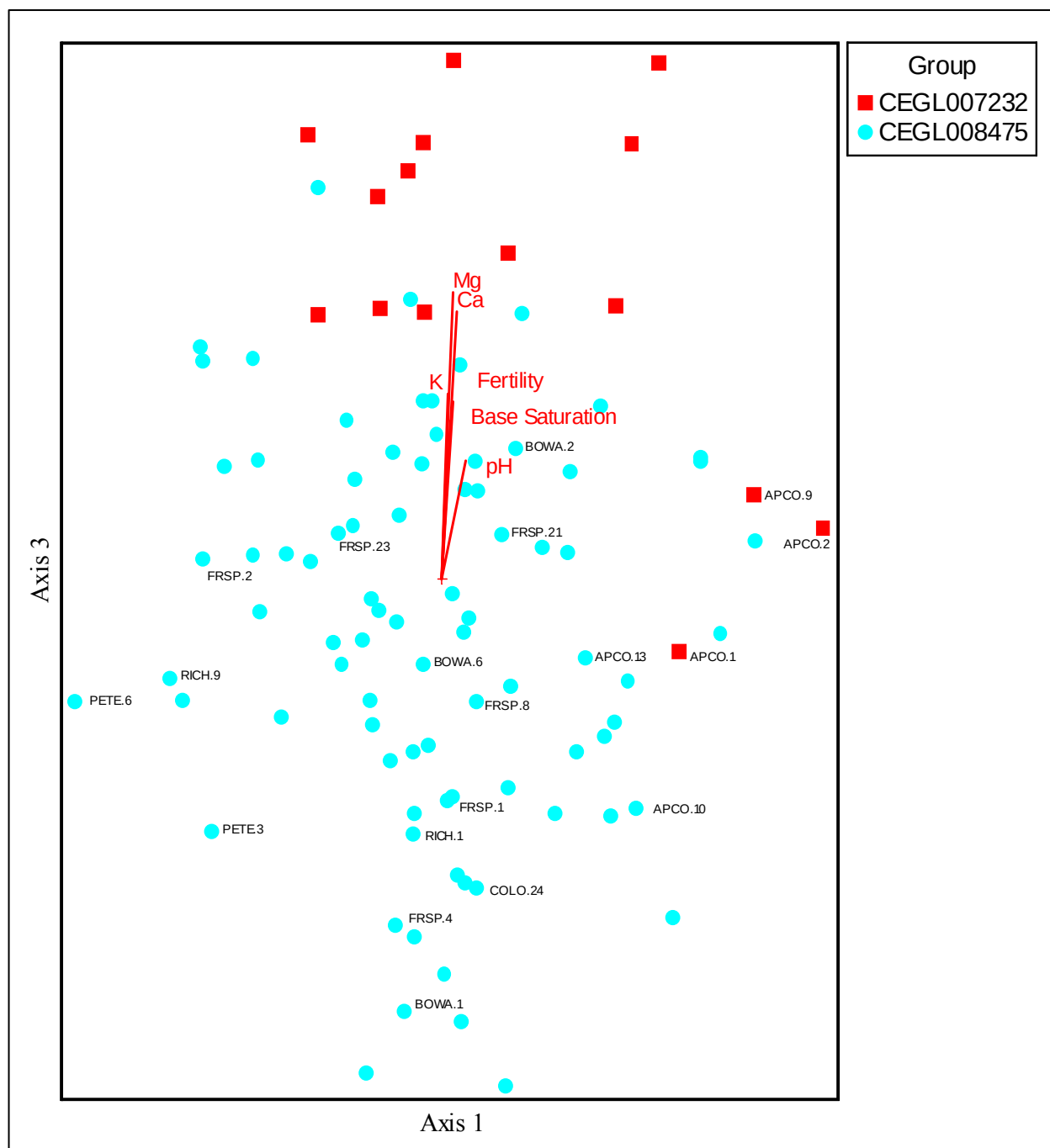


Figure F3. Joint plot showing significant correlations ($r^2 = 0.20$) of environmental variables with ordination scores for 98 oak-hickory forest plots on Axis 1 and Axis 3 of the NMDS ordination. The angles and lengths of the radiating lines indicate the direction and strength of the relationship. Environmental 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.

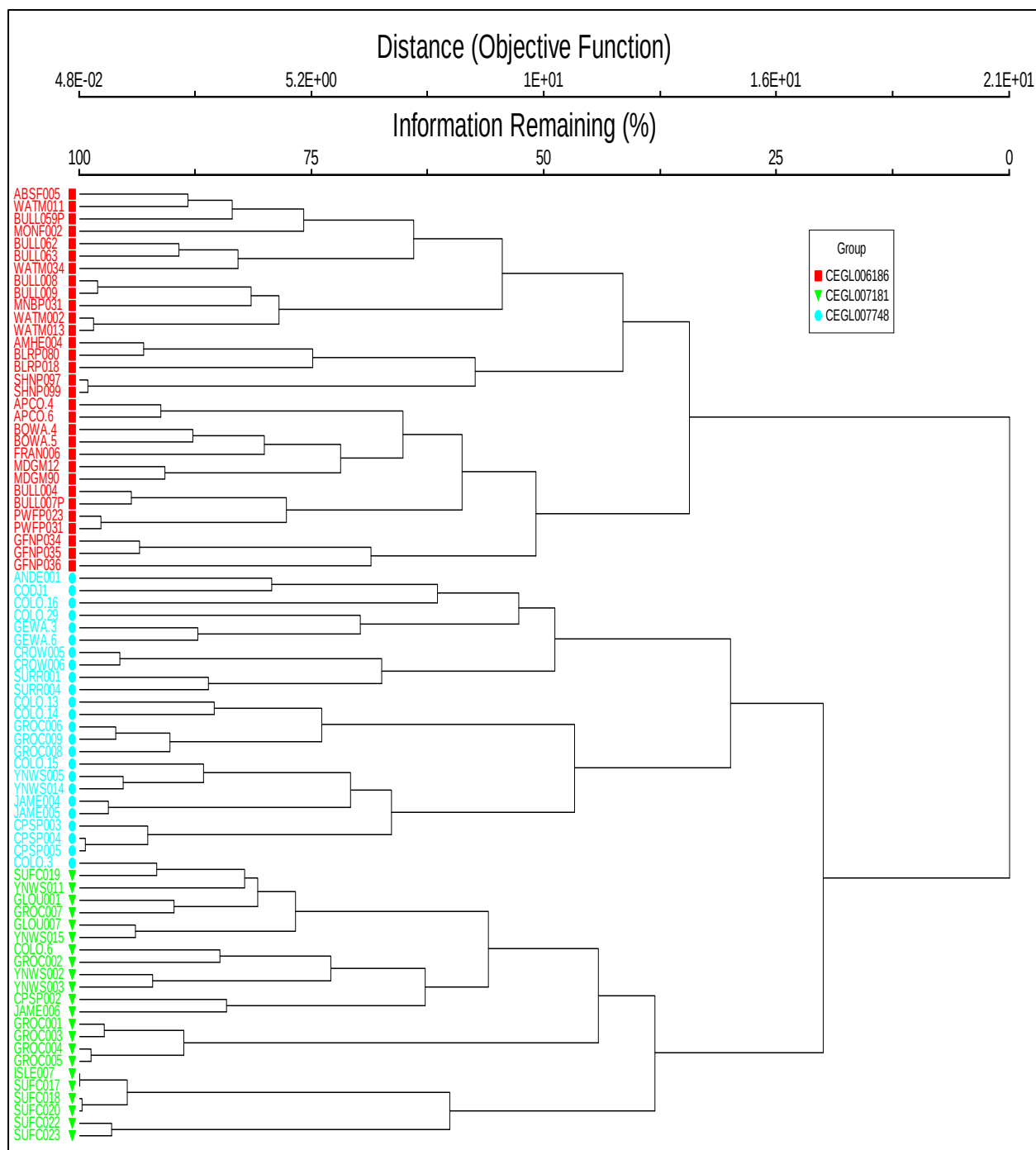


Figure F4. Dendrogram resulting from cluster analysis of species coverage data from 77 basic mesic and calcareous forest plots. Plot membership in three basic and calcareous forest associations is shown. CEGL006186 = Inner Piedmont / Lower Blue Ridge Basic Mesic Forest; CEGL007181 = Coastal Plain Mesic Calcareous Ravine Forest; CEGL007748 = Coastal Plain Mesic Calcareous Ravine Forest. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

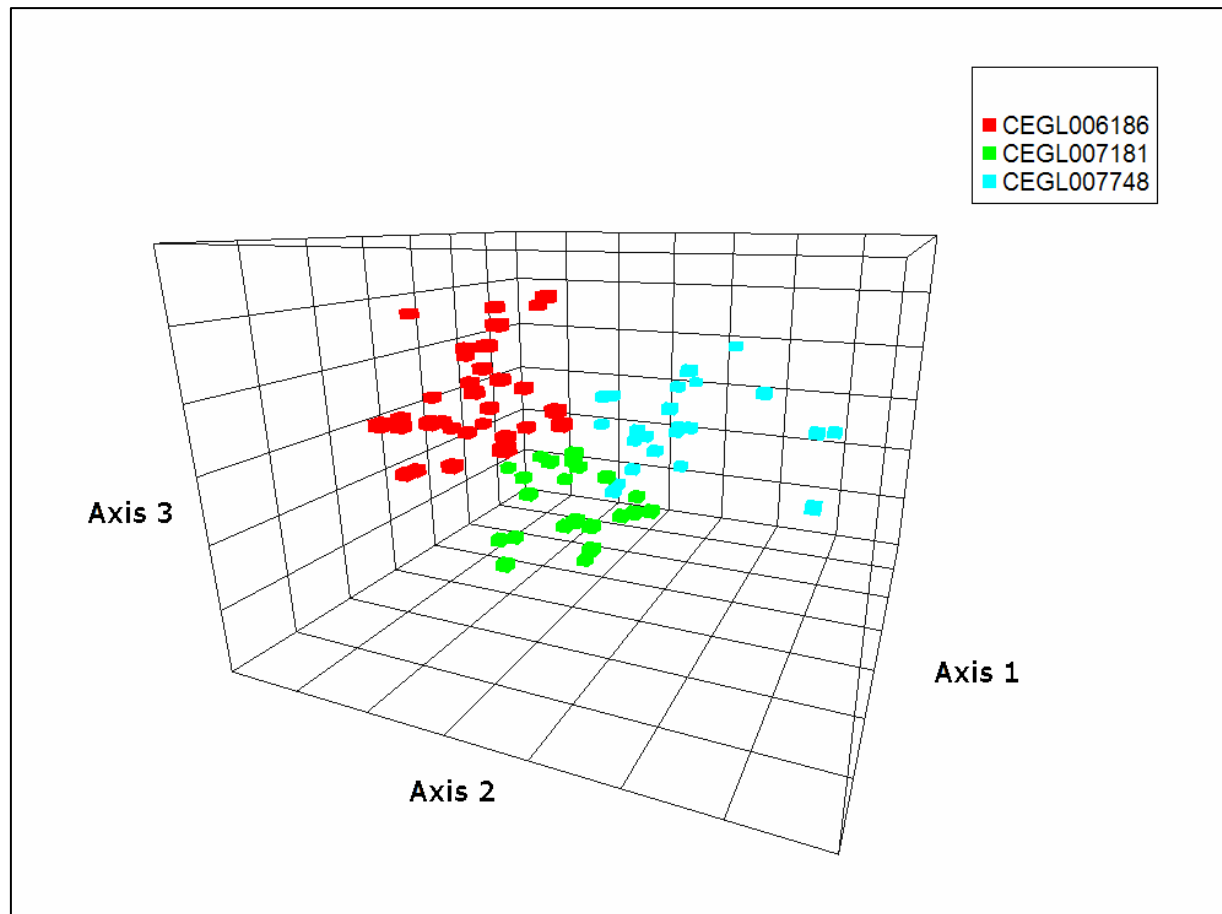


Figure F5. Scatterplot diagram for three-dimensional NMDS ordination of 76 basic mesic and calcareous forest plots. Plot membership in three basic mesic and calcareous forest associations is based on cluster analysis. CEGL006186 = Inner Piedmont / Lower Blue Ridge Basic Mesic Forest; CEGL007181 = Coastal Plain Mesic Calcareous Ravine Forest; CEGL007748 = Coastal Plain Mesic Calcareous Ravine Forest. One plot was determined to be an outlier and eliminated from the dataset prior to ordination.

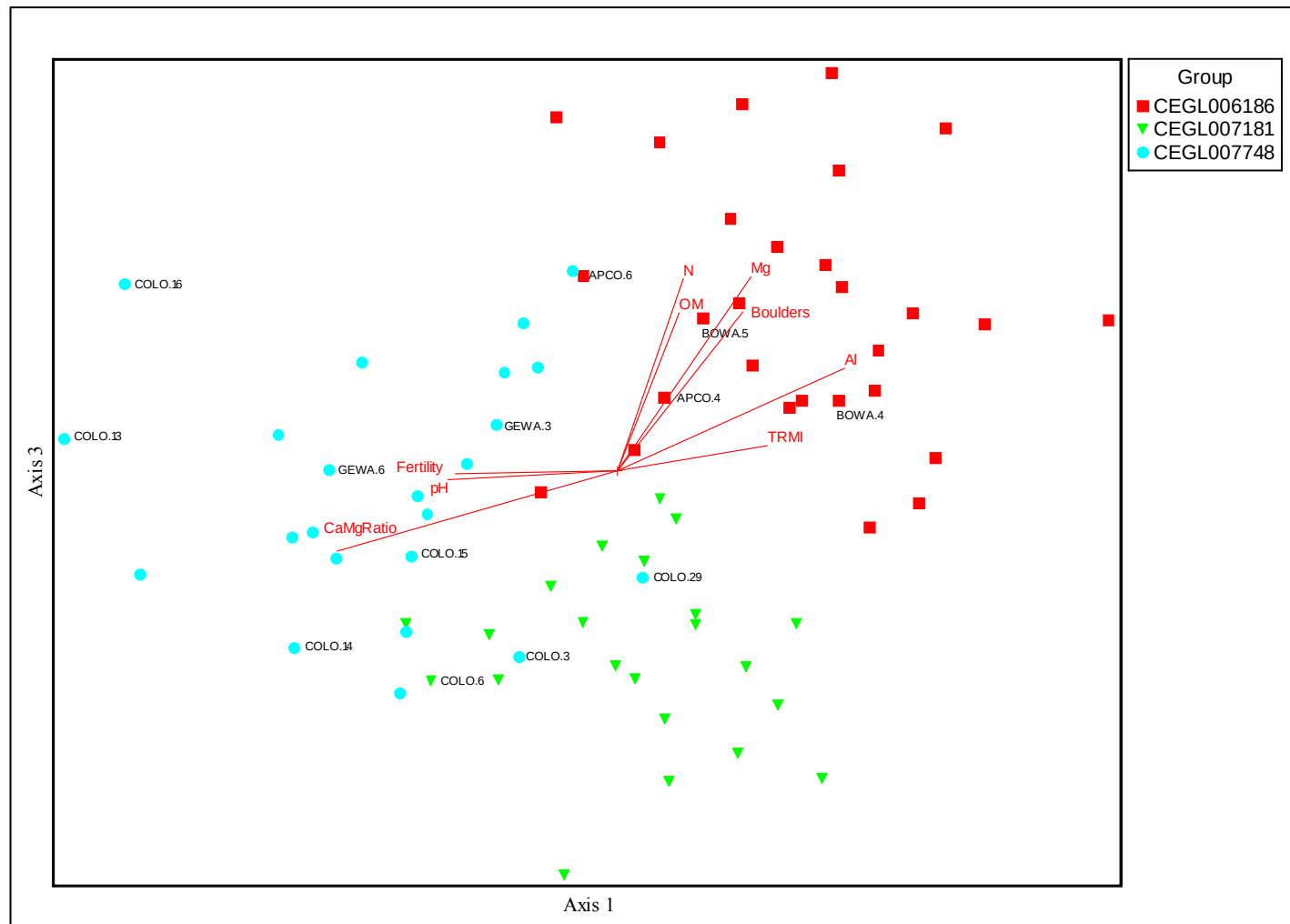


Figure F6. Joint plot showing significant correlations ($r^2=0.290$) of environmental variables with ordination scores for 73 basic mesic and calcareous forest plots on Axis 1 and Axis 3 of the NMDS ordination. The angles and lengths of the radiating lines indicate the direction and strength of the relationship. Boron and Na were also significantly correlated in the same direction as pH and Fertility, but were removed from the graphic for clarity. Environmental variables used in joint plots are listed in Table 5. Plots from the seven Virginia national parks are labeled to the right of or below the symbol. Only the 73 plots in this group with complete environmental data were included in the ordination.

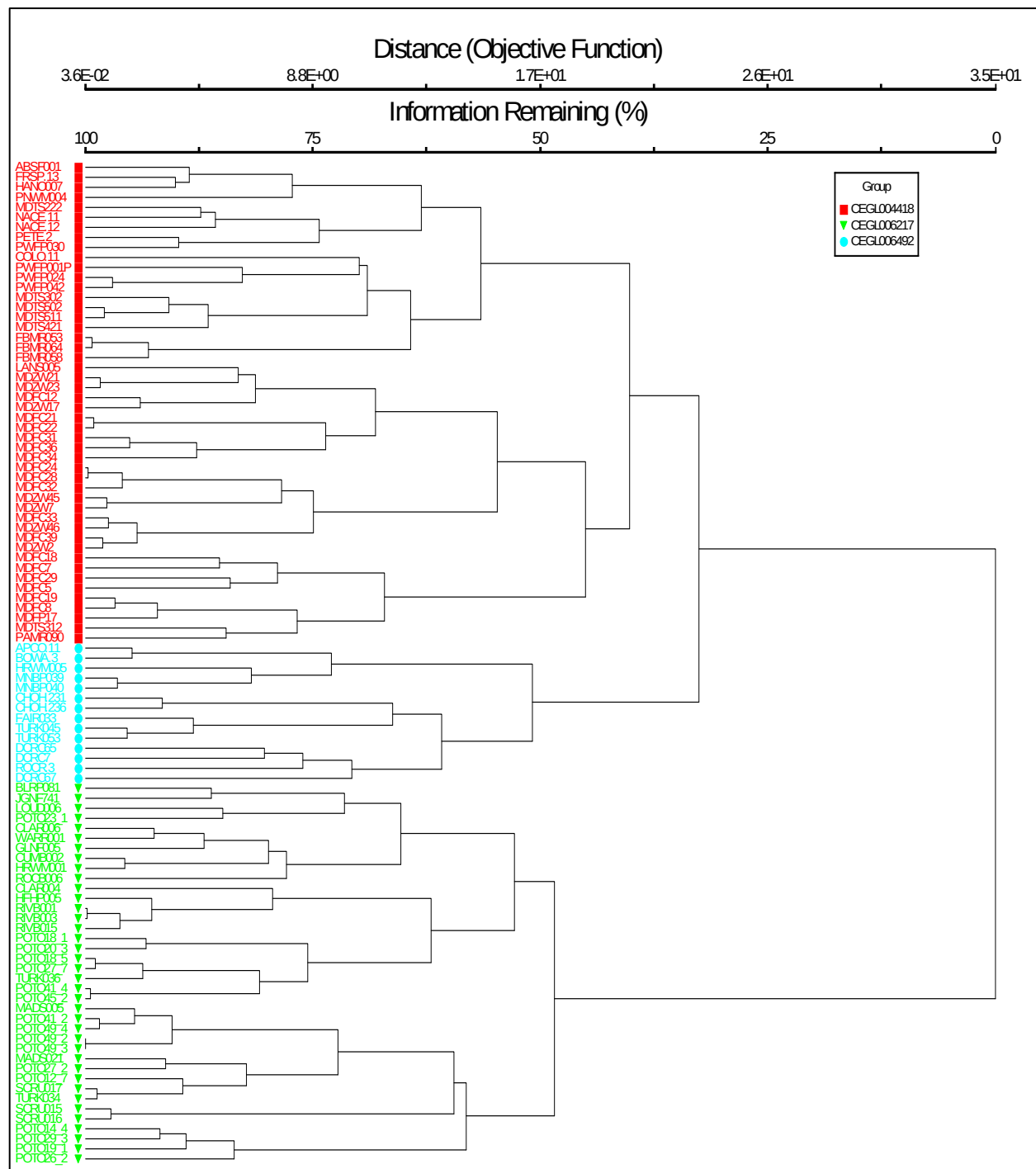


Figure F7. Dendrogram resulting from cluster analysis of species coverage data from 100 alluvial forest plots. Plot membership in three alluvial forest associations is shown. CEGL004418 = Coastal Plain / Piedmont Small-Stream Floodplain Forest; CEGL006217= Piedmont / Mountain Floodplain Forest; CEGL006492= Piedmont / Mountain Alluvial Forest. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

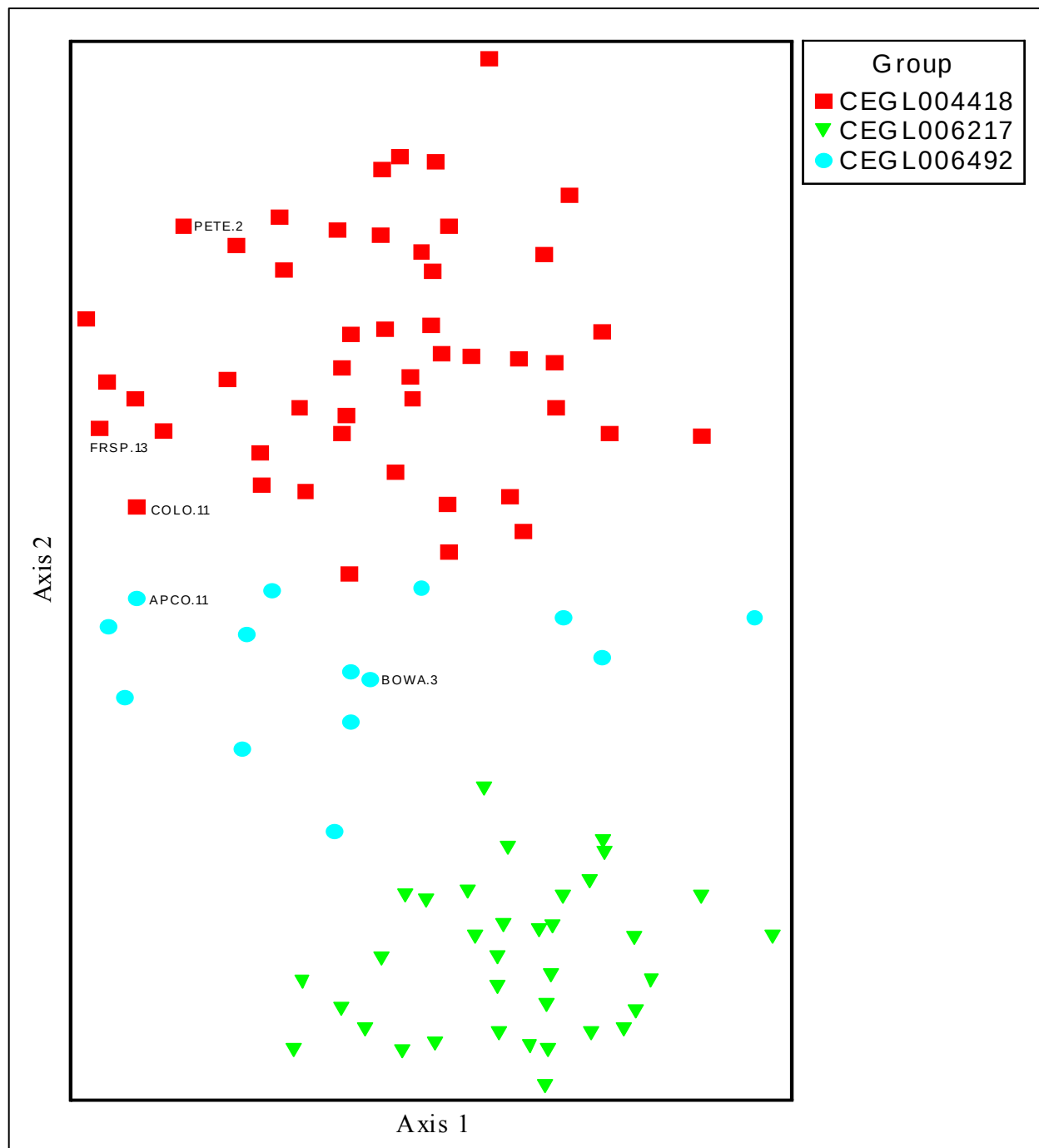


Figure F8. Scatterplot diagram for two-dimensional NMDS ordination of 97 alluvial forest plots. Plot membership in three alluvial forest associations is based on cluster analysis. CEGL004418 = Coastal Plain / Piedmont Small-Stream Floodplain Forest; CEGL006217= Piedmont / Mountain Floodplain Forest; 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.

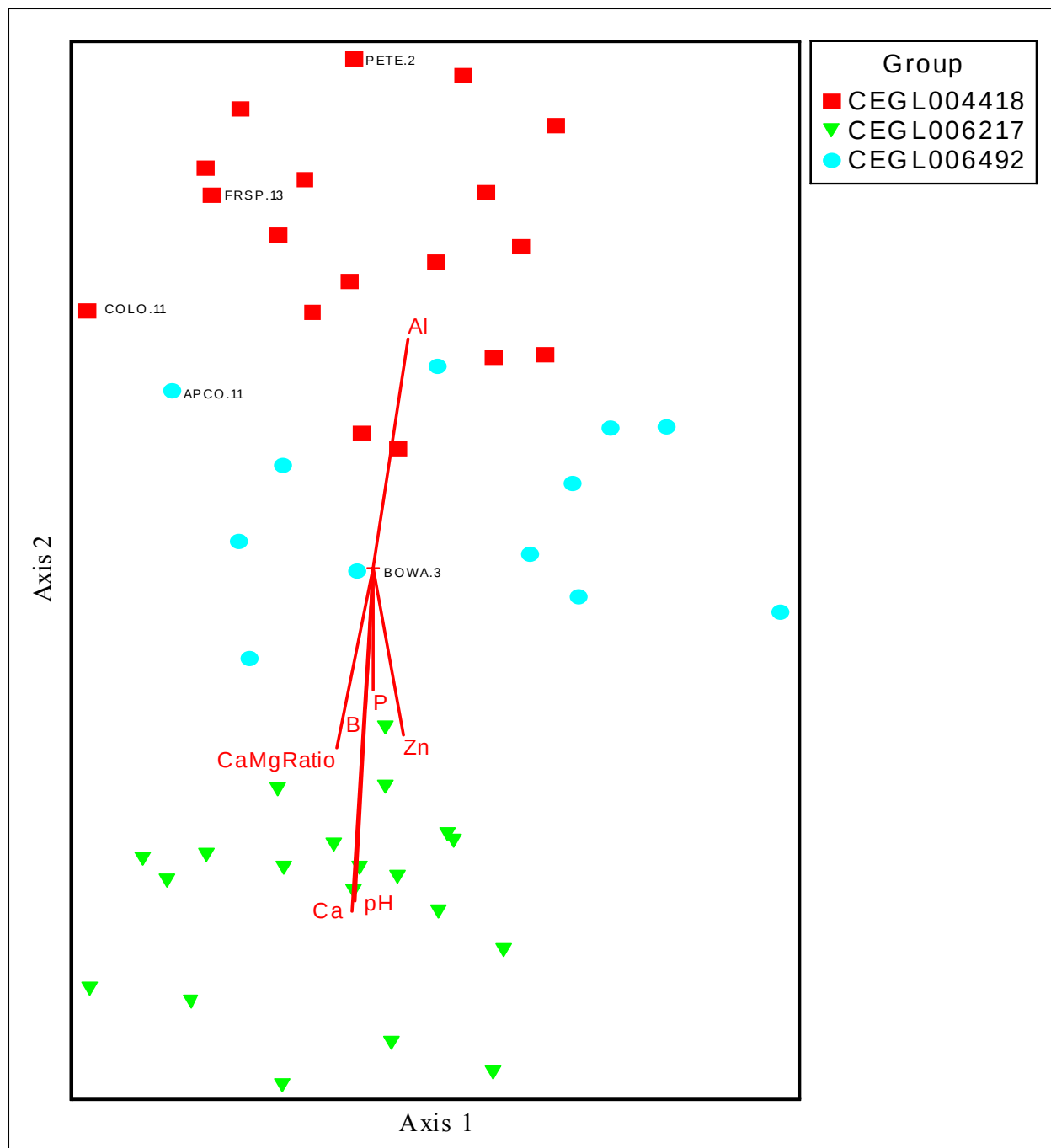


Figure F9. Joint plot showing significant correlations ($r^2=0.20$) of environmental variables with ordination scores for 50 alluvial forest plots on Axis 1 and Axis 2 of the NMDS ordination. The angles and lengths of the radiating lines indicate the direction and strength of the relationship. Environmental 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.

Appendix G. Compositional summary statistics for vegetation associations within Booker T. Washington National Monument derived from the analysis of regional quantitative plot data .

Compositional statistics were calculated to evaluate the adequacy of groups recognized in cluster analysis and, ultimately, to assist in naming and describing vegetation associations. Only associations derived from quantitative analysis of the regional plot data are shown. Total mean cover and total frequency were determined for every taxon across the entire dataset.

Compositional statistics are shown only for prevalent species in each vegetation association. 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 classification and characterization associations are presented as follows:

Acidic Oak - Hickory Forest	Table G1
Inner Piedmont / Lower Blue Ridge Basic Mesic Forest	Table G2
Piedmont / Mountain Alluvial Forest	Table G3

Table G1. Compositional summary statistics from the regional analysis of Acidic Oak - Hickory Forest (CEGL008475).

Mean Species Richness	53
Homogeneity	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 circaezans</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
<i>Polystichum acrostichoides</i>	414	3	2	-	38	11	4	1	2

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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>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 G2. Compositional summary statistics from the regional analysis of Inner Piedmont / Lower Blue Ridge Basic Mesic Forest (CEGL006186).

Mean Species Richness	59									
Homogeneity	0.606									
Number of Plots	31									

Species	Total Freq.	Total Mean Cover	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj. DV (scaled)	Adj DV (unscaled)
<i>Quercus rubra</i>	147	6	6	0	100	21	20	14	20
<i>Parthenocissus quinquefolia</i>	158	3	4	+	100	20	19	8	38
<i>Liriodendron tulipifera</i>	142	6	7	+	91	20	19	14	37
<i>Fraxinus americana</i>	154	6	6	0	91	19	17	11	17
<i>Lindera benzoin</i>	128	5	6	+	88	22	19	13	38
<i>Botrychium virginianum</i>	91	2	2	0	88	31	27	6	27
<i>Polystichum acrostichoides</i>	126	4	5	+	84	21	18	10	36
<i>Cornus florida</i>	110	4	5	+	81	24	19	11	38
<i>Galium circaezans</i>	105	2	2	0	81	25	20	4	20
<i>Maianthemum racemosum</i> ssp. <i>racemosum</i>	113	2	2	0	81	23	19	4	19
<i>Cimicifuga racemosa</i> (= <i>Actaea racemosa</i>)	87	4	4	0	78	29	22	10	22
<i>Toxicodendron radicans</i>	123	2	3	+	78	20	16	5	32
<i>Circaea lutetiana</i> ssp. <i>canadensis</i>	104	3	3	0	78	24	19	6	19
<i>Galium triflorum</i>	84	2	2	0	78	30	23	5	23
<i>Asimina triloba</i>	122	6	6	0	75	20	15	10	15
<i>Cercis canadensis</i> var. <i>canadensis</i>	73	4	5	+	75	33	25	14	49
<i>Arisaema triphyllum</i>	115	3	4	+	75	21	16	7	31
<i>Phryma leptostachya</i>	67	2	2	0	75	36	27	6	27
<i>Sanicula canadensis</i>	87	2	2	0	75	28	21	5	21
<i>Acer rubrum</i>	119	5	5	0	72	19	14	8	14
<i>Smilax rotundifolia</i>	89	2	2	0	72	26	19	4	19
<i>Lonicera japonica</i>	90	3	2	-	72	26	18	4	9
<i>Vitis vulpina</i>	71	2	2	0	69	31	21	5	21
<i>Carya alba</i>	64	4	5	+	66	33	22	12	43
<i>Nyssa sylvatica</i>	67	4	4	0	66	31	21	9	21
<i>Uvularia perfoliata</i>	67	2	3	+	66	31	21	7	41
<i>Dioscorea quaternata</i>	70	2	2	0	66	30	20	4	20
<i>Carya ovalis</i>	45	4	5	+	63	44	28	15	56
<i>Amphicarpaea bracteata</i>	68	4	5	+	63	29	18	10	37
<i>Desmodium nudiflorum</i>	38	2	2	0	63	53	33	7	33
<i>Sanguinaria canadensis</i>	85	2	2	0	63	24	15	3	15
<i>Ulmus rubra</i>	92	4	4	0	59	21	12	5	12
<i>Prunus serotina</i> var. <i>serotina</i>	104	2	2	0	59	18	11	2	11
<i>Quercus alba</i>	90	5	5	0	56	20	11	6	11
<i>Polygonatum biflorum</i>	97	2	2	0	56	19	10	2	10
<i>Viburnum acerifolium</i>	66	2	3	+	53	26	14	5	27
<i>Thalictrum thalictroides</i>	44	2	2	0	47	34	16	4	16
<i>Carex digitalis</i>	54	2	2	0	47	28	13	3	13
<i>Festuca subverticillata</i>	101	2	2	0	47	15	7	2	7
<i>Carpinus caroliniana</i>	78	4	5	+	44	18	8	4	16
<i>Fagus grandifolia</i>	108	6	5	-	44	13	6	3	3
<i>Asplenium platyneuron</i>	52	2	2	0	44	27	12	3	12
<i>Brachyelytrum erectum</i>	57	2	2	0	44	25	11	2	11
<i>Viola sororia</i>	82	2	2	0	44	17	7	2	7
<i>Stellaria pubera</i>	86	2	2	0	44	16	7	2	7
<i>Adiantum pedatum</i>	45	2	4	++	41	29	12	5	47
<i>Celtis occidentalis</i>	54	2	3	+	41	24	10	3	20
<i>Dichanthelium boscii</i>	47	2	2	0	41	28	11	2	11
<i>Viburnum prunifolium</i>	47	2	2	0	41	28	11	2	11
<i>Aristolochia serpentaria</i>	25	1	1	0	41	52	21	2	21

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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>Carya cordiformis</i>	114	5	3	-	38	11	4	1	1
<i>Rubus flagellaris</i>	37	1	2	+	38	32	12	3	24
<i>Collinsonia canadensis</i>	32	2	2	0	38	38	14	3	14
<i>Carex laxiflora</i> var. <i>laxiflora</i>	49	2	2	0	38	24	9	2	9
<i>Sassafras albidum</i>	57	2	2	0	38	21	8	2	8
<i>Agrimonia rostellata</i>	25	1	2	+	34	44	15	3	30
<i>Symphoricarpos orbiculatus</i>	19	2	2	0	34	58	20	4	20
<i>Geranium maculatum</i>	38	2	2	0	34	29	10	2	10
<i>Solidago caesia</i>	54	2	2	0	34	20	7	2	7

Table G3. Compositional summary statistics from the regional analysis of Piedmont / Mountain Alluvial Forest (CEGL006492).

Mean Species Richness	51
Homogeneity	0.567
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>Parthenocissus quinquefolia</i>	899	2	3	+	100	2	2	1	3
<i>Lindera benzoin</i>	456	4	6	++	93	3	3	2	11
<i>Lonicera japonica</i>	516	2	5	+++	93	3	3	1	20
<i>Toxicodendron radicans</i>	747	3	4	+	93	2	2	1	3
<i>Liriodendron tulipifera</i>	753	5	7	++	87	2	1	1	6
<i>Carpinus caroliniana</i>	497	4	6	++	87	3	2	2	9
<i>Microstegium vimineum</i>	255	2	5	+++	80	5	4	2	30
<i>Arisaema triphyllum</i>	405	2	4	++	80	3	2	1	9
<i>Geum canadense</i>	170	2	3	+	80	7	6	2	11
<i>Acer negundo</i>	132	2	6	++++	73	8	6	4	98
<i>Polygonum virginianum</i>	203	2	4	++	73	5	4	2	16
<i>Carya cordiformis</i>	289	3	3	0	73	4	3	1	3
<i>Carex amphibola</i>	88	2	4	++	67	11	8	3	30
<i>Circaea lutetiana</i> ssp. <i>canadensis</i>	247	2	4	++	67	4	3	1	11
<i>Alliaria petiolata</i>	130	2	3	+	67	8	5	2	10
<i>Duchesnea indica</i>	51	1	2	+	67	20	13	3	26
<i>Asimina triloba</i>	519	5	6	+	60	2	1	1	2
<i>Acer rubrum</i>	1090	6	6	0	60	1	0	0	0
<i>Fraxinus pennsylvanica</i>	238	4	5	+	60	4	2	1	5
<i>Verbesina alternifolia</i>	52	1	4	+++	60	17	10	5	83
<i>Carex radiata</i>	146	2	4	++	60	6	4	2	15
<i>Prunus serotina</i> var. <i>serotina</i>	619	2	2	0	60	1	1	0	1
<i>Ulmus americana</i>	238	3	5	++	53	3	2	1	7
<i>Celastrus orbiculatus</i>	111	1	4	+++	53	7	4	2	31
<i>Carex blanda</i>	156	2	3	+	53	5	3	1	5
<i>Impatiens capensis</i>	203	2	2	0	53	4	2	0	2
<i>Boehmeria cylindrica</i>	226	2	2	0	53	4	2	0	2
<i>Viola sororia</i>	252	2	2	0	53	3	2	0	2
<i>Symphyotrichum lateriflorum</i>	308	2	2	0	53	3	1	0	1
<i>Platanus occidentalis</i>	85	2	5	+++	47	8	4	2	31
<i>Juglans nigra</i>	97	2	5	+++	47	7	3	2	27
<i>Polygonum caespitosum</i> var. <i>longisetum</i>	122	2	4	++	47	6	3	1	11
<i>Viburnum prunifolium</i>	361	2	3	+	47	2	1	0	2
<i>Rosa multiflora</i>	99	1	2	+	47	7	3	1	7
<i>Podophyllum peltatum</i>	207	2	2	0	47	3	2	0	2
<i>Polystichum acrostichoides</i>	414	3	2	-	47	2	1	0	0
<i>Smilax rotundifolia</i>	797	3	2	-	47	1	0	0	0
<i>Fagus grandifolia</i>	630	6	4	--	40	1	0	0	0
<i>Claytonia virginica</i>	124	2	3	+	40	5	2	1	4
<i>Amphicarpaea bracteata</i>	261	2	3	+	40	2	1	0	2
<i>Galium aparine</i>	148	2	2	0	40	4	2	0	2
<i>Leersia virginica</i>	201	2	2	0	40	3	1	0	1
<i>Festuca subverticillata</i>	268	2	2	0	40	2	1	0	1
<i>Glechoma hederacea</i>	30	1	3	++	33	17	6	2	22
<i>Berberis thunbergii</i>	51	1	2	+	33	10	3	1	7
<i>Allium vineale</i>	51	1	2	+	33	10	3	1	7
<i>Ranunculus abortivus</i>	106	1	2	+	33	5	2	0	3
<i>Celtis occidentalis</i>	205	2	2	0	33	2	1	0	1
<i>Sanicula canadensis</i>	307	2	2	0	33	2	1	0	1
<i>Rubus flagellaris</i>	329	2	2	0	33	2	1	0	1

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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>Vitis vulpina</i>	384	2	2	0	33	1	0	0	0

Appendix H. Local and global descriptions of vegetation associations and other vegetation-map classes for Booker T. Washington National Monument.

This appendix contains detailed local descriptions for the 10 map classes present at Booker T. Washington National Monument based on information collected within the park boundary. Of the 10 map classes used to map Booker T. Washington National Monument, seven were crosswalked to the finest level of the USNVC (association), one was described as a nonstandard, park-specific vegetation class, and two were crosswalked to Anderson (Anderson et al. 1976) Level II classification.

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 copyright notice precedes the report.

Fields used in the local and global descriptions are defined in Appendix I. Vascular plant species nomenclature within the local and global descriptions follows the nationally standardized list of Kartesz (1999), with very few exceptions. This nomenclature differs from PLANTS 3.5 in only a very few cases, and when this difference occurs, synonymy is indicated parenthetically in the local description information. Nomenclature for nonvascular plants follows Anderson (1990) and Anderson et al. (1990) for mosses, Egan (1987, 1989, 1990, 1991) and Esslinger and Egan (1995) for lichens, and Stotler and Crandall-Stotler (1977) for liverworts/hornworts. English names for associations and alliances use NatureServe Central Ecology-accepted names and may differ slightly from PLANTS 3.5 common names that are used within the local description information and throughout the rest of the report.

Representative photographs of the vegetation types are provided after the descriptions, except for Dense Hardwood Regeneration where an acceptable photograph was not obtained. Photographs were taken by VADNH staff unless otherwise indicated. A bibliography for the sources cited in the global vegetation descriptions from the USNVC is included following the descriptions. Sources cited in the local vegetation descriptions are included in the literature section at the end of this appendix.

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 an *, indicating that the ranking information is not at the association level. State ranks for IVC associations are managed within the Virginia Division of Natural Heritage and the global conservation rank (GRank) and the state/subnational conservation rank (SRank) for all associations are provided in Appendix C. Definitions of the conservation ranks are in Appendix D. Values for the relationship (Rel) and crosswalk confidence (Conf) are defined in Appendix I.

The dichotomous key to the Booker T. Washington National Monument map classes is presented in Appendix J. 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:

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 17 April 2007.

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NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 17 April 2007.

NATURAL / SEMI-NATURAL FORESTS

Acidic Oak - Hickory Forest	130
Inner Piedmont / Lower Blue Ridge Basic Mesic Forest	117
Piedmont / Mountain Alluvial Forest	138
Successional Tuliptree Forest	125
Successional Virginia Pine Forest	110

CULTURAL AND DISTURBED VEGETATION

Cultural Meadow	155
Dense Hardwood Regeneration	149
White Pine Plantation	106

LAND-USE CLASSES (Anderson Level II)

Other Urban or Built-Up Land	150
Transportation, Communications, and Utilities	151

COMMON NAME (PARK-SPECIFIC): WHITE PINE PLANTATION

SYNONYMS

USNVC English Name: Eastern White Pine Planted Forest
USNVC Scientific Name: *Pinus strobus* Planted Forest
USNVC Identifier: CEG007178

LOCAL INFORMATION

Environmental Description: This vegetation was planted in a single upland location in Booker T. Washington National Monument.

Vegetation Description: This stand is dominated by *Pinus strobus* (eastern white pine) with lesser amounts of *Pinus virginiana* (Virginia pine). There is no understory or herbaceous vegetation, and the ground is covered with pine needles.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Pinus strobus</i> (eastern white pine)

Characteristic Species: *Pinus strobus* (eastern white pine).

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: This vegetation occurs in a single 0.6-ha stand in the northern section of the park.

Classification Comments: This association is distinguished from Successional Virginia Pine Forest by the predominance of *Pinus strobus* (eastern white pine) in the canopy with little to no vegetation in the understory or herbaceous layers.

Other Comments: Information not available.

Local Description Authors: K. D. Patterson.

Plots: None.

Booker T. Washington National Monument 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 strobus</i> Planted Forest Alliance (A.98)
Alliance (English name)	Eastern White Pine Planted Forest Alliance
Association	<i>Pinus strobus</i> Planted Forest
Association (English name)	Eastern White Pine Planted Forest
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This white pine plantation type is found throughout the northeastern and midwestern United States and adjacent Canada. Stands contain plantations of *Pinus strobus* (eastern white pine) that are maintained for the extraction of forest products. Some have been planted as reclamation projects (e.g., following strip-mining). At maturity, the tree canopy is usually dense and contains a monospecific layer of *Pinus strobus* (eastern white pine). *Pinus resinosa* (red pine) is occasionally present in small amounts. In older stands or gaps, regenerating trees may include *Fagus grandifolia* (American beech), *Acer saccharum* (sugar maple), *Acer rubrum* (red maple), and *Prunus serotina* (black cherry); *Robinia pseudoacacia* and *Betula lenta* are occasionally present. *Acer pensylvanicum* (striped maple) and *Ostrya virginiana* (hophornbeam) are common small trees. The shrub layer is typically sparse and mostly consists of smaller individuals of the tree species. The field layer varies from sparse to absent; it may be locally well-developed in small openings, with variable composition. In some stands, mosses may be abundant. Susceptibility to a variety of pests or diseases, including white pine blister rust (*Cronartium ribicola*) and southern pine beetle (*Dendroctonus frontalis*), has had some impact on its commercial use.

Environmental Description: Stands contain plantations of *Pinus strobus* (eastern white pine) that are maintained for the extraction of forest products. The type does well on a variety of soils. Some have been planted on strip-mine reclamation sites.

Vegetation Description: The tree canopy at maturity is usually dense and contains a monospecific layer of *Pinus strobus* (eastern white pine). *Pinus resinosa* (red pine) is occasionally present in small amounts. In older stands or gaps, regenerating trees may include *Fagus grandifolia* (American beech), *Acer saccharum* (sugar maple), *Acer rubrum* (red maple), and *Prunus serotina* (black cherry); *Robinia pseudoacacia* (black locust) and *Betula lenta* (sweet birch) are occasionally present. *Acer pensylvanicum* (striped maple) and *Ostrya virginiana* (hophornbeam) are common small trees. The shrub layer is typically sparse and mostly consists of smaller individuals of the tree species. The field layer varies from sparse to absent; it may be locally well-developed in small openings, with variable composition. In some stands, mosses may be abundant.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Pinus strobus</i> (eastern white pine)

Characteristic Species: *Pinus strobus* (eastern white pine).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This white pine plantation type is found throughout the northeastern and midwestern United States and adjacent Canada.

States/Provinces: GA, KY, MD, NC, NH, NY, PA, SC, TN, VA, VT, WV.

Federal Lands: DOD (Camp Dawson); NPS (Blue Ridge Parkway, Booker T. Washington, Chickamauga-Chattanooga, Marsh-Billings-Rockefeller, New River Gorge, Valley Forge); USFS (Chattahoochee, Chattahoochee (Southern Blue Ridge), Cherokee, Daniel Boone, George Washington, Jefferson, Nantahala, Pisgah, Sumter, Sumter (Mountains)); USFWS (Chesapeake Marshlands).

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: There was a lot of planting of white pine from the 1930s into the 1950s, but there has been very little planting since then (P. Manion pers. comm. 2001). On the Daniel Boone National Forest of Kentucky, *Pinus strobus* (eastern white pine) plantings are of limited extent and are related to wildlife plantings. In the southern part of this type's range, there has been some damage from southern pine beetle (*Dendroctonus frontalis*). These plantations have been observed in the Peters Mountain area (James River Ranger District) and various other sites in the George Washington and Jefferson national forests.

Similar Associations:

- *Pinus* spp. Planted Forest (CEGL006313).
- *Pinus strobus* Successional Forest (CEGL007944).

Related Concepts:

- IF3b. Plantation (Hardwood or Conifer) (Allard 1990) B
- Unclassified Clearcut Regeneration (Fleming and Moorhead 2000) ?

SOURCES

Description Authors: D. Faber-Langendoen, mod. S. C. Gawler.

References: Allard 1990, Fleming and Coulling 2001, Fleming and Moorhead 2000, Reschke 1990, Southeastern Ecology Working Group n.d., TDNH unpubl. data, Vanderhorst 2001a, Vanderhorst 2001b, Vanderhorst 2007.



Figure H1. White Pine Plantation at Booker T. Washington National Monument. August 2007.
NAD 1983 / UTM easting 612567, northing 4108768.

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 Booker T. Washington National Monument 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. *Pinus virginiana* (Virginia pine) makes up 25–85% of the canopy cover, occurring with mixtures of successional hardwood species. Deciduous species can comprise up to 75% of the canopy composition and can be almost any species from the surrounding forests, but typical species are *Liriodendron tulipifera* (tuliptree), *Acer rubrum* (red maple), *Quercus alba* (white oak), and *Quercus falcata* (southern red oak). Other common associates in the canopy and subcanopy include *Cornus florida* (flowering dogwood), *Oxydendrum arboreum* (sourwood), and *Prunus serotina* var. *serotina* (black cherry). In older stands, the *Pinus virginiana* (Virginia pine) are mostly dead or dying and there are fallen trees and standing dead stems. Woody shrubs and vines can have high cover and often include *Parthenocissus quinquefolia* (Virginia creeper), *Lonicera japonica* (Japanese honeysuckle), *Vaccinium stamineum* (deerberry), and *Vaccinium pallidum* (Blue Ridge blueberry). Pine litter covers the ground, and herbs are sparse to absent, although in many stands the clubmoss *Lycopodium digitatum* (fan clubmoss) can cover large areas and be locally dominant.

The structure of Successional Virginia Pine Forest varies greatly within Booker T. Washington National Monument depending mostly on stand age. Typically this association occurs with decadent *Pinus virginiana* (Virginia pine) forming a patchy, emergent canopy over dense hardwood regeneration. It can also occur as a tall, pure evergreen forest with no understory or herb layer or as windrows dominated by *Pinus virginiana* (Virginia pine) in agricultural fields.

Most Abundant Species:

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

Characteristic Species: *Lonicera japonica* (Japanese honeysuckle), *Lycopodium digitatum* (fan clubmoss), *Pinus virginiana* (Virginia pine).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Ailanthus altissima</i> (tree of heaven)	-	plant	nonnative
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	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	SNA	.	.	[not crosswalked]	.

Local Range: Successional Virginia Pine Forest is common in Booker T. Washington National Monument and is mapped as 12 stands (15 polygons) occurring throughout the park, ranging in size from 0.2 to 15 ha.

Classification Comments: Even though this association is placed within an Evergreen Forest Class of the USNVC, stands in Booker T. Washington National Monument can have up to a 75% deciduous canopy. Stands transitional to Successional Tuliptree Forest, with a mixed to mostly deciduous photo-signature, are included in this map class but are tagged as “transitional” in the attribute table. If left undisturbed, stands mapped as Successional Virginia Pine will eventually succeed to Successional Tuliptree Forest.

Other Comments: Some stands of Successional Virginia Pine Forest could be confused with the map class Successional Tuliptree Forest. Successional Virginia Pine Forest can be distinguished by having a canopy comprised of 25–100% *Pinus virginiana* (Virginia pine).

Local Description Authors: K. D. Patterson.

Plots: None.

Booker T. Washington National Monument 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* (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* (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. (rhododendron).

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> (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),

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Vine/Liana	<i>Sassafras albidum</i> (sassafras) <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 (Appomattox Court House, Big South Fork, Blue Ridge Parkway?, Booker T. Washington, 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, CEG007119 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 1990a) B

SOURCES

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

References: Allard 1990, Ambrose 1990a, 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 1998, Vanderhorst 2001b, Vanderhorst 2007.



Figure H2. Successional Virginia Pine Forest at Booker T. Washington National Monument. August 2007. NAD 1983 / UTM easting 612741, northing 4108178.

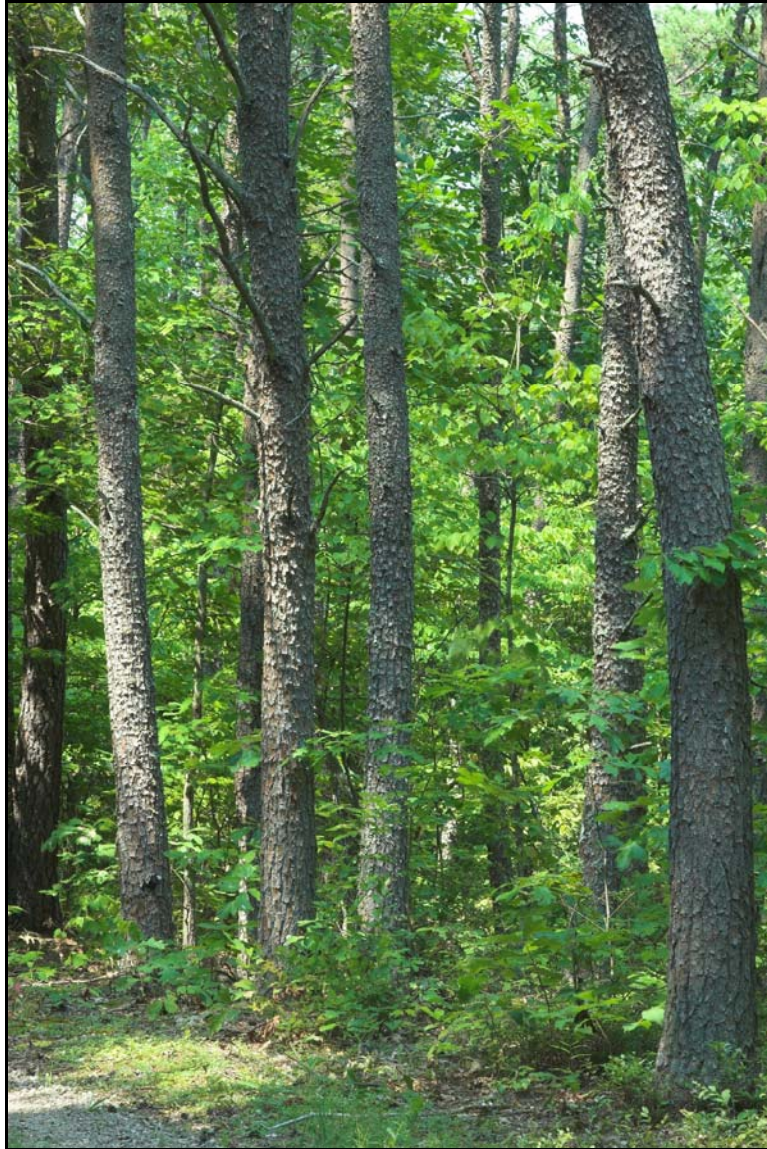


Figure H3. Successional Virginia Pine Forest at Booker T. Washington National Monument. August 2007. NAD 1983 / UTM easting 612689, northing 4107971.

COMMON NAME (PARK-SPECIFIC): **INNER PIEDMONT / LOWER BLUE RIDGE
BASIC MESIC FOREST**

SYNONYMS

USNVC English Name: **Tuliptree - Northern Red Oak - White Ash / Common Pawpaw
/ Black Cohosh / Perfoliate Bellwort Forest**

USNVC Scientific Name: ***Liriodendron tulipifera* - *Quercus rubra* - *Fraxinus americana* /
Asimina triloba / *Actaea racemosa* - *Uvularia perfoliata* Forest**

USNVC Identifier: **CEGL006186**

LOCAL INFORMATION

Environmental Description: Inner Piedmont / Lower Blue Ridge Basic Mesic Forest occurs on lower, gentle to moderately steep, east- and north-facing slopes, at elevations ranging from 260–290 m (860–940 ft). These forests are found on low slopes and ravines over rocky soils weathered from ultramafic rock; thus, the soils have high fertility. Soil samples collected in these sites have pH values greater than 6.0 and total base saturation greater than 90%.

Vegetation Description: Inner Piedmont / Lower Blue Ridge Basic Mesic Forest is a deciduous forest with a tall (>35 m) canopy dominated by *Liriodendron tulipifera* (tuliptree), with *Acer rubrum* (red maple), *Fraxinus americana* (white ash), and *Quercus rubra* (northern red oak). Other characteristic canopy associates include *Carya cordiformis* (bitternut hickory), *Carya ovalis* (red hickory), *Magnolia acuminata* (cucumber-tree), and *Quercus alba* (white oak). Dominant species in the moderately dense (10–50% cover) shrub layer include *Asimina triloba* (pawpaw), *Carpinus caroliniana* (American hornbeam), and *Lindera benzoin* (northern spicebush). Other characteristic shrub associates include *Celtis occidentalis* (common hackberry), *Cercis canadensis* var. *canadensis* (eastern redbud), *Cornus florida* (flowering dogwood), *Euonymus americanus* (strawberry bush), and *Parthenocissus quinquefolia* (Virginia creeper). The herb layer is lush and diverse with coarse forbs and ferns dominating. Species that occur as patch-dominants include *Adiantum pedatum* (northern maidenhair), *Arisaema triphyllum* (Jack in the pulpit), and *Deparia acrostichoides* (silver false spleenwort). Other characteristic herbs include *Aristolochia serpentaria* (Virginia snakeroot), *Asarum canadense* (Canadian wildginger), *Botrychium virginianum* (rattlesnake fern), *Carex amphibola* (eastern narrowleaf sedge), *Carex laxiculmis* var. *laxiculmis* (spreading sedge), *Actaea racemosa* (= *Cimicifuga racemosa*) (black bugbane), *Desmodium nudiflorum* (nakedflower ticktrefoil), *Dichanthelium boscii* (Bosc's panicgrass), *Elymus hystrix* var. *hystrix* (eastern bottlebrush grass), *Galearis spectabilis* (showy orchid), *Galium circaezans* (licorice bedstraw), *Galium triflorum* (fragrant bedstraw), *Passiflora lutea* (yellow passionflower), *Phryma leptostachya* (American lopseed), *Polystichum acrostichoides* (Christmas fern), *Sanguinaria canadensis* (bloodroot), *Uvularia perfoliata* (perfoliate bellwort), and *Uvularia sessilifolia* (sessileleaf bellwort). Disturbed stands of this forest will have less tree and herbaceous diversity and more cover by exotic and weedy species such as *Ailanthus altissima* (tree of heaven), *Lonicera japonica* (Japanese honeysuckle), and *Microstegium vimineum* (Nepalese browntop).

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 rubra</i> (northern red oak)
Tree subcanopy	Broad-leaved deciduous tree	<i>Magnolia acuminata</i> (cucumber-tree)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Asimina triloba</i> (pawpaw), <i>Lindera benzoin</i> (northern spicebush)
Herb (field)	Forb	<i>Arisaema triphyllum</i> (Jack in the pulpit)
Herb (field)	Fern or fern ally	<i>Adiantum pedatum</i> (northern maidenhair), <i>Deparia acrostichoides</i> (silver false spleenwort)

Characteristic Species: *Asimina triloba* (pawpaw), *Lindera benzoin* (northern spicebush), *Liriodendron tulipifera* (tuliptree), *Magnolia acuminata* (cucumber-tree), *Quercus rubra* (northern red oak).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Adelges tsugae</i> (hemlock woolly adelgid)	-	animal	exotic forest pathogen
<i>Ailanthus altissima</i> (tree of heaven)	-	plant	invasive nonnative
<i>Carya cordiformis</i> (bitternut hickory)	-	plant	county record
<i>Euonymus atropurpureus</i> (eastern wahoo)	-	plant	county record
<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	Basic Mesic Forest	Fleming et al. 2006

Local Range: Inner Piedmont / Lower Blue Ridge Basic Mesic Forest occurs along the southwestern and western boundary of the park, on the slopes over Gill's Creek. It is mapped as two polygons that extend beyond the park boundary, with about 3.5 ha within the park.

Classification Comments: One highly disturbed example of this community is included in this map class and is tagged as "disturbed" in the attribute table. This community can be distinguished from Successional Tuliptree Forest by the presence of species indicative of high soil fertility such as *Adiantum pedatum* (northern maidenhair), *Asarum canadense* (Canadian wildginger), *Asimina triloba* (pawpaw), *Carya cordiformis* (bitternut hickory), *Deparia acrostichoides* (silver false spleenwort), *Fraxinus americana* (white ash), and *Sanguinaria canadensis* (bloodroot). Inner Piedmont / Lower Blue Ridge Basic Mesic Forests in Booker T. Washington National Monument share many species in common with Basic Oak - Hickory Forest, but it is distinguished by its association with more mesic sites and the greater importance of nutrient-demanding, mesophytic species such as *Adiantum pedatum* (northern maidenhair), *Asarum canadense* (Canadian wildginger), *Actaea racemosa* (= *Cimicifuga racemosa*) (black bugbane), *Deparia acrostichoides* (silver false spleenwort), *Euonymus atropurpureus* (eastern wahoo), and *Galearis spectabilis* (showy orchid).

Other Comments: The polygon mapped along the western boundary of the park is highly disturbed. While the stand in the southwestern portion of the park is more mature and has a more intact herbaceous layer, invasive nonnative plants were noted in both stands.

Local Description Authors: K. D. Patterson.

Plots: BOWA.4, BOWA.5.

Booker T. Washington National Monument 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 rubra</i> - <i>Fraxinus americana</i> / <i>Asimina triloba</i> / <i>Actaea racemosa</i> - <i>Uvularia perfoliata</i> Forest
Association (English name)	Tuliptree - Northern Red Oak - White Ash / Common Pawpaw / Black Cohosh / Perfoliate Bellwort Forest
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This community is a mesic rich forest occurring in the Piedmont and lower-elevation Appalachians of Virginia and Maryland and possibly extending into adjacent West Virginia, Pennsylvania, and Delaware. These forests are dominated by *Liriodendron tulipifera* (tuliptree), occurring with or codominating with *Quercus rubra* (northern red oak) or *Fraxinus americana* (white ash). This community type occupies fertile, well-drained soils of mesic lower slopes and ravines, often in areas underlain by metabasalt of the Catoclin Formation but also on a variety of igneous metamorphic and metasedimentary rocks. Occasionally, stands occur on well-weathered boulder “streams” that have been deposited in low-elevation ravine bottoms and slope concavities. Other species possible in the overstory include *Quercus alba* (white oak), *Quercus prinus* (chestnut oak), *Carya ovalis* (red hickory), *Carya alba* (mockernut hickory), *Carya cordiformis* (bitternut hickory), *Ulmus rubra* (slippery elm), *Nyssa sylvatica* (blackgum), *Fagus grandifolia* (American beech), and *Juglans nigra* (black walnut). Subcanopy tree layers contain representatives of the overstory species and *Acer rubrum* (red maple). The lowest tree and shrub layers usually contain small to large colonies of *Asimina triloba* (pawpaw) and *Lindera benzoin* (northern spicebush), along with *Cercis canadensis* (eastern redbud) and *Cornus florida* (flowering dogwood). The herb layer is usually lush and dense, except where boulder streams prevail or deer grazing is severe. Patch-dominance of ferns and leafy forbs is characteristic; species achieving local abundance in the type include *Adiantum pedatum* (northern maidenhair), *Amphicarpaea bracteata* (American hogpeanut), *Arisaema triphyllum* (Jack in the pulpit), *Asarum canadense* (Canadian wildginger), *Actaea racemosa* (black bugbane), *Deparia acrostichoides* (silver false spleenwort), *Phegopteris hexagonoptera* (broad beechfern), *Polystichum acrostichoides* (Christmas fern), and *Uvularia perfoliata* (perfoliate bellwort). Other constant or characteristic herbaceous species include *Botrychium virginianum* (rattlesnake fern), *Carex laxiflora* var. *laxiflora* (broad looseflower sedge), *Circaea lutetiana* ssp. *canadensis* (broadleaf enchanter’s nightshade), *Collinsonia canadensis* (richweed), *Cypripedium parviflorum* var. *pubescens* (greater yellow lady’s slipper), *Desmodium nudiflorum* (nakedflower ticktrefoil), *Galearis spectabilis* (showy orchid), *Galium circaezans* (licorice bedstraw), *Galium triflorum* (fragrant bedstraw), *Hepatica nobilis* var. *obtusata* (roundlobe hepatica), *Maianthemum racemosum* ssp. *racemosum* (feathery false lily of the valley), *Phryma leptostachya* (American lopseed), *Podophyllum peltatum* (mayapple), *Sanguinaria canadensis* (bloodroot), *Sanicula*

canadensis (Canadian blacksnakeroot), and *Stellaria pubera* (star chickweed). This association is distinguished from more montane rich cove forests by its lower-elevation habitats, shrub layer dominance by *Asimina triloba* (pawpaw) (a low-elevation species in the mid-Atlantic region), and the absence or unimportance of many common species of montane cove forests, e.g., *Acer saccharum* (sugar maple), *Tilia americana* (American basswood), *Caulophyllum thalictroides* (blue cohosh), *Laportea canadensis* (Canadian woodnettle), *Osmorhiza claytonii* (Clayton's sweetroot), *Impatiens pallida* (pale touch-me-not), and *Trillium grandiflorum* (snow trillium).

Environmental Description: This community type occupies fertile, well-drained soils of mesic lower slopes and ravines. It is most extensive in areas underlain by metabasalt of the Catoclin Formation but also occurs on a variety of igneous metamorphic and metasedimentary rocks. Slopes vary from moderate to steep (range = 7 to 30 degrees) and are typically straight or concave. The surface substrate usually has less than 10% exposed boulder and stone cover, and more than 90% cover of leaf litter and other humic material. However, a small number of stands occur on well-weathered boulder "streams" that have been deposited in low-elevation ravine bottoms and slope concavities. Soils are deep, dark loams or sandy loams of colluvial origin. Soil samples collected from representative stands were moderately acidic (mean pH is about 5.5 to 5.9), with moderately high Ca and high Mg, Mn, K, Cu, B, and total base saturation.

Vegetation Description: The typical stand structure of this community type consists of a tall, closed overstory, with very open understory tree layers, and a variably dense shrub layer. The overstory of most stands is dominated by tall, straight *Liriodendron tulipifera* (tuliptree) often exceeding 35 m in height. *Fraxinus americana* (white ash) and *Quercus rubra* (northern red oak) are the most frequent overstory associates and often codominate. Less frequent overstory associates include *Quercus alba* (white oak), *Quercus prinus* (chestnut oak), *Carya ovalis* (red hickory), *Carya alba* (mockernut hickory), *Carya cordiformis* (bitternut hickory), *Ulmus rubra* (slippery elm), *Nyssa sylvatica* (blackgum), *Fagus grandifolia* (American beech), and *Juglans nigra* (black walnut). Subcanopy tree layers contain representatives of the overstory species and *Acer rubrum* (red maple). The lowest tree and shrub layers usually contain small to large colonies of *Asimina triloba* (pawpaw) and *Lindera benzoin* (northern spicebush), along with *Cercis canadensis* (eastern redbud) and *Cornus florida* (flowering dogwood). More locally important small trees and shrubs include *Carpinus caroliniana* (American hornbeam) and *Hamamelis virginiana* (American witchhazel). High-climbing vines of *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), and *Vitis* spp. (grapes) are common. The herb layer is usually lush and dense, except where boulder streams prevail or deer grazing is severe. Patch-dominance of ferns and leafy forbs is characteristic; species achieving local abundance in the type include *Adiantum pedatum* (northern maidenhair), *Amphicarpaea bracteata* (American hogpeanut), *Arisaema triphyllum* (Jack in the pulpit), *Asarum canadense* (Canadian wildginger), *Actaea racemosa* (black bugbane), *Deparia acrostichoides* (silver false spleenwort), *Phegopteris hexagonoptera* (broad beechfern), *Polystichum acrostichoides* (Christmas fern), and *Uvularia perfoliata* (perfoliate bellwort). The most constant, low-cover herbs in 22 Virginia and Maryland plots of the type are *Botrychium virginianum* (rattlesnake fern), *Circaea lutetiana* ssp. *canadensis* (broadleaf enchanter's nightshade), *Desmodium nudiflorum* (nakedflower ticktrefoil), *Galium circaezans* (licorice bedstraw), *Galium triflorum* (fragrant bedstraw), *Maianthemum racemosum* ssp. *racemosum* (feathery false lily of the valley), *Phryma leptostachya* (American lopseed), *Sanguinaria canadensis* (bloodroot), and *Sanicula canadensis* (Canadian blacksnakeroot). Additional characteristic herbs include *Carex laxiflora* var. *laxiflora* (broad looseflower sedge),

Collinsonia canadensis (richweed), *Cypripedium parviflorum* var. *pubescens* (greater yellow lady's slipper), *Galearis spectabilis* (showy orchid), *Hepatica nobilis* var. *obtusa* (roundlobe hepatica), *Podophyllum peltatum* (mayapple), and *Stellaria pubera* (star chickweed).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Fraxinus americana</i> (white ash), <i>Liriodendron tulipifera</i> (tuliptree), <i>Quercus rubra</i> (northern red oak)
Tree subcanopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Asimina triloba</i> (pawpaw), <i>Lindera benzoin</i> (northern spicebush)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Lindera benzoin</i> (northern spicebush)
Herb (field)	Vine/Liana	<i>Parthenocissus quinquefolia</i> (Virginia creeper), <i>Toxicodendron radicans</i> (eastern poison ivy)
Herb (field)	Fern or fern ally	<i>Botrychium virginianum</i> (rattlesnake fern)

Characteristic Species: *Actaea racemosa* (black bugbane), *Asimina triloba* (pawpaw), *Lindera benzoin* (northern spicebush), *Liriodendron tulipifera* (tuliptree).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This vegetation type is scattered in small to large patches throughout the lower Blue Ridge and northern and western Piedmont of Virginia, and much of the Maryland Piedmont and Blue Ridge. It may also occur in eastern West Virginia, Pennsylvania, and the Piedmont portion of Delaware.

States/Provinces: DE?, MD, PA, VA, WV?

Federal Lands: NPS (Appomattox Court House, Blue Ridge Parkway, Booker T. Washington, C&O Canal, Catoctin Mountain, George Washington Parkway, Gettysburg, Harpers Ferry, Manassas, Prince William, Rock Creek?).

CONSERVATION STATUS

Rank: G4? (24-Jan-2005).

Reasons: While not a naturally rare type, this community has a restricted geographic distribution, mature examples are uncommon, and all stands are vulnerable to logging and degradation by introduced invasive weeds. Many examples are poorly buffered because of upslope land-use change, timber removal, or conversion of upslope forests to managed forest types.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 – Moderate.

Comments: This description is based on analysis of 32 plots from Virginia and Maryland. This association is distinguished from more montane rich cove forests by its lower-elevation habitats, shrub-layer dominance by *Asimina triloba* (pawpaw) (a low-elevation species in the mid-Atlantic region), and the absence or unimportance of many common species of montane cove forests, e.g., *Acer saccharum* (sugar maple), *Tilia americana* (American basswood), *Caulophyllum thalictroides* (blue cohosh), *Laportea canadensis* (Canadian woodnettle), *Osmorhiza claytonii* (Clayton's sweetroot), *Impatiens pallida* (pale touch-me-not), and *Trillium grandiflorum* (snow trillium).

Similar Associations:

- *Fagus grandifolia* - *Liriodendron tulipifera* - *Carya cordiformis* / *Lindera benzoin* / *Podophyllum peltatum* Forest (CEGL006055)--is associated with fertile ravines of the outer Piedmont and Inner Coastal Plain in Maryland and Virginia. It differs from CEGL006186 in having *Fagus grandifolia* and *Carya cordiformis* as major overstory components, as well as a number of more coastal-ranging species such as *Ilex opaca* var. *opaca*.
- *Liriodendron tulipifera* - *Aesculus flava* - (*Fraxinus americana*, *Tilia americana*) / *Actaea racemosa* - *Laportea canadensis* Forest (CEGL007710)--occurs at higher elevations in more montane landscapes and contains many species more characteristic of the Appalachians; it lacks several low-elevation species (e.g., *Asimina triloba*, *Cercis canadensis*) that are characteristic of CEGL006186.

Related Concepts:

- *Liriodendron tulipifera* - *Quercus rubra* / *Asimina triloba* / *Arisaema triphyllum* - *Cimicifuga racemosa* Forest (Fleming 2002b) =
- Yellow-Poplar - White Oak - Northern Red Oak: 59 (Eyre 1980) B
- Yellow-Poplar: 57 (Eyre 1980) B

SOURCES

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

References: Busing 1995, Davis 1993, Eastern Ecology Working Group n.d., Eyre 1980, Fleming 2002b, Fleming et al. 2004, Orwig and Abrams 1994, Townsend 2006, VDNH 2003.



Figure H4. Inner Piedmont / Lower Blue Ridge Basic Mesic Forest (plot BOWA.4) at Booker T. Washington National Monument. May 2002. NAD 1983 / UTM easting 612386, northing 4107750.



Figure H5. Inner Piedmont / Lower Blue Ridge Basic Mesic Forest (plot BOWA.5) at Booker T. Washington National Monument. May 2002. NAD 1983 / UTM easting 612391, northing 4107626.

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: CEG007221

LOCAL INFORMATION

Environmental Description: Successional Tuliptree Forest is an upland deciduous forest that develops on areas that were once clearcut, utilized as fields, or cleared by fire or other natural disturbances. It occurs on lower slopes and in draws, on all aspects and elevations in Booker T. Washington National Monument. Soils are often eroded with little to no organic matter or A horizon development.

Vegetation Description: This deciduous forest has a canopy dominated by even-aged *Liriodendron tulipifera* (tuliptree), sometimes occurring with other early successional trees such as *Acer rubrum* (red maple), *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Prunus serotina* (black cherry), and *Pinus virginiana* (Virginia pine). Other deciduous trees, including *Quercus alba* (white oak), *Quercus falcata* (southern red oak), *Quercus velutina* (black oak), and *Carya alba* (mockernut hickory), may be in the canopy, but these species do not dominate. Stands that were former pastures may have open-grown *Quercus* spp. (oak species) in the canopy, formerly pasture shade trees that remained as the successional hardwood species filled in around them. Successional Virginia Pine forest is often the precursor of this association, thus standing dead or fallen *Pinus virginiana* (Virginia pine) is often present. If a distinct subcanopy has developed, typical trees include *Cornus florida* (flowering dogwood), *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), and *Oxydendrum arboreum* (sourwood). Shrubs are mostly *Smilax* spp. (greenbriers) vines, *Parthenocissus quinquefolia* (Virginia creeper), *Lonicera japonica* (Japanese honeysuckle), *Symphoricarpos orbiculatus* (coralberry), and sometimes *Lindera benzoin* (northern spicebush). 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. Typical species include *Botrychium virginianum* (rattlesnake fern), *Carex* spp. (sedges), *Desmodium* spp. (ticktrefoil species), *Galium aparine* (stickywilly), *Lonicera japonica* (Japanese honeysuckle), *Lycopodium digitatum* (fan clubmoss), *Microstegium vimineum* (Nepalese browntop), *Polystichum acrostichoides* (Christmas fern), *Symphoricarpos orbiculatus* (coralberry), and *Viola* spp. (violet species).

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>Liriodendron tulipifera</i> (tuliptree)

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

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 Forest occurs throughout Booker T. Washington National Monument. It is mapped as five polygons that extend beyond the park boundary, ranging in size from 0.6 to 1.6 ha, covering a total of 6.2 ha in the park.

Classification Comments: Former Successional Virginia Pine stands that have developed greater than 75% deciduous canopy are included in this map class and may have scattered *Pinus virginiana* (Virginia pine) in the canopy. Successional Tuliptree Forest is distinguished from other upland deciduous forests in Booker T. Washington National Monument by having a canopy dominated or codominated by *Liriodendron tulipifera* (tuliptree) and species-poor shrub and herb strata composed of primarily weedy and exotic species. Hardwood inclusions within decadent Successional Virginia Pine Forests may be mistaken for this association.

Other Comments: Depending on soil chemistry and other site characteristics, this community, if left undisturbed, will succeed to one of the later successional upland hardwood forests occurring in the area; Acidic Oak - Hickory Forest or Inner Piedmont / Lower Blue Ridge Basic Mesic Forest.

Local Description Authors: K. D. Patterson.

Plots: None.

Booker T. Washington National Monument 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. (oak species), 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 circaezans* (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 (Appomattox Court House, 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, Petersburg, Richmond, 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 H6. Successional Tuliptree Forest at Booker T. Washington National Monument. August 2007. NAD 1983 / UTM easting 612810, northing 4108284.

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 occurs on middle to lower, gentle to moderately steep, south-facing slopes, at elevations ranging from 260–300 m (860–1,000 ft). These forests are found on rolling uplands over very deep, well-drained soils mapped as Clifford fine, sandy loam (NRCS 2006). Given the past land use in Booker T. Washington National Monument, these forests often have highly eroded, rocky soils and lack the herbaceous diversity of similar forests on less disturbed landscapes. Soils collected in stands of this community have low pH values (4.2–4.9) and low percentage base saturation (9–35%), properties associated with low soil fertility.

Vegetation Description: Acidic Oak - Hickory Forests are deciduous forests with a well-developed canopy and subcanopy, a moderately dense tall-shrub stratum, with sparse herbs and low shrubs. Overstory composition may vary but is dominated by mixtures of oaks and hickories. The least disturbed stands of this association are dominated by large oaks and hickories. Younger portions of this forest may have codominance by *Liriodendron tulipifera* (tuliptree). *Quercus alba* (white oak) is the most typical canopy dominant, although *Quercus coccinea* (scarlet oak) and *Quercus falcata* (southern red oak) sometimes dominate stands. Other oaks found in this community include *Quercus rubra* (northern red oak), *Quercus velutina* (black oak), and on drier sites, *Quercus prinus* (chestnut oak) and *Quercus stellata* (post oak). Hickory species (*Carya alba* (mockernut hickory), *Carya glabra* (pignut hickory), *Carya ovalis* (red hickory)) can be found in the canopy and subcanopy. Species often occurring as small trees and tall shrubs include *Carpinus caroliniana* (American hornbeam), *Cornus florida* (flowering dogwood), *Nyssa sylvatica* (blackgum), and *Oxydendrum arboreum* (sourwood). Low shrubs and herbs are sparse to absent with patches of heath species like *Gaylussacia baccata* (black huckleberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Vaccinium stamineum* (deerberry) and woody seedlings common. No herbaceous species are constant, but the herb stratum typically consists of a mix of graminoid species like *Carex albicans* var. *australis* (stellate sedge), *Dichanthelium boscii* (Bosc's panicgrass), *Dichanthelium commutatum* (variable panicgrass), and *Piptochaetium avenaceum* (blackseed speargrass); forbs, including *Chimaphila maculata* (striped prince's pine), *Galium circaezans* (licorice bedstraw), *Maianthemum racemosum* ssp. *racemosum* (feathery false lily of the valley), *Potentilla canadensis* (dwarf cinquefoil), *Desmodium nudiflorum* (nakedflower ticktrefoil), *Polygonatum biflorum* (smooth Solomon's seal), *Solidago bicolor* (white goldenrod), *Viola hastata* (halberdleaf yellow violet), and ferns such as *Polystichum acrostichoides* (Christmas fern).

Stands with a history of disturbance may have successional species such as *Acer rubrum* (red maple), *Liriodendron tulipifera* (tuliptree), *Pinus strobus* (eastern white pine), and *Pinus virginiana* (Virginia pine) with high cover in the canopy and subcanopy and little to no *Carya* spp. (hickories) present. Disturbed stands also will have nonnative or weedy species present such as *Arctium minus* (lesser burdock), *Lobelia inflata* (Indian-tobacco), *Lycopodium digitatum* (fan clubmoss), *Microstegium vimineum* (Nepalese browntop), and *Symphoricarpos orbiculatus* (coralberry).

Portions of this forest occurring on lower slopes or near outcroppings of dark colored, ultramafic rocks may be compositionally transitional to Inner Piedmont / Lower Blue Ridge Basic Mesic Forest and have some species more typical of soils with high fertility such as *Asimina triloba* (pawpaw), *Cercis canadensis* var. *canadensis* (eastern redbud), *Lindera benzoin* (northern spicebush), and *Sanguinaria canadensis* (bloodroot).

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), <i>Quercus falcata</i> (southern red oak)

Characteristic Species: *Oxydendrum arboreum* (sourwood), *Quercus alba* (white oak), *Vaccinium pallidum* (Blue Ridge blueberry).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Acer saccharum</i> var. <i>saccharum</i> (sugar maple)	-	plant	rare in park
<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 11 polygons, ranging in size from 0.3 to 5.5 ha.

Classification Comments: Acidic Oak - Hickory Forest can be distinguished by canopy dominance of oaks and hickories. Some areas may be transitional to Inner Piedmont / Lower Blue Ridge Basic Mesic Forest, especially on lower slopes.

Other Comments: Evidence of deer browsing was noted in stands of this community and may be a cause of the low herbaceous diversity relative to typical stands of this forest. Some polygons of this association may have below minimum mapping unit inclusions of Cultural Meadow.

Local Description Authors: K. D. Patterson.

Plots: BOWA.1, BOWA.2, BOWA.6.

Booker T. Washington National Monument 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. (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* (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* sp. (heartleaf), *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. (pine), *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* (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* sp. (heartleaf), *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:

Stratum

Tree canopy

Lifeform

Broad-leaved deciduous tree

Species

Quercus alba (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 1990a) 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 1990a, 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 H7. Acidic Oak - Hickory Forest (plot BOWA.1) at Booker T. Washington National Monument. May 2002. NAD 1983 / UTM easting 612623, northing 4108083.



Figure H8. Acidic Oak – Hickory Forest at Booker T. Washington National Monument. August 2007. NAD 1983 / UTM easting 612786, northing 4107695.

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

SYNONYMS

USNVC English Name: **Tuliptree - (Red Maple, Box-elder) - (Sycamore) / American Hornbeam / Jumpseed Forest**

USNVC Scientific Name: ***Liriodendron tulipifera* - *Acer (rubrum, negundo)* - (*Platanus occidentalis*) / *Carpinus caroliniana* / *Polygonum virginianum* Forest**

USNVC Identifier: **CEGL006492**

LOCAL INFORMATION

Environmental Description: Piedmont / Mountain Alluvial Forest is found on small stream floodplains and terraces at elevations ranging from 250–313 m (820–900 ft) elevation. They occur over deep, sandy alluvium mapped as Comus-Maggodee-Elsinboro complex (NRCS 2006).

Vegetation Description: These deciduous forests have dense shrub layers and species-rich herbaceous openings composed of a mix of wetland and mesic forest graminoids and coarse forbs. The vegetation is often rank and can have high cover by exotic species. The canopy and subcanopy are dominated by various mixtures of *Carpinus caroliniana* (American hornbeam), *Fraxinus pennsylvanica* (green ash), *Juglans nigra* (black walnut), *Liriodendron tulipifera* (tuliptree), and *Platanus occidentalis* (American sycamore). The shrub layers are moderately dense and often dominated by *Asimina triloba* (pawpaw) and *Lindera benzoin* (northern spicebush). Vines are characteristic in this forest, climbing high into the tree canopy. Common vine species are *Campsis radicans* (trumpet creeper), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax rotundifolia* (roundleaf greenbrier), and *Toxicodendron radicans* (eastern poison ivy). The herb stratum of this community is very diverse with no one dominant species. Herb species that often have high cover include *Carex amphibola* (eastern narrowleaf sedge), *Carex normalis* (greater straw sedge), *Elymus virginicus* (Virginia wildrye), *Microstegium vimineum* (Nepalese browntop), *Polygonum virginianum* (jumpseed), *Verbesina alternifolia* (wingstem), and *Viola cucullata* (marsh blue violet). Other herbaceous species indicative of this community include *Agrimonia rostellata* (beaked agrimony), *Bidens frondosa* (devil's beggartick), *Boehmeria cylindrica* (smallspike false nettle), *Chasmanthium laxum* (slender woodoats), *Cinna arundinacea* (sweet woodreed), *Cryptotaenia canadensis* (Canadian honewort), *Dichanthelium clandestinum* (deertongue), *Elymus hystrix* (eastern bottlebrush grass), *Geum canadense* (white avens), *Hydrophyllum canadense* (bluntleaf waterleaf), *Phryma leptostachya* (American lopseed), and *Rudbeckia laciniata* (cutleaf coneflower). Disturbed examples of this forest have less herbaceous diversity and high cover by weedy or nonnative species such as *Cyperus strigosus* (strawcolored flatsedge), *Duchesnea indica* (Indian strawberry), *Lonicera japonica* (Japanese honeysuckle), *Microstegium vimineum* (Nepalese browntop), and *Polygonum caespitosum* (oriental ladysthumb).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Carpinus caroliniana</i> (American hornbeam), <i>Juglans nigra</i> (black walnut), <i>Liriodendron tulipifera</i> (tuliptree), <i>Platanus occidentalis</i> (American sycamore)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Asimina triloba</i> (pawpaw), <i>Carpinus caroliniana</i> (American hornbeam), <i>Lindera benzoin</i> (northern spicebush)
Herb (field)	Forb	<i>Verbesina alternifolia</i> (wingstem)
Herb (field)	Graminoid	<i>Carex amphibola</i> (eastern narrowleaf sedge), <i>Elymus virginicus</i> (Virginia wildrye)

Characteristic Species: *Asimina triloba* (pawpaw), *Carpinus caroliniana* (American hornbeam), *Elymus virginicus* (Virginia wildrye), *Juglans nigra* (black walnut), *Lindera benzoin* (northern spicebush), *Liriodendron tulipifera* (tuliptree), *Platanus occidentalis* (American sycamore), *Verbesina alternifolia* (wingstem).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Actaea racemosa</i> (= <i>Cimicifuga racemosa</i>) (black bugbane)	-	plant	indicator of high base status soils
<i>Celtis occidentalis</i> (common hackberry)	-	plant	indicator of high base status soils
<i>Cercis canadensis</i> var. <i>canadensis</i> (eastern redbud)	-	plant	indicator of high base status soils
<i>Duchesnea indica</i> (Indian strawberry)	-	plant	invasive nonnative
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	plant	invasive nonnative
<i>Microstegium vimineum</i> (Nepalese browntop)	-	plant	invasive nonnative
<i>Packera aurea</i> (golden ragwort)	-	plant	indicator of high base status soils
<i>Polygonum caespitosum</i> (oriental ladythumb)	-	plant	invasive nonnative
<i>Sanguinaria canadensis</i> (bloodroot)	-	plant	indicator of high base status soils

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 Alluvial Forest	Fleming et al 2006

Local Range: Piedmont / Mountain Alluvial Forest occurs on the floodplains and stream terraces along the Gill's Creek, Jack-O-Lantern Branch and other small drainages in the park where the floodplain is broad enough for this forest to develop. This community is mapped as three polygons that extend beyond the park boundary. The total acreage of this community in the park is 6.7 ha.

Classification Comments: Piedmont / Mountain Alluvial Forest can be recognized by its occurrence on floodplains and stream terraces, its distinctive canopy composition, and its temporarily flooded hydrology.

Other Comments: Areas mapped as this community include a disturbed area (less than 0.5 ha) around a natural spring. It is mapped separately and tagged as "disturbed" in the attribute table.

Local Description Authors: K. D. Patterson.

Plots: BOWA.3.

Booker T. Washington National Monument 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>Platanus occidentalis</i> - (<i>Liquidambar styraciflua</i> , <i>Liriodendron tulipifera</i>) Temporarily Flooded Forest Alliance (A.289)
Alliance (English name)	Sycamore - (Sweetgum, Tuliptree) Temporarily Flooded Forest Alliance
Association	<i>Liriodendron tulipifera</i> - <i>Acer (rubrum, negundo)</i> - (<i>Platanus occidentalis</i>) / <i>Carpinus caroliniana</i> / <i>Polygonum virginianum</i> Forest
Association (English name)	Tuliptree - (Red Maple, Box-elder) - (Sycamore) / American Hornbeam / Jumpseed Forest
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This community occupies floodplains of medium-sized streams (large streams and small rivers) in the Piedmont of Maryland and Virginia. These floodplains are moderately extensive and subject to frequent overflow, but topographically fairly homogeneous. In these habitats, the alluvial landforms (e.g., levees, backswamps) are poorly developed or occur at very small scales. Hydrologic regime is temporarily flooded. Soils are generally alluvial silt loams washed from various metamorphic and igneous rocks. This association is a closed forest with consistent overstory codominance by *Liriodendron tulipifera* (tuliptree) in variable combinations with other trees. *Acer negundo* (boxelder), *Acer rubrum* (red maple), or both are characteristic in the overstory or understory. *Platanus occidentalis* (American sycamore) varies from codominant to absent. Other trees that may be important in some stands include *Juglans nigra* (black walnut), *Fraxinus pennsylvanica* (green ash), *Fraxinus americana* (white ash), *Carya cordiformis* (bitternut hickory), *Ulmus americana* (American elm), *Betula nigra* (river birch), and *Quercus palustris* (pin oak). *Lindera benzoin* (northern spicebush), *Carpinus caroliniana* (American hornbeam), and, less constantly, *Asimina triloba* (pawpaw) and/or *Viburnum prunifolium* (blackhaw) dominate the shrub layer. Vines of *Toxicodendron radicans* (eastern poison ivy) and other species may occur. Relatively diverse herb layers are composed of both mesophytic and hydrophytic species. Common herbs include *Arisaema triphyllum* (Jack in the pulpit), *Geum canadense* (white avens), *Polygonum virginianum* (jumpseed), *Carex amphibola* (eastern narrowleaf sedge), *Circaea lutetiana* ssp. *canadensis* (broadleaf enchanter's nightshade), *Verbesina alternifolia* (wingstem), *Carex radiata* (eastern star sedge), *Carex blanda* (eastern woodland sedge), *Impatiens capensis* (jewelweed), *Boehmeria cylindrica* (smallspike false nettle), *Viola sororia* (common blue violet), and *Symphyotrichum lateriflorum* (calico aster). Although less constant, *Elymus virginicus* (Virginia wildrye), *Claytonia virginica* (Virginia springbeauty), and *Erythronium americanum* (dogtooth violet) form dominance patches in some stands. Because land-use effects (agriculture, grazing, utility corridors in and near the floodplain, excessively frequent flooding and sediment deposition following watershed

development) frequently disturb the habitat, the herb layer is often weedy and is commonly dominated by the exotic grass *Microstegium vimineum* (Nepalese browntop).

Environmental Description: This community occupies floodplains of medium-sized streams (large streams and small rivers). These floodplains are moderately extensive and subject to frequent overflow, but topographically fairly homogeneous. In these habitats, the alluvial landforms (e.g., levees, backswamps) are poorly developed or occur at very small scales. Hydrologic regime is temporarily flooded, and the mean flood return interval is thought to be roughly once or twice a year, but may vary with stream order and position in the watershed. Soils are generally alluvial silt loams washed from various metamorphic and igneous rocks. Samples collected from plots have moderately high calcium, magnesium, and total base saturation levels.

Vegetation Description: This association is a closed forest with consistent overstory codominance by *Liriodendron tulipifera* (tuliptree) in variable combinations with other trees. *Acer negundo* (boxelder), *Acer rubrum* (red maple), or both are characteristic in the overstory or understory. *Platanus occidentalis* (American sycamore) varies from codominant to absent. Other trees that may be important in some stands include *Juglans nigra* (black walnut), *Fraxinus pennsylvanica* (green ash), *Fraxinus americana* (white ash), *Carya cordiformis* (bitternut hickory), *Ulmus americana* (American elm), *Betula nigra* (river birch), and *Quercus palustris* (pin oak). *Lindera benzoin* (northern spicebush), *Carpinus caroliniana* (American hornbeam), and, less constantly, *Asimina triloba* (pawpaw) and/or *Viburnum prunifolium* (blackhaw) dominate the shrub layer. Vines of *Toxicodendron radicans* (eastern poison ivy) and other species may occur. Relatively diverse herb layers are composed of both mesophytic and hydrophytic species. The most constant herbs in 15 Virginia and Maryland plot samples were *Arisaema triphyllum* (Jack in the pulpit), *Geum canadense* (white avens), *Polygonum virginianum* (jumpseed), *Carex amphibola* (eastern narrowleaf sedge), *Circaea lutetiana* ssp. *canadensis* (broadleaf enchanter's nightshade), *Verbesina alternifolia* (wingstem), *Carex radiata* (eastern star sedge), *Carex blanda* (eastern woodland sedge), *Impatiens capensis* (jewelweed), *Boehmeria cylindrica* (smallspike false nettle), *Viola sororia* (common blue violet), and *Symphotrichum lateriflorum* (calico aster). Although less constant, *Elymus virginicus* (Virginia wildrye), *Claytonia virginica* (Virginia springbeauty), and *Erythronium americanum* (dogtooth violet) form dominance patches in some stands. Because land-use effects (agriculture, grazing, utility corridors in and near the floodplain, excessively frequent flooding and sediment deposition following watershed development) frequently disturb the habitat, the herb layer is often weedy and is commonly dominated by the exotic grass *Microstegium vimineum* (Nepalese browntop).

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 the Piedmont of Maryland and Virginia. In Virginia, it is the principal small floodplain forest in the northern and western Piedmont.

States/Provinces: MD, VA.

Federal Lands: NPS (Appomattox Court House, Booker T. Washington, C&O Canal, George Washington Parkway, Manassas, Rock Creek).

CONSERVATION STATUS

Rank: G4? (16-Apr-2007).

Reasons: More information is needed to rank this community.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 – Weak.

Comments: Classification of this type is supported by 15 Virginia and Maryland plot samples analyzed during the NCR vegetation mapping project, plus additional observational data. The collection of additional data from across the full range would assist in refining the description of this type and its full range of compositional variation. However, the smaller floodplains supporting this type are typically low priorities for sampling or research, in part because they are highly disturbed and good examples are hard to locate.

Similar Associations:

- *Liquidambar styraciflua* - *Liriodendron tulipifera* / *Lindera benzoin* / *Arisaema triphyllum* Forest (CEGL004418)--on average occurs on smaller-order streams and floodplains with more nutrient-poor soils; its distribution in the mid-Atlantic states is more coastal and southern.
- *Liriodendron tulipifera* - *Acer negundo* Forest (CEGL007184)--a more southern successional forest developing on formerly cleared floodplains and uplands.
- *Platanus occidentalis* - *Acer negundo* - *Juglans nigra* / *Asimina triloba* / *Mertensia virginica* Forest (CEGL004073)--occurs on larger streams with more calcareous soils.
- *Platanus occidentalis* - *Liquidambar styraciflua* / *Carpinus caroliniana* - *Asimina triloba* Forest (CEGL007340)--southern Piedmont analogue of CEGL006492; habitats and composition are similar, but austral species such as *Liquidambar styraciflua*, *Quercus phellos*, *Ilex decidua*, *Aesculus sylvatica*, and *Arundinaria gigantea* are prominent.

Related Concepts: Information not available.

SOURCES

Description Authors: G. P. Fleming.

References: Eastern Ecology Working Group n.d., Fleming et al. 2006, Harrison 2004, Lea 2004, NRCS 2006.



Figure H9. Piedmont / Mountain Alluvial Forest at Booker T. Washington National Monument. August 2007. NAD 1983 / UTM easting 612877, northing 4107698.



Figure H10. Piedmont / Mountain Alluvial Forest (disturbed stand) at Booker T. Washington National Monument. August 2007. NAD 1983 / UTM easting 612788, northing 4108675.

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: These areas are maintained by the park, kept open by frequent mowing or clearing for the purposes of historic interpretation. This association includes herbaceous-dominated vegetation that is maintained as open fields, pastures, agricultural leases, lawns, and mowed roadsides.

Vegetation Description: The map class Cultural Meadow includes areas kept open by mowing or clearing and dominated by herbaceous plants, either planted grasses or other crops. These areas are vegetated by a mix of native and European grasses and forbs. Fields tend to be dense stands of sod-forming grasses such as *Lolium pratense* (meadow ryegrass), *Andropogon virginicus* (broomsedge bluestem), and *Dactylis glomerata* (orchardgrass). In areas that are mowed more closely, *Cynodon dactylon* (Bermudagrass), *Digitaria sanguinalis* (hairy crabgrass), and *Echinochloa crus-galli* (barnyardgrass) are common. Planted crops may vary from season to season.

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 Meadows are concentrated in the northern half of the park but are also found along the boundaries, where agricultural areas on adjacent lands extend into the park.

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

Other Comments: Information not available.

Local Description Authors: K. D. Patterson.

Plots: None.

Booker T. Washington National Monument 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 0.3–0.9 m (1–3 ft 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 ft]) 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. (hawkweed), *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* sp. (hawkweed), *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, George Washington Birthplace, 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 H11. Cultural Meadow at Booker T. Washington National Monument. August 2007. NAD 1983 / UTM easting 612572, northing 4108797.

COMMON NAME (PARK-SPECIFIC): DENSE HARDWOOD REGENERATION

SYNONYMS

USNVC English Name: Not applicable
USNVC Scientific Name: Not applicable
USNVC Identifier: Nonstandard

LOCAL INFORMATION

Environmental Description: This map class is found on slopes with eroding soils at elevations of 260–280 m (840–920 ft).

Vegetation Description: This map class includes dense, shrubby regeneration of hardwood species on areas that have been clearcut in the recent past (less than 20 years). Deciduous sprouts from stumps and small trees form an impenetrable thicket 4–6 m tall, often intertwined with woody vines. Species composition includes *Acer rubrum* (red maple), *Carya alba* (mockernut hickory), *Cornus florida* (flowering dogwood), *Oxydendrum arboreum* (sourwood), *Liriodendron tulipifera* (tuliptree), *Nyssa sylvatica* (blackgum), *Prunus serotina* var. *serotina* (black cherry), *Quercus falcata* (southern red oak), *Smilax* spp. (greenbriers), and others.

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	NA	.	.	[not crosswalked, not ranked]	.

Local Range: A single polygon (1.2 ha) in the central portion of the park is mapped as Dense Hardwood Regeneration.

Classification Comments: This map class is deciduous and has a shrubby structure with no significant canopy stratification. Although its species composition is similar to that of Successional Tuliptree Forest, it was mapped separately due to its shrubby structure.

Other Comments: Information not available.

Local Description Authors: K. D. Patterson.

Plots: None.

Booker T. Washington National Monument Inventory Notes: Information not available.

GLOBAL INFORMATION

Dense Hardwood Regeneration is a park-specific, nonstandard type and has no global information.

COMMON NAME (PARK-SPECIFIC): OTHER URBAN OR BUILT-UP LAND

SYNONYMS

USNVC English Name: Not applicable

USNVC Scientific Name: Not applicable

USNVC Identifier: Not applicable

LOCAL INFORMATION

Local Range: Other Urban or Built-up Land is concentrated in the northern half of the park.

Classification Comments: This map class includes areas with buildings associated with park maintenance and historic interpretation. This map class includes all buildings, walkways, minor roads, and their associated lawns and vegetation. This map class is equal to the Anderson et al. (1976) Level II unit 17, Other Urban or Built-up Land.

Other Comments: Lawns and other mowed areas greater than 0.5 ha are mapped as Cultural Meadow.

Local Description Authors: K. D. Patterson.

Plots: None.

Booker T. Washington National Monument Inventory Notes: Information not available.

Citation: Anderson et al. 1976.

COMMON NAME (PARK-SPECIFIC): **TRANSPORTATION, COMMUNICATIONS, AND UTILITIES**

SYNONYMS

USNVC English Name: **Not applicable**

USNVC Scientific Name: **Not applicable**

USNVC Identifier: **Not applicable**

LOCAL INFORMATION

Local Range: Areas mapped as Transportation, Communications, and Utilities occur in the northern portion of the park.

Classification Comments: This map class includes major paved roads and parking areas. This map class is equal to the Anderson (1976) Level II unit 14, Transportation, Communications, and Utilities.

Other Comments: The comment field in the map attribute table indicates if a polygon represents transportation or utilities.

Local Description Authors: K. D. Patterson.

Plots: None.

Booker T. Washington National Monument Inventory Notes: Information not available.

Citation: Anderson et al. 1976.

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Appendix I. 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 sclerophyllous tree	Epiphyte
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 J. Key to the vegetation-map classes at Booker T. Washington National Monument.

1a.	Land covered with vegetation with no buildings or paved roads.	2
1b.	Land use includes buildings and paved areas.	10
2a.	Forested vegetation: vegetation dominated by trees (> 6 m tall, single-stemmed woody plants) with canopy coverage of at least 25%.	3
2b.	Vegetation dominated shrubs, small trees or herbaceous plants.	9
3a.	Upland forests; lacking wetland plants and soils.	4
3b.	Alluvial Forests; associated with floodplains and stream terraces; vegetation often dense and exotic species may form high cover; trees include black walnut (<i>Juglans nigra</i>), tuliptree (<i>Liriodendron tulipifera</i>), American hornbeam (<i>Carpinus caroliniana</i>), and American sycamore (<i>Platanus occidentalis</i>).	Piedmont / Mountain Alluvial Forest
4a.	Forests dominated by deciduous trees, canopy with greater than 75% cover by deciduous species.	5
4b.	Forests with Pines (<i>Pinus</i> spp.) making up greater than 25% of the canopy.	8
5a.	Young, mostly deciduous forest of successional hardwood species with a sparse, emergent canopy of dead and dying Virginia Pine (<i>Pinus virginiana</i>).	Successional Virginia Pine Forest
5b.	Mostly deciduous forests comprised of oaks (<i>Quercus</i> spp.), tuliptree (<i>Liriodendron tulipifera</i>), and/ or hickories (<i>Carya</i> spp.); Virginia pine (<i>Pinus virginiana</i>) is absent or with only very low cover in canopy.	6
6a.	Forest dominated by tuliptree (<i>Liriodendron tulipifera</i>).	7
6b.	Forests dominated by oaks; white oak (<i>Quercus alba</i>), southern red oak (<i>Quercus falcata</i>), scarlet oak (<i>Quercus coccinea</i>), or chestnut oak (<i>Quercus prinus</i>), and hickories (<i>Carya alba</i> , <i>Carya glabra</i> , and <i>Carya ovalis</i>); understory associates include sourwood (<i>Oxydendrum arboreum</i>) or redbud (<i>Cercis canadensis</i>); may have patchy understory of heath shrubs; blueberries (<i>Vaccinium</i> spp.), and huckleberries (<i>Gaylussacia</i> spp.); herb cover sparse.	Acidic Oak - Hickory Forest
7a.	Tuliptree (<i>Liriodendron tulipifera</i>) strongly dominant and usually even-aged; nonnative weeds and vines often prevalent in the herb and shrub layers.	Successional Tuliptree Forest
7b.	Mixed hardwood forest of steep slopes; canopy characterized by tuliptree (<i>Liriodendron tulipifera</i>), red oak (<i>Quercus rubra</i>), cucumber-tree (<i>Magnolia acuminata</i>), and white ash (<i>Fraxinus americana</i>); herb layer containing species indicating high base status, such as northern maidenhair (<i>Adiantum pedatum</i>), and silver false spleenwort (<i>Deparia acrostichoides</i>).	Inner Piedmont / Lower Blue Ridge Basic Mesic Forest

- 8a. Canopy dominated by eastern white pine (*Pinus strobus*), may have minor coverage by Virginia pine (*Pinus virginiana*). **White Pine Plantation**
- 8b. Canopy dominated by Virginia pine (*Pinus virginiana*) or Virginia pine with young deciduous trees such as tuliptree (*Liriodendron tulipifera*), red maple (*Acer rubrum*), black cherry (*Prunus serotina* var. *serotina*), sourwood (*Oxydendrum arboreum*), or flowering dogwood (*Cornus florida*). **Successional Virginia Pine Forest**
- 9a. Open herbaceous dominated vegetation, dominated by grasses and forbs, may have scattered trees and shrubs. **Cultural Meadow**
- 9b. Very dense, shrubby vegetation dominated by shrubs and small trees. **Dense Hardwood Regeneration**
- 10a. Land use includes buildings and maintained lawns and plantings. **Other Urban or Built-Up Land**
- 10b. Land use is primarily a transportation corridor with paved roadway and mowed roadsides. **Transportation, Communications, and Utilities**

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/>