

National Park Service
U.S. Department of the Interior

Northeast Region
Philadelphia, Pennsylvania



Vegetation Classification and Mapping at George Washington Birthplace National Monument, Virginia

Technical Report NPS/NER/NRTR—2008/099



ON THE COVER

Top: Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) on Bridges Creek. Photograph by Philip Coulling.

Bottom: Coastal Plain Dry Calcareous Forest on slopes over Bridges Creek. Photograph by Gary Fleming.

Vegetation Classification and Mapping at George Washington Birthplace National Monument, Virginia

Technical Report NPS/NER/NRTR—2008/099

Karen D. Patterson

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

June 2008

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

The Northeast Region of the National Park Service (NPS) comprises national parks and related areas in 13 New England and Mid-Atlantic states. The diversity of parks and their resources are reflected in their designations as national parks, seashores, historic sites, recreation areas, military parks, monuments and memorials, and rivers and trails. Biological, physical, and social science research results, natural resource inventory and monitoring data, scientific literature reviews, bibliographies, and proceedings of technical workshops and conferences related to these park units are disseminated through the NPS/NER Technical Report (NRTR) and Natural Resources Report (NRR) series. The reports are a continuation of series with previous acronyms of NPS/PHSO, NPS/MAR, NPS/BSO-RNR, and NPS/NERBOST. Individual parks may also disseminate information through their own report series.

Natural Resources Reports are the designated medium for information on technologies and resource management methods; "how to" resource management papers; proceedings of resource management workshops or conferences; and natural resource program descriptions and resource action plans.

Technical Reports are the designated medium for initially disseminating data and results of biological, physical, and social science research that addresses natural resource management issues; natural resource inventories and monitoring activities; scientific literature reviews; bibliographies; and peer-reviewed proceedings of technical workshops, conferences, or symposia.

Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the National Park Service.

This report was accomplished under Cooperative Agreement 400089027, Supplemental Agreement No. 5, with assistance from the NPS. The statements, findings, conclusions, recommendations, and data in this report are solely those of the author(s), and do not necessarily reflect the views of the U.S. Department of the Interior, National Park Service.

Print copies of reports in these series, produced in limited quantity and only available as long as the supply lasts, or preferably, file copies on CD, may be obtained by sending a request to the address on the back cover. Print copies also may be requested from the NPS Technical Information Center (TIC), Denver Service Center, PO Box 25287, Denver, CO 80225-0287. A copy charge may be involved. To order from TIC, refer to document D-358.

This report may also be available as a downloadable portable document format file from the Internet at <http://www.nps.gov/nero/science/>.

Please cite this publication as:

Patterson, Karen D. 2008. Vegetation Classification and Mapping at George Washington Birthplace National Monument, Virginia. Technical Report NPS/NER/NRTR—2008/099. National Park Service. Philadelphia, PA.

Table of Contents

	Page
Figures	v
Tables	vii
Appendixes	ix
Contacts and Contributors	xi
Acknowledgments	xiii
Summary	xv
Introduction	1
General Background	1
Park-specific Information	4
Project Area	7
Location and Regional Setting	7
Park Environmental Attributes	7
Methods	11
Project Scoping and Planning	11
Preliminary Data Collection and Review of Existing Information	11
Aerial Photography Acquisition and Processing	12
Preliminary Photointerpretation	12
Field Data Collection	13
Vegetation Classification and Characterization	17
Vegetation Map Preparation	23
Accuracy Assessment	24
Metadata Preparation	24

Table of Contents (continued)

	Page
Results	29
Field Surveys	29
Vegetation Classification and Characterization	29
Vegetation Community Descriptions and Map Classes	34
Vegetation Map Production	37
Accuracy Assessment	41
Project Deliverables	41
Discussion	43
Vegetation Classification and Characterization	43
Vegetation Map Production	46
Recommendations for Future Projects	46
Literature Cited	49

Figures

	Page
Figure 1. General location of George Washington Birthplace National Monument (GEWA), Virginia.	5
Figure 2. Physiographic provinces of Virginia showing the location of George Washington Birthplace National Monument (GEWA) in the outer Coastal Plain.	8
Figure 3. Location of George Washington Birthplace National Monument on the Colonial Beach South, VA 1:24000 USGS topographic quadrangle map.	9
Figure 4. Ground control points used to calculate horizontal positional accuracy of the George Washington Birthplace National Monument (GEWA) leaf-on (fall) mosaic.	25
Figure 5. Ground control points used to calculate horizontal positional accuracy of the George Washington Birthplace National Monument (GEWA) leaf-off (spring) mosaic.	25
Figure 6. Locations of quantitative vegetation plots and qualitative observation points over the draft formation-level vegetation map of George Washington Birthplace National Monument.	30
Figure 7. Vegetation and Anderson Level II map classes for George Washington Birthplace National Monument.	39
Figure 8. Distribution of the wetland vegetation-map classes in George Washington Birthplace National Monument.	41

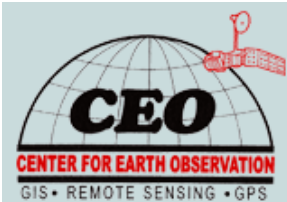
Tables

	Page
Table 1. United States National Vegetation Classification System physiognomic-floristic hierarchy for terrestrial vegetation (from Grossman et al. 1998).	3
Table 2. Cover-class scores used in field sampling and data analysis.	14
Table 3. Topographic / hydrologic environmental data recorded at each plot sample location.	16
Table 4. Ordinal values for topographic position and slope inclination used in data analysis.	18
Table 5. Environmental variables used in ordination joint plots. Only variables correlated with plot ordination scores are shown in the joint plot diagrams.	22
Table 6. Summary of key information for George Washington Birthplace National Monument leaf-on (fall) mosaic.	27
Table 7. Summary of key information for George Washington Birthplace National Monument leaf-off (spring) mosaic.	28
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 George Washington Birthplace National Monument.	31
Table 9. Vegetation-map classes and corresponding USNVC associations or other classification for George Washington Birthplace National Monument.	35
Table 10. Number of polygons, total mapped hectares, mapped hectares within the park boundary, and number of quantitative plots sampled and observations for 19 map classes at George Washington Birthplace National Monument.	39
Table 11. Summary of products resulting from the classification and mapping of vegetation at George Washington Birthplace National Monument.	41

Appendixes

	Page
Appendix A. Quantitative vegetation plot sampling form.	55
Appendix B. Vascular plants observed in quantitative vegetation plots and qualitative observation points in George Washington Birthplace National Monument during 2002 and 2003.	59
Appendix C. Distribution of vegetation classes, derived from the analysis of regional quantitative plot data, across seven national parks in Virginia.	65
Appendix D. Definitions of global and subnational (state) conservation ranks.	69
Appendix E. Environmental variable averages for associations derived from the analysis of regional quantitative plot data.	77
Appendix F. Cluster dendrograms, ordination scatterplots, and joint plots resulting from quantitative analysis of regional plot data for five major vegetation groups present at George Washington Birthplace National Monument.	83
Appendix G. Compositional summary statistics for vegetation associations within George Washington Birthplace National Monument derived from the analysis of regional quantitative plot data.	99
Appendix H. Local and global descriptions of vegetation associations and other vegetation-map classes for George Washington Birthplace National Monument.	111
Appendix I. Field definitions for local and global descriptions of vegetation associations and other map classes.	227
Appendix J. Key to the vegetation classes at George Washington Birthplace National Monument.	239

Contacts and Contributors

 DCR Department of Conservation & Recreation CONSERVING VIRGINIA'S NATURAL AND RECREATIONAL RESOURCES <i>Virginia Natural Heritage Program</i> 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@dc.virginia.gov J. Christopher Ludwig Chief Biologist, Inventory Manager 804-371-6206 chris.ludwig@dc.virginia.gov Contributors: Gary P. Fleming, Kirsten Hazler, Kristin Taverna, John Townsend, Philip Coulling, Gina Pisoni
 CEO CENTER FOR EARTH OBSERVATION GIS • REMOTE SENSING • GPS 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
 NatureServe A Network Connecting Science With Conservation 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

George Washington Birthplace National Monument

Rijk Morawe,
Chief, Natural & Cultural Resources Management
804-224-1732, ext 237
Rijk_Morawe@nps.gov

Acknowledgments

We would like to acknowledge the following people and organizations for assistance and support during this project. Rijk Morawe and all the other staff at George Washington Birthplace National Monument provided on-site logistical assistance and expertise on park resources. Philip Coulling, Gary Fleming, Mark Hall, Gary MacDonald, Gina Pisoni, and Rebecca Wilson provided field assistance. Jim Drake and Rickie White, both of NatureServe, provided advice on National Vegetation Mapping Program protocols and standards and a sounding board for ideas on mapping procedures. Bill Millinor, formerly with North Carolina State University, Center for Earth Observation, provided advice about onscreen digitizing and help with editing the draft vegetation maps. My colleagues Gary Fleming, Kristin Taverna, and Philip Coulling were responsible for all the data preparation and analysis of the regional dataset. John Townsend and Gary Fleming provided assistance with plant identification. Mary Russo and Kristin Snow of NatureServe provided valuable feedback and assistance with report formats and Lesley Sneddon spent hours on the phone with me crosswalking problematic map classes to the USNVC, reviewing vegetation keys, and providing morale support. Kristina Callahan, of the National Park Service Mid-Atlantic Inventory and Monitoring Network and my colleague Kirsten Hazler helped me wade through the wilderness of metadata creation. My colleague Kristin Taverna was a critical partner in this project and helped with every step, providing excellent ideas and solutions throughout the project. Thank you to Kristin for all the review and hours of listening to me. John Karish and Beth Johnson of the National Park Service, Northeast Region, provided funding and contractual oversight for all Cooperators in this project.

This project would not have been possible without funding from the National Park Service, Northeast Region.

A large thank you to all involved, both those listed and those unacknowledged.

Summary

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

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

This report documents the classification and mapping of vegetation and other land-use classes at George Washington Birthplace National Monument. Nineteen map classes representing 16 USNVC associations, two nonstandard park-specific vegetation classes, and four Anderson Level II land-use categories were used to map the 223 ha (551 ac) park. Vegetation map classes were determined through extensive field reconnaissance, data collection, and analysis. The map was based on 2002 aerial photography and field sampling conducted in 2002 and 2003. Spatial data were digitized onscreen over digital orthophoto mosaics created from scanned color infrared, stereo pair 1:6,000 scale aerial photography using a 0.5 ha minimum mapping unit.

Four cultural map classes cover 49% (113 ha [279 ac]) of the park: Cultural Meadow; Other Urban or Built-Up Land; Transportation, Communications, and Utilities; and Semipermanent Impoundment. Early successional or transitional vegetation covers approximately 19% (44 ha [109 ac]) of park land: Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest, Disturbed Calcareous Forest, Disturbed Acidic Slope Forest, Successional Red-cedar Forest, Successional Sweetgum Forest, and Successional Black Locust Forest. Tidal wetlands account for approximately 7% (16.5 ha [40.7 ac]) of the park: Beaches, Tidal Oligohaline Marsh, Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh), and Tidal Shrub Swamp (Iva Type). Nontidal forested wetlands cover just 3% (7.5 ha [18.5 ac]) of the park land: Coastal Plain / Piedmont Acidic Seepage Swamp and Non-Riverine Saturated Forest. The remaining 16% (35.8 ha [88.5 ac]) of the park land is mapped as later successional forests: Coastal Plain Dry Calcareous Forest and Loblolly Pine - Hardwood Forest.

A vegetation map of George Washington Birthplace National Monument was created following the USGS-NPS Vegetation Mapping Program protocols. Vegetation map classes were crosswalked to the Natural Communities of Virginia and to the USNVC in order to provide a regional and global context for the park's vegetation. A field key to the map classes and detailed descriptions for map classes or vegetation associations within a map class were developed to assist with field recognition and classification. Additional products associated with this project include: leaf-on and leaf-off orthophoto mosaics, database of vegetation plot data, digital photos of vegetation associations, and spatial data files for the vegetation map and plot sample points with associated Federal Geographic Data Committee (FGDC)-compliant metadata.

Products for George Washington Birthplace 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, George Washington Birthplace 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 datasets 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 National Park Service and the U.S. Geological Survey (USGS) have worked cooperatively to classify, describe, and map vegetation communities in more than 250 national 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 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 database 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 ha (1.23 ac) and classification accuracy of 80% for each map class. The spatial databases are required to have a horizontal positional accuracy that meets National Map Accuracy Standards at the 1:24,000 scale. This means that each well-defined object in the spatial database will be within 1/50 of an inch of its actual location or 12.2 m (40 ft).

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

The USNVC is currently maintained and updated by NatureServe. Additional support has come from federal agencies, the FGDC, and the Ecological Society of America. Refinements to the

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

The USNVC is a hierarchical system that classifies vegetation using physiognomic (structural) features at the highest levels of the hierarchy and floristic features at the lower levels. The physiognomic units have a broad geographic perspective and the floristic units have local and site-specific perspectives (TNC and ESRI 1994a; Grossman et al. 1998). The USNVC includes most existing vegetation, whether natural or cultural, but attention is focused on natural vegetation types. Natural vegetation, as defined in TNC and ESRI (1994a), includes types that “occur spontaneously without regular management, maintenance, or planting and have a strong component of native species.” Cultural vegetation includes planted/cultivated vegetation types such as orchards, pastures, forestry plantations, and vineyards.

The physiognomic-floristic classification includes all upland terrestrial vegetation and all wetland vegetation with rooted vascular plants. The hierarchy has five physiognomic levels and two floristic levels (Table 1). The basic unit of the physiognomic portion of the classification is the formation, a type defined by dominance of a given growth form in the uppermost stratum and characteristics of the environment (e.g., cold-deciduous alluvial forests). The physiognomic portion of the classification is based upon the United Nations Educational, Scientific, and Cultural Organization world physiognomic classification of vegetation, which was modified to provide greater consistency at all hierarchical levels and to include additional types (UNESCO 1973).

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

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

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

The goal of the study was to accurately map and classify, at least to the alliance level of the USNVC, the vegetation in Appomattox Court House National Historical Park, Booker T. Washington National Monument, Colonial National Historical Park, Fredericksburg and Spotsylvania National Military Park, George Washington Birthplace National Monument, Petersburg National Battlefield, and Richmond National Battlefield Park. The classification used to map these parks was developed regionally, using quantitative data that was 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 George Washington Birthplace 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 to the vegetation, and descriptions of the vegetation in the park. Baseline information on plant community composition and rarity is critical to developing desired conditions and park management goals relating to native plant communities, nonnative plant and insect species, and effects of deer browse and other disturbances. Identification and description of plant communities also provide habitat information important to understanding associated organisms, including animals, protozoa, bacteria, and fungi. A vegetation map can also allow

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

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

Park-specific Information

George Washington Birthplace National Monument is a 223 ha (551 ac) unit of the National Park Service located in Westmoreland County, Virginia. It lies 61 km (38 mi) east of Fredericksburg, Virginia, along the Potomac River, 121 km (75 mi) downstream from Washington, DC. (Figure 1). George Washington Birthplace National Monument preserves the birth site of the first president of the United States. Born in 1732, George Washington spent his first 3 1/2 yrs at the plantation, then known as Popes Creek Plantation. Although Washington's family moved to Mount Vernon in 1735, the property was inherited by Washington's half-brother, Augustine, and, from time to time during his youth, George lived there and continued to visit through 1771. In 1779, during the Revolutionary War, George Washington's birthplace home was accidentally burned down, the family moved away, and the house was never rebuilt. Efforts to preserve and protect the site began as early as 1812, well before the site was established as a national park in 1930. Today the monument contains the plantation grounds and archaeological sites for a number of historic structures associated with the Washington family. A 55 ft granite memorial, constructed in 1896, stands at the park entrance. To commemorate the 200th anniversary of George Washington's birth, a memorial house, colonial kitchen, and other structures were built to serve as representations of typical 18th-century plantation buildings. The site also preserves the Washington family burial ground. Today, costumed interpreters, maintaining a typical farm of the 1730s, help to evoke the feeling of the plantation as George Washington may have known in his youth. The park also provides a resource for public education on Native American use of the land, 17th-century settlement, and the life of slaves on the plantation. Park facilities include a visitor center, the historic mansion area, colonial farm, burial grounds, a nature trail, and a picnic area. In 2006, nearly 136,000 people visited George Washington Birthplace National Monument.

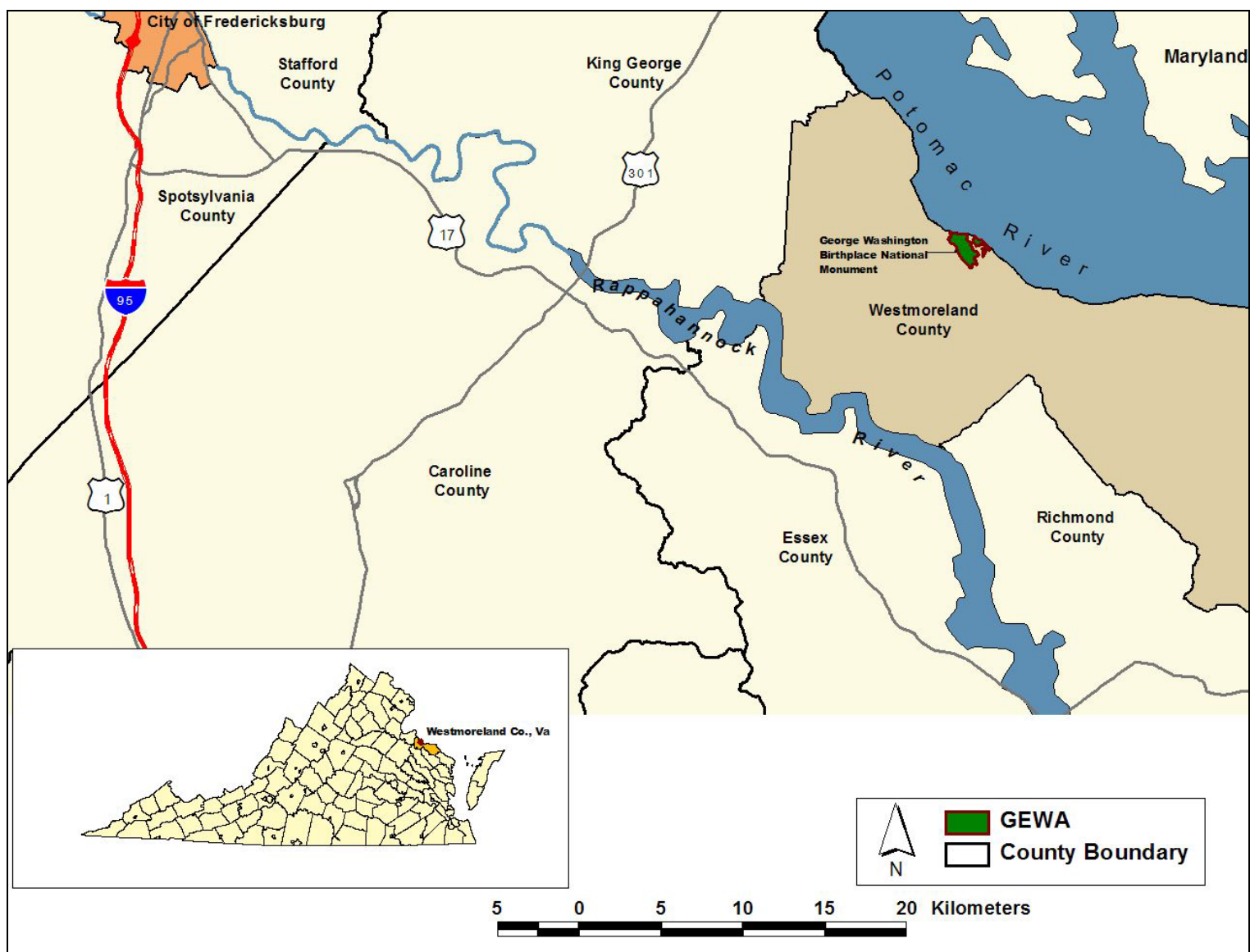


Figure 1. General location of George Washington Birthplace National Monument (GEWA), Virginia.

Project Area

Location and Regional Setting

George Washington Birthplace National Monument is located in the northern-most portion of Virginia's outer Coastal Plain (Figure 2). This region is also known as the "Northern Neck," one of three prominent peninsulas formed as four large tidal rivers dissect the Coastal Plain, draining into the Chesapeake Bay. The Northern Neck is bounded by the Potomac River on the north and the Rappahannock River on the south. The park boundary falls within the Colonial Beach South, Virginia USGS quadrangle map (Figure 3). This portion of the Coastal Plain is known as the Tidal Area subsection of the Atlantic Coastal Flatwoods section (Keys et al. 1995) and consists of flat plains with elevations ranging from 0–30 m (0–100 ft). The surficial geology is undifferentiated Quaternary marine deposits of sand, silt, and clay. The mean annual precipitation across the area ranges from 114–127 cm (45–50 in), and the mean annual temperature across the area ranges from 13–24°C (55–75°F) (McNab and Avers 1994; Keys et al. 1995). Historic climate data from Colonial Beach, Virginia (38°15'N / 76°58'W) from the years 1963 through 2002 report that the mean monthly minimum temperature is 8.5° C (47.4° F) and the mean monthly maximum is 20.8° C (69.6° F). The mean January minimum temperature is –2.7° C (27.1° F), and the mean July maximum is 32.4° C (90.4° F). Annual precipitation averages 104.6 cm (41.18 in), with annual average snowfall of 4 cm (1.6 in) (Southeast Regional Climate Center 2007).

The upland forests that originally covered much of Virginia's Coastal Plain have been extensively cleared or altered, so that it is now difficult to determine which species and natural communities were historically prevalent. Much of the contemporary forest consists of successional or silvicultural stands of loblolly pine (*Pinus taeda*), and secondary pine-hardwood forests that have developed after repeated cutting or agricultural abandonment. The most mature remnant stands on mesic uplands are characterized by associations of American beech (*Fagus grandifolia*), several oaks (*Quercus* spp.), and American holly (*Ilex opaca* var. *opaca*), representing what once was the common, matrix-forming forest type in region. The Coastal Plain also supports terrestrial communities that are restricted to special habitats on ravine slopes and estuarine-fronting bluffs that have down-cut into Tertiary shell deposits or limesands. Soils of these forests and woodlands have extraordinarily high levels of calcium and support a number of inland, calciphilic species that are disjunct from the mountains.

Wetlands of the Coastal Plain are extensive and have fared somewhat better than the province's upland forests, supporting a great variety of natural communities. The diversity of wetlands in this region spans a range of freshwater to saline, lunar-tidal estuaries; tidal and palustrine swamps; nonriverine, groundwater-saturated flats; seasonally flooded ponds and depressions; seepage slope wetlands; and various tidal and non-tidal aquatic habitats.

Park Environmental Attributes

Many environmental factors, such as geology, topography, soils, and hydrology, affect the types and distribution of vegetation within George Washington Birthplace National Monument. The surficial geology over the entire park is mapped as the Sedgefield Member (late Pleistocene) of

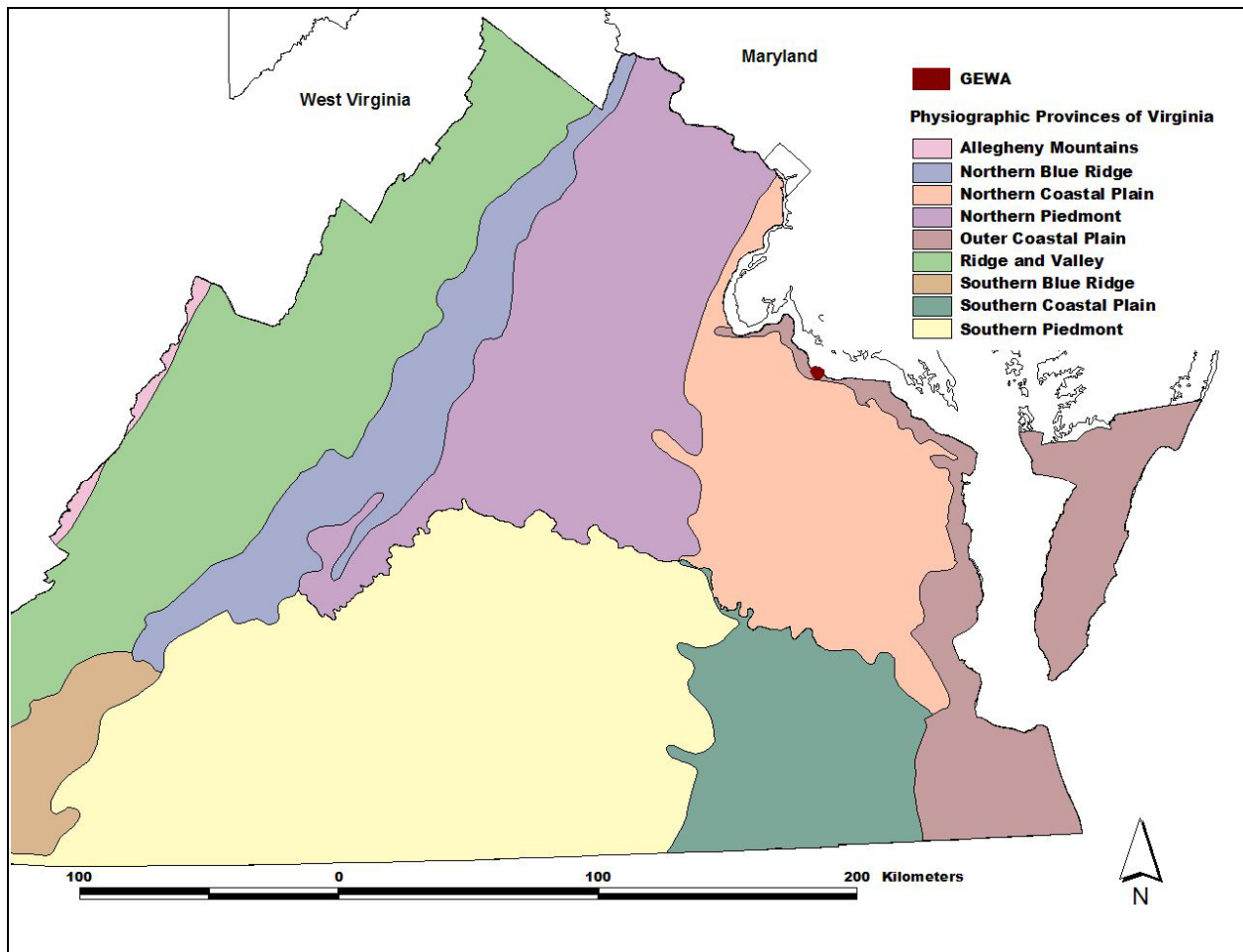


Figure 2. Physiographic provinces of Virginia showing the location of George Washington Birthplace National Monument (GEWA) in the outer Coastal Plain.

the Tabb Formation (VADMR 1993) which consists of marine and fluvial deposits of sands, silts, and clays. These sediments often contain abundant fossils of mollusks and coral, while fossilized shark teeth are common in the underlying Calvert Formation. These fossil-rich deposits are exposed on the park's steep slopes and have an influence on soil chemistry, thus the plants that are found on these habitats.

The Soil Survey Geographic (SSURGO) database for Westmoreland County, VA (USDA, NRCS 2006) maps ten soils series within the boundary of George Washington Birthplace National Monument. The soils in the park are classed as either Ultisols or Entisols. Over half the park's acreage is mapped in hydric (wetland) soils. The majority of the hydric soils are classed as Aquults. In general, soils classed as Aquults are either saturated with water for some period of the year or artificially drained. They are deep and poorly drained and occur on the flat terraces and gently sloping areas of the park. The two series in the park are mapped as Leaf silt

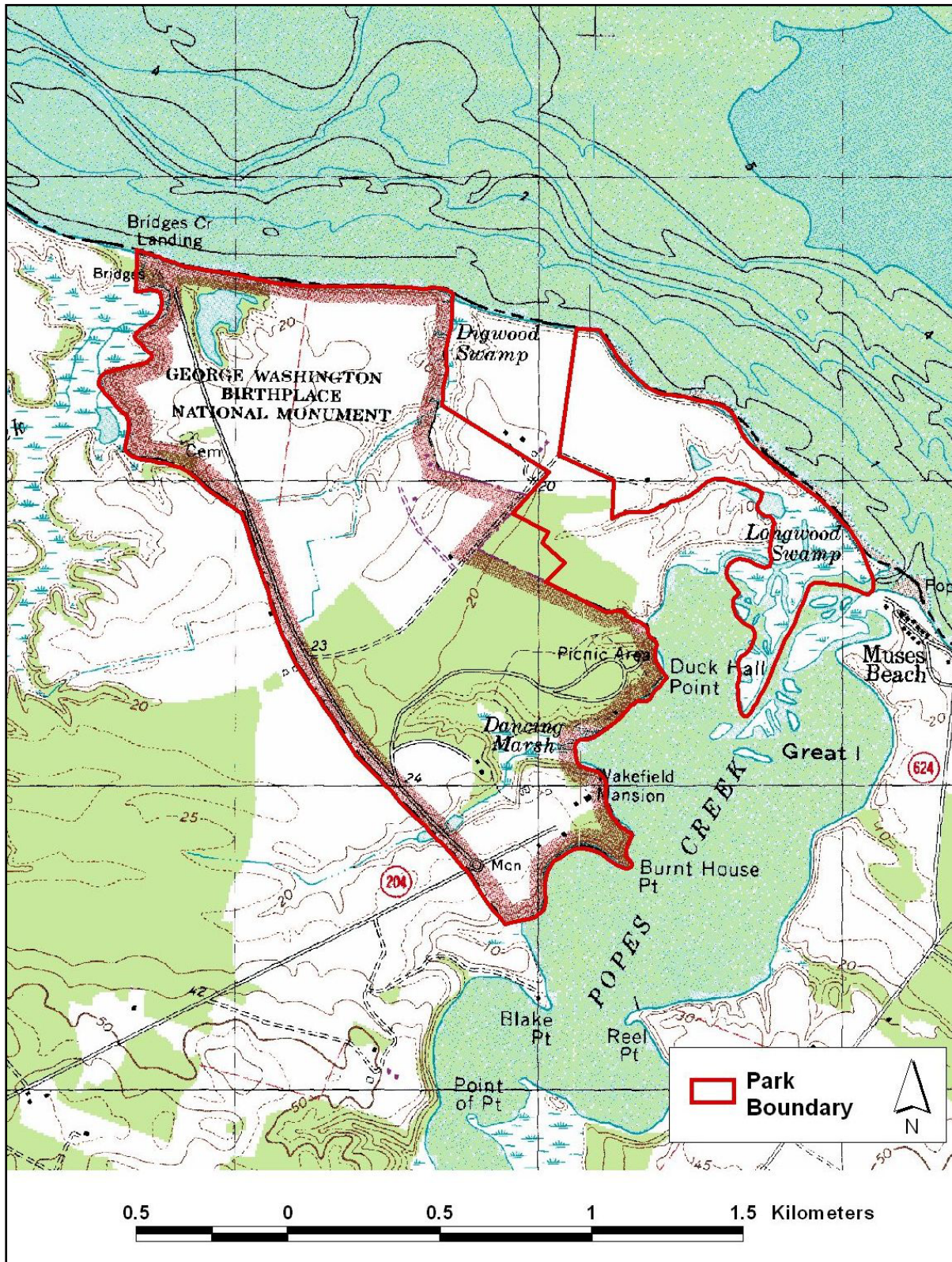


Figure 3. Location of George Washington Birthplace National Monument on the Colonial Beach South, VA 1:24000 USGS topographic quadrangle map.

loam (an Albaquult) and Lenoir silt loam (a Paleaquult). These soils are weathered from felsic or Coastal Plain sediments, have low base saturation, and greater than 35% clay in the surface horizons. The remaining wetland soils are classified as Aquents. In general, soils classed as Aquents are permanently or seasonally wet and they display bluish-gray (gleyed) or mottled horizons, even if artificially drained. Bohicket silty clay loam (a Sulfaquent) is found in the tidal marshes and along the shoreline. Small drainages in the park are mapped as Bibb (a Fluvaquent) and Levy soils (a Hydraquent). The upland soils in the park are all classed as Udults, which are deep, well-drained soils with low organic matter content. The majority of the uplands are mapped as Rumford fine sandy loam and Tetotum loam (both classed as Hapludults). Other upland soils are mapped as Montross silt loam, Nansemond fine sandy loam, and State fine sandy loam. These soils occur on flats and gentle to steep slopes throughout the park.

Two large tidal creeks, Popes Creek and Bridges Creek, form the east and west boundaries of the park. The western bank of the Potomac River delineates the northern boundary for 2.8 km (1.7 mi), from the mouth of Bridges Creek to the mouth of Popes Creek. There are four major tidal marsh areas in the park; Bridges Creek, Digwood Swamp, Longwood Swamp, and Dancing Marsh. A small, unnamed stream originates within the park and flows north into Digwood Swamp and then into the Potomac River. Longwood Swamp opens into Pope's Creek and is fed by a small stream that originates within the park. Another small unnamed stream originates outside the park, enters the park at the southern boundary and flows into Dancing Marsh. There are three freshwater ponds within the park boundary, at least two were formed by historic impoundment structures and one may be a fluvial erosion feature (NPS, Rick Morawe, Chief, Resources Management, George Washington Birthplace National Monument, pers. comm., 2007).

Methods

Project Scoping and Planning

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

The three entities worked cooperatively and with the NPS to develop accurate vegetation maps and a regional vegetation classification to apply to the vegetation of all seven parks. Ecologists at VADNH took the primary role in field data collection, data analysis, regional classification development, and map validation and editing. They developed the local association descriptions and the field key to map classes, and wrote the final reports. NatureServe reviewed the vegetation classification developed by VADNH and ensured that the USNVC standard was followed. They also took responsibility for entering all new information into the USNVC databases and completed global association descriptions. They assisted in the development of or reviewed field keys to the mapping units, and provided in-the-field consultation on problematic vegetation types. Researchers at NCSU-CEO were responsible for aerial photography acquisition and processing, preliminary photointerpretation, 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 George Washington Birthplace National Monument were reviewed for information pertinent to the park's vegetation. These included floristic surveys of the park and of Westmoreland County (Lam 1985; Dodge 2000), several studies examining tidal marsh vegetation (Mercer 1978; Wilcox 1989; Siberhorn and Shields 1995), a dendroecological study of a 5 ha (12.35 ac) pine - hardwood forest in the park (Abrams and Black 2000), and a previous inventory by VADNH (Ludwig and Pague 1993). Existing aerial photography (Virginia Geographic Information Network 2002), topographic maps and digital raster graphics (DRGs), National Wetland Inventory maps, the soil survey for Westmoreland County, VA, 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 George Washington Birthplace National Monument. Kucera International acquired color infrared, stereo pair 1:6,000 scale aerial photography for the leaf-on mosaic on October 20, 2001 and for the leaf-off mosaic on February 18, 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 and saved in .tif format, and placed in the air photo archive maintained at North Carolina State University for the NPS Northeast Region Inventory & Monitoring Program. Associated data and information provided by Kucera International, and also stored in the air photo archive, include the airborne global positioning system (GPS) and inertial mapping unit (IMU) data files, the camera calibration certificates for the cameras, and hardcopy flight reports for the photography that crosswalk the airborne GPS/IMU data to the photo frame numbers.

The leaf-on and leaf-off mosaics were produced from 24- and 23-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 airborne GPS and IMU data that Kucera International supplied with the aerial photography. Each photo block was manipulated until it could be triangulated with a root mean square error of less than 1. At this point, single frame orthophotos (one for each air photo) were generated within Imagine and exported to IMAGINE .lan format. Then the .lan files were imported into ER Mapper's native (.ers) format, and an ER Mapper algorithm was created which contains the color-balancing information and the cutlines created for each of the final mosaics. In ER Mapper, band interleaved by line (.bil) image and header files for each mosaic were generated, the .bil images were imported into IMAGINE .img format, and, finally, the .img images were compressed using MrSID software with a 20:1 compression ratio. The final mosaics, in both .img and MrSID formats, are stored in the NCSU-CEO data archive.

Preliminary Photointerpretation

A preliminary vegetation dataset for George Washington Birthplace 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 dataset, a photointerpreter, viewing the leaf-off and leaf-on mosaics in two dimensions, delineated visible areas of homogenous vegetation, land cover, and land use using ArcMap's onscreen digitizing tools. The minimum mapping unit was 0.5 ha (1.25 ac); however, the photointerpreter was able to delineate polygons as small as 0.2 ha (0.5 ac). After polygons were delineated for the entire park area, the photointerpreter created and populated three fields in the attribute table, entering a unique polygon identification number, the formation-level vegetation class or land use/land cover code, and notes if the interpreter was unsure of the appropriate code or could not assign a code. At the time this dataset was developed, the USGS-NPS Vegetation Mapping Program had no standard protocol for attributing developed and water-dominated land covers; therefore, user-defined codes were used to attribute developed areas and water, and codes developed by Mitchell (1995) were used to attribute urban landscapes. Next, the photointerpreter examined each polygon in three dimensions using ERDAS IMAGINE's Stereo Analyst software, checked the vegetation class code entered in the attribute table, and

entered a corrected vegetation class code, if appropriate. The final formation-level vegetation 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 George Washington Birthplace National Monument in June, September, and October 2002 and in August 2003. 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 (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 (1,076 ft²) 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 (4,305 ft²) 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 [52.5×82 ft], 13.33×30 m [43.75×98.4 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 1000 m² (10,764 ft²) 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 was measured or estimated at each plot (Table 3). Slope inclination was measured with a clinometer, and slope direction (aspect) was evaluated using a compass. Both measurements were taken to the nearest degree from the plot center. In plots with variable microtopography, slope was measured at several points and averaged. The percent cover of different surface substrates was estimated visually, with precision varying such that values sum to 100%. Topographic position, slope shape (both horizontally and vertically), soil drainage class, soil moisture regime, and inundation were assessed using scalar values. Landform was assessed at the landscape level using a topographic map and assigned to values from a standard landform classification (Driscoll et al. 1984). When conditions permitted, a digital photo was taken of each sampling location. Each vegetation sample was georeferenced using a GarminMap76s global positioning system (GPS), when possible. If a satellite reading could not be obtained, UTM coordinates were derived from the estimated position on a topographic quadrangle map. Elevation was also derived from the position on a topographic quadrangle map.

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

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

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

All field data for quantitative vegetation samples were entered into the PLOTS database version 2.0 (NatureServe 2004) and are provided as a supplement to this report. 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) subhydryc (water table at or near surface for most of the year) hydryc (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 from seven national parks in Virginia as of November 2002 were combined into a regional dataset 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 fieldwork 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 + 798 tidal).

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

Prior to analysis, most environmental variables were transformed, either to normalize frequency distributions or to assign numeric values to categorical variables. Topographic position and slope were converted to ordinal variables (Table 4). Aspect was transformed using the cosine method of Beers et al. (1966), using the formula $A' = \cos(45^\circ - A) + 1$, where A' = transformed

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

Topographic Position Values	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	

aspect and A = aspect in degrees. The Beers transformation is a commonly used formula for the conversion of the circular measure of slope aspect in degrees into linear values that can be used in correlation and regression analysis. Beers transformation yields values between 0 and 2 that are used to relate aspect to topographic moisture and solar exposure. Drier, solar exposed slopes (SW, 225°) have the lowest values, and moist, sheltered slopes (NE, 45°) 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 plot 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 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 dataset) ($\text{Mean Cover} - \text{Total Mean Cover}$). 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 dataset.
- 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 dataset. 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 $\text{DV} \times \text{Mean Cover}$ 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 dataset 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 dataset 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 (S); only species rooted inside plot boundaries were included in this calculation.
- Homoteneity - the average constancy of the S-most constant species, where S = mean species richness for the type. This value (*sensu* Curtis 1959) can be considered an index of the relative uniformity of a group of plots; higher values for homoteneity indicate greater uniformity in species composition among plots. Although homoteneity is not independent of group size, often increasing as the number of group members decreases, it can be used to evaluate whether community types have been defined at an appropriate level.

Environmental Summary Statistics

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

Ordination

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

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

Based on preliminary plots of stress vs. dimensionality, most ordinations were extracted in three dimensions (some were in two dimensions). Pearson's r^2 correlations between environmental

variables and ordination axes were calculated, and significant correlations were displayed through joint plot overlays. A joint plot is a diagram that shows the relationship of a set of variables and ordination scores. Radiating lines (vectors) representing environmental variables are depicted within ordination space. The angles and lengths of the radiating lines indicate the direction and strength of the relationship between the variable and the ordination scores. The 19 soil variables and 10 topographic variables used in ordination analyses are listed in Table 5.

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

Topographic variables and percentage substrate	
Beers Aspect	transformed aspect (Beers et al. 1966)
Slope Value	ordinal value for slope
Topographic 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)
Ca:Mg Ratio	calcium:magnesium ratio
CEC	cation exchange capacity (m.e.q. / 100 g)
Cu	extractable copper (in parts-per-million)
Fe	extractable iron (in parts-per-million)
Fertility	synthetic fertility index (= CEC X Base Saturation / 100)
K	exchangeable potassium (in parts-per-million)
Mg	exchangeable magnesium (in parts-per-million)
Mn	extractable manganese (in parts-per-million)
N	estimated nitrogen release (in lbs-per-acre)
Na	exchangeable sodium (in parts-per-million)
OM	% organic matter (by loss on ignition)
P	phosphorus (in parts-per-million)
pH	measure of acidity based on the activity of hydrogen
S	soluble sulphur (in parts-per-million)
Zn	extractable zinc (in parts-per-million)

Crosswalking Classification Units to the USNVC

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

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

Characterization of Vegetation

Once the regional vegetation classification was complete, vegetation classes across all seven parks were assigned a common name based on the Natural Communities of Virginia (Fleming et al. 2006) or, if no appropriate name existed in Fleming et al. (2006), the USNVC association common name was used, or a park-specific common name was assigned. Park-specific descriptions for all vegetation classes occurring at George Washington Birthplace National Monument were drafted using data from field observation points and quantitative plots. A dichotomous key to the vegetation occurring in George Washington Birthplace 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 vegetation class. The dichotomous key should be used in conjunction with the detailed vegetation class descriptions to confirm that the class selected with the key is appropriate.

Vegetation Map Preparation

Spatial data from observation points and quantitative plots were used to edit the formation-level maps of George Washington Birthplace National Monument to better reflect homogeneous 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 George

Washington Birthplace National Monument map was assigned to one of 19 map classes based on plot data, field observations, aerial photography signatures, and topographic maps.

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. For each plotted ground control point, field staff noted any alterations to the locations in the field, and then recorded the coordinates with a Trimble Pro XR/XRS or GeoXT. Mapped ground control points that were physically inaccessible were also noted. The field crew correctly located and collected accuracy assessment data at 22 ground control points for the leaf-on mosaic and at 27 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 were identified as outliers with SAS's JMP program and removed. The field-collected "true" or "reference" GPS coordinates for the remaining 20 points for the leaf-on mosaic and for the 27 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 Euclidean distance. 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.

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 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.

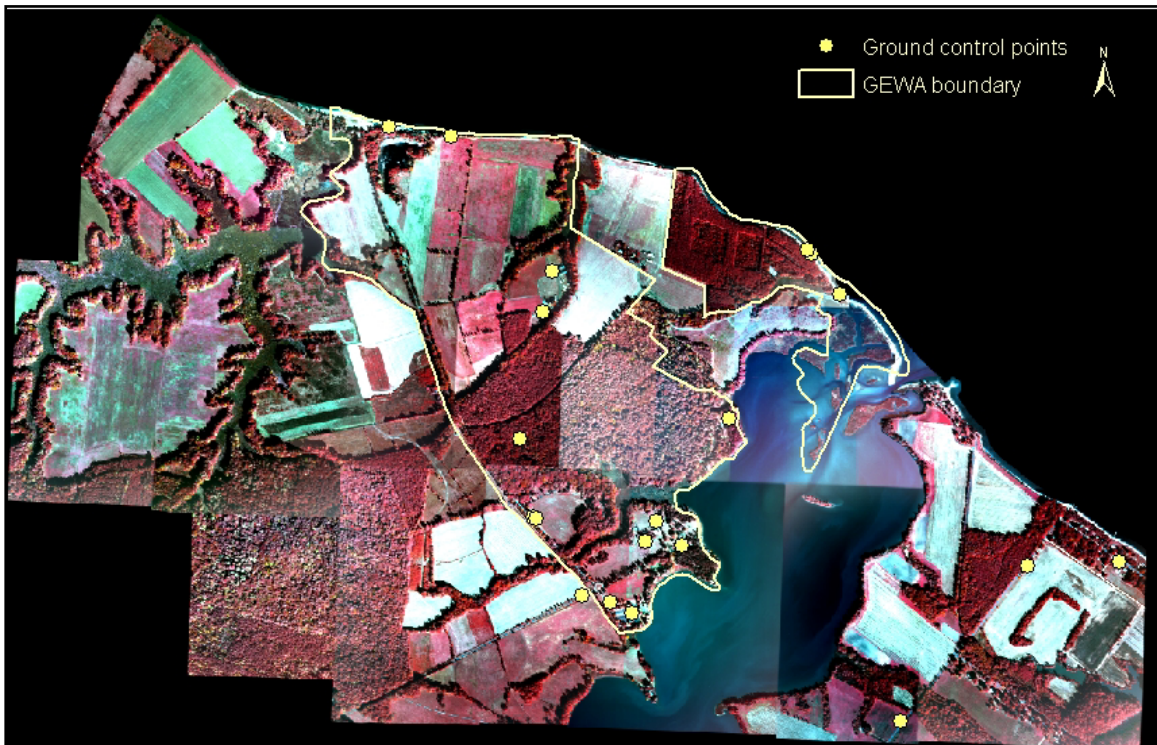


Figure 4. Ground control points used to calculate horizontal positional accuracy of the George Washington Birthplace National Monument (GEWA) leaf-on (fall) mosaic.



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

Metadata records for both mosaics and for the formation-level vegetation dataset were prepared in accordance with the current FGDC standards (FGDC 1998a). Metadata were produced in notepad and parsed using the USGS metadata compiler (USGS 2004). After all errors and omissions identified by the parser were corrected, the metadata compiler was used to generate final TXT, HTML, and XML versions of each metadata record which are stored in the air photo archive. Key information for the leaf on (fall) and leaf-off (spring) is summarized in Tables 6, and 7, and 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 George Washington Birthplace National Monument leaf-on (fall) mosaic.

Title of metadata record:	George Washington Birthplace National Monument Color Infrared Orthorectified Photomosaic-Leaf-on (ERDAS Imagine IMG and MrSID formats)
Publication date of mosaic (from metadata):	October 2, 2002
Date aerial photography was acquired:	October 20, 2001 (leaf-on)
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:	24
Archive location of air photos, airborne GPS/IMU files, and camera calibration certificate:	North Carolina State University, Center for Earth Observation
Scanning specifications:	600 dpi, 24-bit color depth
Horizontal positional accuracy of mosaics:	1.54 meters, meets Class 2 National Map Accuracy Standard
Number of ground control points upon which estimated accuracy is based:	20
Method of calculating positional accuracy:	Euclidean distance
Archive location of mosaics and metadata:	North Carolina State University, Center for Earth Observation
Format(s) of archived mosaics:	.img (uncompressed); MrSID (20:1 compression)

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

Title of metadata record:	George Washington Birthplace National Monument Color Infrared Orthorectified Photomosaic-Leaf-off (ERDAS Imagine IMG and MrSID formats)
Publication date of mosaics (from metadata):	October 2, 2002
Date aerial photography was acquired:	February 18, 2002 (leaf-off)
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:	23
Archive location of air photos, airborne GPS/IMU files, and camera calibration certificate:	North Carolina State University, Center for Earth Observation
Scanning specifications:	600 dpi, 24-bit color depth
Horizontal positional accuracy of mosaics:	1.08 meters, meets Class 1 National Map Accuracy Standard
Number of ground control points upon which estimated accuracy is based:	27
Method of calculating positional accuracy:	Euclidean distance
Archive location of mosaics and metadata:	North Carolina State University, Center for Earth Observation
Format(s) of archived mosaics:	.img (uncompressed); MrSID (20:1 compression)

Results

Field Surveys

Field work was completed in George Washington Birthplace National Monument in 2003. Data were collected from six quantitative vegetation plots and 120 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 and 2003 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. Of the 196 vascular plant species noted during fieldwork, 23 were nonnative species. One hundred nine vascular plant species were recorded in the six quantitative plots and an additional 87 species were noted only at observation points.

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 George Washington Birthplace 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 units 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) 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 five major vegetation groupings represented at George Washington Birthplace National Monument are 1) basic mesic and calcareous forests, 2) seepage wetlands, 3) nonriverine forests, 4) tidal herbaceous marshes, and 5) tidal forests and shrublands. 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 George Washington Birthplace National Monument are presented in Appendix G.

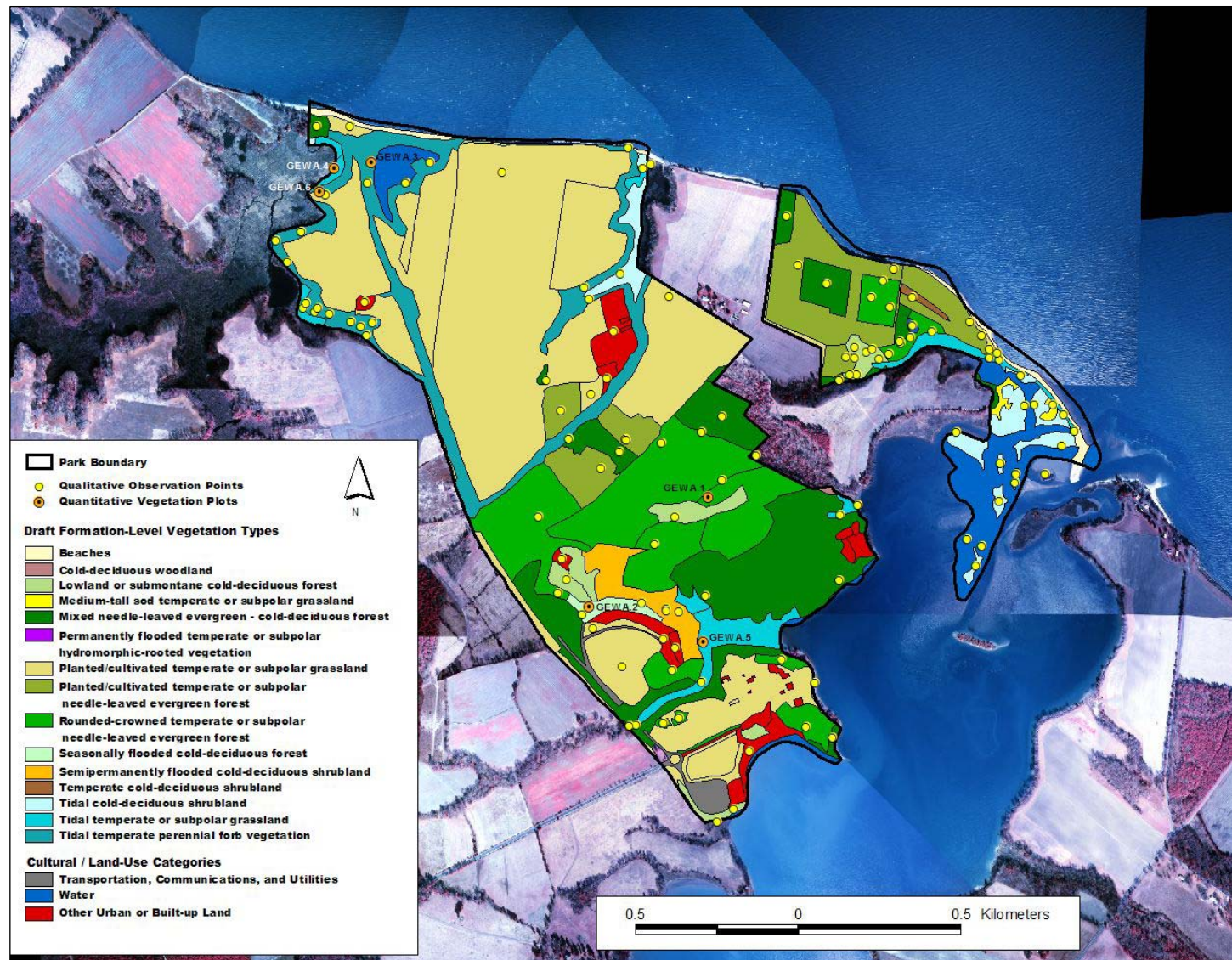


Figure 6. Locations of quantitative vegetation plots and qualitative observation points over the draft formation-level vegetation map of George Washington Birthplace National Monument.

The analysis results presented in Appendix F support the classification of plot samples into the five major vegetation groups represented at George Washington Birthplace 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 George Washington Birthplace 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 George Washington Birthplace National Monument. In this way, species and environmental relationships among associations can be examined in a regional context.

The classification of 77 basic mesic and calcareous forest sample plots is illustrated in Figures F1–F3 of Appendix F. Plot samples cluster into three compositionally similar groups in both the dendrogram and the three-dimensional ordination (Appendix F, Figures F1 and F2). Two associations in this group, Coastal Plain Mesic Calcareous Ravine Forest (CEGL007181) and Coastal Plain Dry Calcareous Forest (CEGL007748), are restricted to the Coastal Plain where they are found in association with Tertiary shell deposits. Coastal Plain Dry Calcareous Forest is represented in the analysis results by 24 sample plots, including two from George Washington Birthplace National Monument. The third association in this group, Inner Piedmont / Lower Blue Ridge Basic Mesic Forest (CEGL006186), is known from steep rocky sites of sub-montane landscapes in the western and northern Piedmont and on lower slopes of the Blue Ridge. All associations in this group have high soil fertility relative to all other upland forest types (Appendix E), but even within this group, soil nutrients have a strong influence on vegetation pattern. Axis 1 of the joint plot (Appendix F, Figure F3) is highly correlated with the joint plot vectors representing pH, calcium:magnesium ratio, and fertility index. In the context of this ordination, plot samples representing the calcareous forest present at George Washington

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 George Washington Birthplace National Monument. Two-dimensional ordinations have "n/a" listed in Axis 3 column.

Vegetation Group	Increment			Cumulative
	Axis 1	Axis 2	Axis 3	
basic mesic and calcareous forests	0.341	0.272	0.215	0.828
seepage wetlands	0.320	0.531	n/a	0.860
nonriverine forests	0.064	0.539	0.225	0.818
tidal herbaceous marshes	0.291	0.220	0.214	0.725
tidal forests and shrublands	0.718	0.126	n/a	0.843

Birthplace National Monument are correlated with some of the highest values of soil fertility variables and lower values of Topographic Relative Moisture Index (TRMI). Coastal Plain Dry Calcareous Forest is known from steep, usually south-facing, erosive ravine slopes that have cut down into deposits of shells and limesands. Plots classified as this association have the highest average soil pH values (6.5) and soil calcium (4707 ppm) of any upland forests in the study (Appendix E). A compositional summary of the association is presented in Appendix G, Table G1. The two plot samples from George Washington Birthplace National Monument are representative, if somewhat depauperate, examples of Coastal Plain Dry Calcareous Forest. They lack some of the nominal species and have rather low species richness for the type, most likely because of past disturbances. The mean species richness for the association is 67 species (Appendix G, Table G1). The plots from George Washington Birthplace National Monument have 35 and 51 species in each plot sample, respectively. Coastal Plain Dry Calcareous Forest is a globally rare natural community (G1) found only in scattered locations in Virginia and Maryland. This association is also found at Colonial National Historical Park, but is not at any of the other parks included in this study (Appendix C).

Classification results for the seepage wetland group are presented in Figures F4–F6 of Appendix F. Plot samples from 72 seepage wetlands cluster into three compositionally similar groupings in both the dendrogram and the two-dimensional ordination (Appendix F, Figures F4 and F5). Axis 1 of the joint plot (Appendix F, Figure F6) is highly correlated with the joint plot vectors representing pH, calcium:magnesium ratio, base saturation, and fertility index, while axis 2 is significantly correlated with high percentage cover of boulders. The only seepage wetland present in George Washington Birthplace National Monument is Coastal Plain / Piedmont Acidic Seepage Swamp (CEGL006238). Plots classified as this association have the lowest average soil pH value in the group and low levels of base cations (Appendix E). A compositional summary of the association is presented in Table G2 of Appendix G. The single plot from the park is compositionally representative of the association, lacking only one nominal species, sweetbay (*Magnolia virginiana*), and with many of the constant species. This association is found in four of the seven national parks included in this study (Appendix C). The remaining two seepage wetland associations represent basic seepage swamps and occur on high base status soils with high cation levels (Appendix F, Figure F6). All three seepage wetland associations are considered either globally rare or uncommon in the state of Virginia (Appendix C).

The nonriverine forest group is presented in Appendix F, Figures F7–F9. Plot samples from 62 nonriverine forest plots cluster into four compositionally distinct groupings in the dendrogram, the two-dimensional ordination, and the three-dimensional ordination (Appendix F, Figures F7–F9). The associations show the most separation in terms of species composition along axis 2 of the ordinations (Table 8; Appendix F, Figure F8). Ordination scores were not significantly correlated with available environmental data; however, as a group, these forests have low values for soil chemistry variables, indicating acid soils with low fertility (Appendix E). Only one association, Non-Riverine Saturated Forest (CEGL004644), is found in George Washington Birthplace National Monument. A compositional summary for this association is presented in Appendix G, Table G3. The single sample plot from George Washington Birthplace National Monument is depauperate for the type, with only three of the six nominal species and lacking many of the indicative herbaceous species. Non-Riverine Saturated Forest occurs in four of the seven national parks included in this study. All four of the nonriverine forest associations

recognized in this analysis are uncommon to rare in the mid-Atlantic region and three are globally rare (Appendix C).

Classification of 129 tidal herbaceous marsh plots is illustrated in Appendix F, Figure F10. The dendrogram shows eight distinct compositional groupings that correspond to eight tidal marsh associations. The ordination of these same plot samples do not show as clear a separation of associations along the three ordination axes (Appendix F, Figure F11). The eight associations were grouped into three map classes that were used to map tidal herbaceous marshes. Figure F12 illustrates how these three map classes separate along all three ordination axes.

Environmental relationships were not explored due to lack of environmental data for the majority of the tidal herbaceous plot samples. Four associations illustrated in the dendrogram (Appendix F, Figure F10) are found at George Washington Birthplace National Monument. Only Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) was plot sampled at the park. The remaining three associations, Tidal Oligohaline Marsh (Mixed Forbs Type), Tidal Oligohaline Marsh (Common Reed Tidal Marsh), and Tidal Oligohaline Marsh (Big Cordgrass Type), were very small or disturbed examples. Compositional summaries for these four associations are presented in Tables G4–G7. These four tidal marsh associations are common in the mid-Atlantic region, but have not yet been given conservation ranks. They are also found at Colonial National Historical Park, but not at the other five parks included in this study (Appendix C).

Figure F13 in Appendix F illustrates the classification of 94 tidal forest and shrubland plot samples. The same groupings segregate on axis 1 of the two-dimensional ordination (Figure F14) which represents 72% of the variance in the compositional data (Table 8). Environmental relationships were not explored due to lack of environmental data for the tidal forest and shrubland plot samples. Only one of the four associations classified in this group is present at George Washington Birthplace National Monument, Tidal Shrub Swamp (Iva Type). A compositional summary of this association is presented in Appendix G, Table G8. This association was not plot sampled at George Washington Birthplace National Monument, but was positively identified through observation. The other three associations in this group all occur at Colonial National Historical Park and not in the other six national parks in this study. All are common tidal communities in the mid-Atlantic region except for the globally rare Tidal Bald Cypress Forest / Woodland, which is found only in Virginia and Maryland in very specific environmental settings.

In addition to the vegetation classes derived from quantitative analysis, other vegetation classes used to describe the vegetation in the seven parks were developed from qualitative observations in the parks. Many of these qualitatively-derived units were crosswalked to the USNVC association level, while others were not appropriate for inclusion in the USNVC, and were described as nonstandard, park-specific vegetation classes. A total of 19 associations and 12 nonstandard park-specific vegetation classes representing disturbed or cultural vegetation were recognized from the seven parks. George Washington Birthplace National Monument had nine of these cultural, disturbed, or exotic vegetation classes. Seven of these vegetation classes were crosswalked to the association level of the USNVC and two represented vegetation that had no defined classification in the USNVC. These two vegetation classes were given nonstandard, park-specific names to describe the vegetation in George Washington Birthplace National Monument. 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

Nineteen map classes were used in the vegetation map for George Washington Birthplace 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 19 map classes used to map the park and shows the relationships to standard classifications and to the regional vegetation classes developed for the seven parks in this study. Sixteen of the 19 map classes were crosswalked to the finest level of the USNVC (association). Two of the 19 map classes were described as nonstandard, park-specific vegetation classes and four 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 George Washington Birthplace National Monument were written based on information collected within the park boundary. Because of the difficulty of distinguishing some associations in the field or on photography, two map classes, Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest and Tidal Oligohaline Marsh are crosswalked to more than one association. A detailed local description was written for each association within these two map classes. All map classes crosswalked to the association level of the USNVC include range wide descriptions (i.e. global descriptions). Global descriptions of the USNVC associations were extracted from the September 26, 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) 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 each description, except for Tidal Oligohaline Marsh (Big Cordgrass Type). 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 USNVC 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 George Washington Birthplace National Monument vegetation map classes is presented in Appendix J. The dichotomous key should be used in conjunction with the detailed descriptions.

Table 9. Vegetation-map classes and corresponding USNVC associations (NatureServe 2007) or other classification for George Washington Birthplace National Monument. Where a map class represents more than one vegetation class in the regional classification, a unique common name is listed for each vegetation class.

Map Class	USNVC Association (association code)	Regional Vegetation or Land-use Class * (name source)
Beaches	Not defined - Anderson Land-use class	Beaches (72) (Anderson et al. 1976)
Coastal Plain / Piedmont Acidic Seepage Swamp	<i>Acer rubrum</i> - <i>Nyssa sylvatica</i> - <i>Magnolia virginiana</i> / <i>Viburnum nudum</i> var. <i>nudum</i> / <i>Osmunda cinnamomea</i> - <i>Woodwardia areolata</i> Forest (CEGL006238)	Coastal Plain / Piedmont Acidic Seepage Swamp (Fleming et. al 2006)
Coastal Plain Dry Calcareous Forest	<i>Quercus muehlenbergii</i> / <i>Cercis canadensis</i> / <i>Dichanthelium boscii</i> - <i>Bromus pubescens</i> - <i>Erigeron pulchellus</i> var. <i>pulchellus</i> - <i>Aquilegia canadensis</i> Forest (CEGL007748)	Coastal Plain Dry Calcareous 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)
Disturbed Acidic Slope Forest	<i>Liquidambar styraciflua</i> - <i>Quercus (nigra, phellos)</i> - <i>Pinus taeda</i> / <i>Vaccinium elliotii</i> - <i>Morella cerifera</i> Forest (CEGL007726)	Disturbed Acidic Slope Forest (park-specific name)
Disturbed Calcareous Forest	Not defined - nonstandard, park-specific vegetation class	Disturbed Calcareous Forest (park-specific name)
Loblolly Pine - Hardwood Forest	<i>Pinus taeda</i> - <i>Liquidambar styraciflua</i> Semi-natural Forest (CEGL008462)	Loblolly Pine - Hardwood Forest (park-specific name)
Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest	<i>Pinus taeda</i> Planted Forest (CEGL007179) OR <i>Pinus taeda</i> / <i>Liquidambar styraciflua</i> - <i>Acer rubrum</i> var. <i>rubrum</i> / <i>Vaccinium stamineum</i> Forest (CEGL006011)	Loblolly Pine Plantation (NatureServe 2007)
		Early-Successional Loblolly Pine Forest (park-specific name)
Non-Riverine Saturated Forest	<i>Quercus (phellos, pagoda, michauxii)</i> / <i>Ilex opaca</i> var. <i>opaca</i> / <i>Clethra alnifolia</i> / <i>Woodwardia areolata</i> Forest (CEGL004644)	Non-Riverine Saturated Forest (Fleming et. al 2006)

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

Table 9. Vegetation-map classes and corresponding USNVC associations (NatureServe 2007) or other classification for George Washington Birthplace National Monument. Where a map class represents more than one vegetation class in the regional classification, a unique common name is listed for each vegetation class (continued).

Map Class	USNVC Association (association code)	Regional Vegetation or Land-use Class * (name source)
Other Urban or Built-up Land	Not defined - Anderson Land-use class	Other Urban or Built-up Land (17) (Anderson et al. 1976)
Semipermanent Impoundment	Not defined - nonstandard, park-specific vegetation class	Semipermanent Impoundment (park-specific name)
Successional Black Locust Forest	<i>Robinia pseudoacacia</i> Forest (CEGL007279)	Successional Black Locust Forest (NatureServe 2007)
Successional Red-cedar Forest	<i>Juniperus virginiana</i> Forest (CEGL006024)	Successional Red-cedar Forest (park-specific name)
Successional Sweetgum Forest	<i>Liquidambar styraciflua</i> Forest (CEGL007216)	Successional Sweetgum Forest (NatureServe 2007)
Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh)	<i>Spartina alterniflora</i> - <i>Distichlis spicata</i> Tidal Herbaceous Vegetation (CEGL006586)	Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) (Fleming et al. 2006)
Tidal Oligohaline Marsh	<i>Phragmites australis</i> Tidal Herbaceous Vegetation (CEGL004187) OR <i>Spartina cynosuroides</i> Herbaceous Vegetation (CEGL004195) OR <i>Hibiscus moscheutos</i> - <i>Polygonum punctatum</i> - <i>Peltandra virginica</i> Tidal Herbaceous Vegetation (CEGL006181)	Tidal Oligohaline Marsh (Common Reed Tidal Marsh) (park-specific name)
		Tidal Oligohaline Marsh (Big Cordgrass Type) (Fleming et al. 2006)
		Tidal Oligohaline Marsh (Mixed Forbs Type) (Fleming et al. 2006)
Tidal Shrub Swamp (Iva Type)	<i>Iva frutescens</i> / <i>Spartina patens</i> Shrubland (CEGL006848)	Tidal Shrub Swamp (Iva Type) (park-specific name)
Transportation, Communications, and Utilities	Not defined - Anderson Land-use class	Transportation, Communications, and Utilities (14) (Anderson et al. 1976)
Water	Not defined - Anderson Land-use class	Water (53/54) (Anderson et al. 1976)

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

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 uses (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 George Washington Birthplace 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.

Because Early-Successional Loblolly Pine Forest can be difficult to distinguish from abandoned Loblolly Pine Plantations, these two associations were combined into one map class; Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest. Seven of the 11 polygons of Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest are in discernible rows and are tagged as “plantation” in the comment field of the map attribute table. The remaining polygons in this map class are successional loblolly pine of uncertain origin, perhaps from natural regeneration or the result of “failed” or abandoned plantations. Polygons of the map class Tidal Oligohaline Marsh may be one of three associations included in that map class. Due to the difficulty of delineating these three associations separately over large areas, these associations were combined into a single map class that was used in all parks in this study. Other Urban or Built-up Land is further distinguished in the comment field of the map attribute table if it represents either a forested developed area, cemetery, or water tower. Polygons attributed with Anderson Level II class 14 (Transportation, Communication, and Utilities) are further attributed in the comment field to identify what feature they represent (utilities or transportation).

A field was included in the map attribute table to indicate which United States Fish and Wildlife Service (USFWS) wetland system (*sensu* Cowardin et al. 1979) the map classes 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), as well as areas of open water and intertidal beaches, 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. A map of polygons representing the wetland map classes is shown in Figure 8. This is not a map of jurisdiction wetlands, but rather a map of the distribution of wetland map classes; those with USNVC formations containing wetland modifiers (seasonally flooded, saturated, semipermanently flooded, tidal) or unvegetated areas of open water or intertidal beaches. The hydrology of the map class may not represent the hydrology on the ground and small areas of wetlands may be included within polygons classed as “upland.” The vegetation map of George Washington Birthplace National Monument includes eight wetland map classes which represent two USFWS Systems.

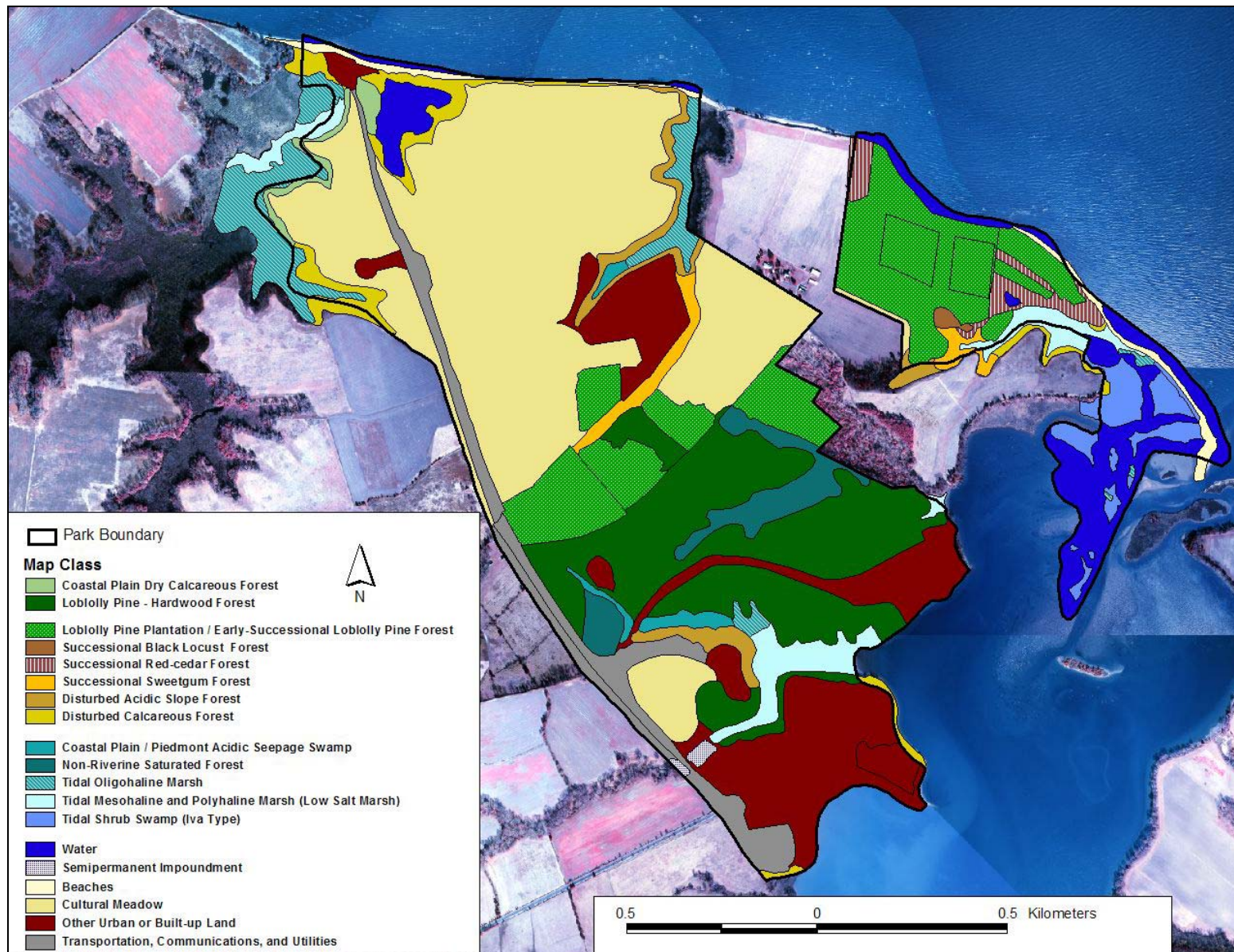


Figure 7. Vegetation and Anderson Level II map classes for George Washington Birthplace National Monument.

Table 10. Number of polygons, total mapped hectares, mapped hectares within the park boundary, and number of quantitative plots sampled and observations for 19 vegetation-map classes at George Washington Birthplace National Monument.

Map Class - Local Name	Number of polygons	Total mapped hectares	Mapped hectares within park boundary	Number of plots sampled	Number of observations
Beaches	2	2.528	2.145	0	1
Coastal Plain / Piedmont Acidic Seepage Swamp	3	1.568	1.568	1	4
Coastal Plain Dry Calcareous Forest	2	1.699	1.592	2	4
Cultural Meadow	5	71.870	71.870	0	5
Disturbed Acidic Slope Forest	3	4.570	4.123	0	5
Disturbed Calcareous Forest	7	6.326	4.465	0	9
Loblolly Pine - Hardwood Forest	5	34.228	34.228	0	8
Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest	11	29.212	29.212	0	22
Non-Riverine Saturated Forest	2	5.852	5.852	1	3
Other Urban or Built-up Land	8	29.531	29.531	0	16
Semipermanent Impoundment	2	0.412	0.412	0	2
Successional Black Locust Forest	1	0.333	0.333	0	2
Successional Red-cedar Forest	2	2.952	2.851	0	6
Successional Sweetgum Forest	2	2.852	2.498	0	2
Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh)	4	7.245	5.425	2	6
Tidal Oligohaline Marsh	7	9.700	4.415	0	9
Tidal Shrub Swamp (Iva Type)	11	4.717	4.496	0	13
Transportation, Communications, and Utilities	3	10.956	10.956	0	1
Water	8	14.445	14.445	0	2
TOTAL	88	240.9	230.4	6	120

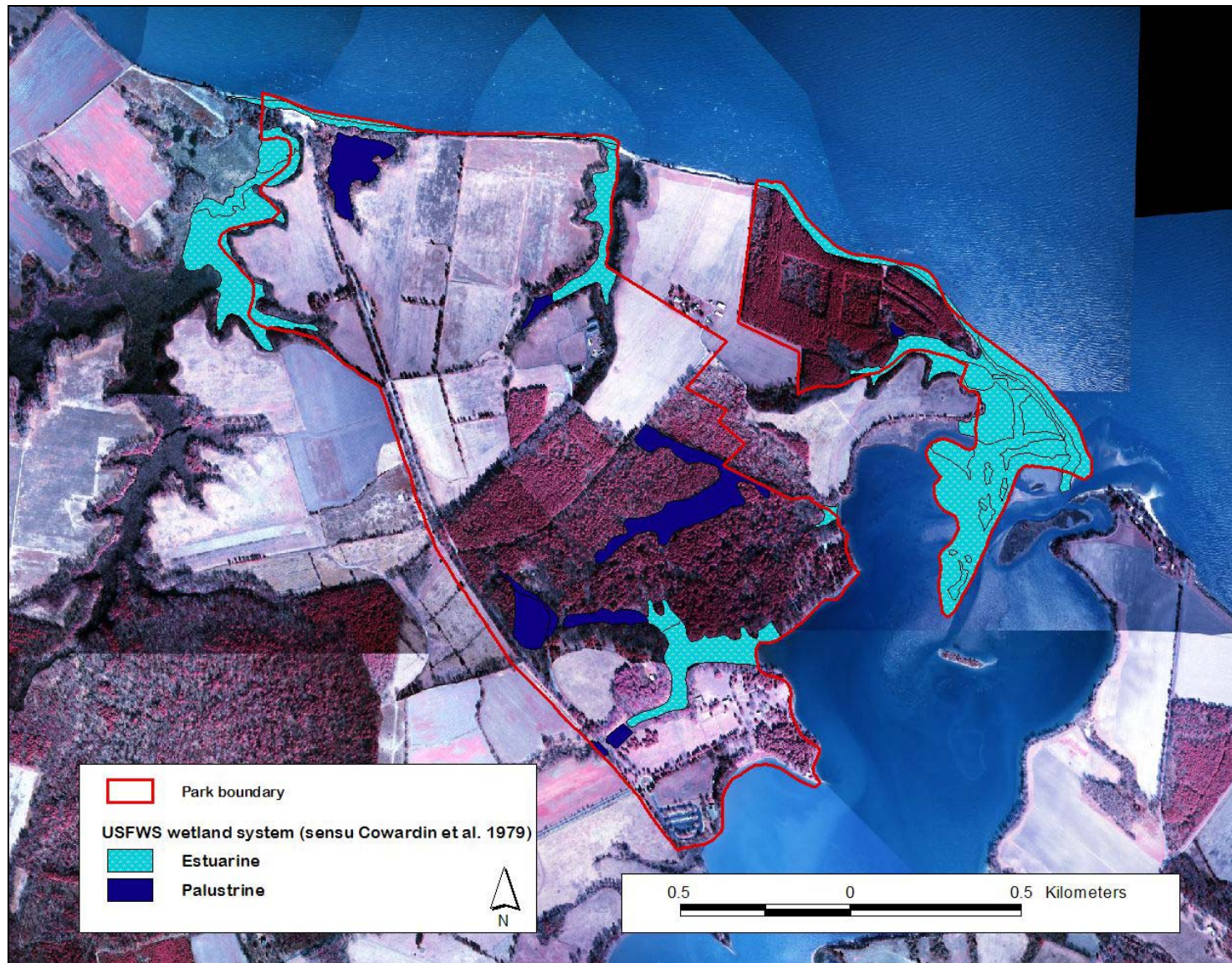


Figure 8. Distribution of wetland vegetation-map classes in George Washington Birthplace National Monument.

Accuracy Assessment

The final horizontal positional accuracy of the leaf-on and leaf-off mosaics is 1.54 meters (meets Class 2 National Map Accuracy Standard) and 1.08 meters (meets Class 1 National Map Accuracy Standard), respectively (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 air photo 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 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 Virginia Department of Conservation and Recreation, Division of Natural Heritage 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 George Washington Birthplace 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, thirty-five of which are represented in the seven national 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. This study at George Washington Birthplace National Monument identified and characterized 19 map classes, representing 16 USNVC associations, four Anderson Level II land-use classes (Anderson et al. 1976), and two nonstandard, park-specific vegetation classes representing disturbed or cultural vegetation (Table 9).

The ongoing management to maintain the historic and cultural landscape of a 1730s rural plantation has a significant influence on the vegetation present in the park. Maintained cultural map classes represent 49% of the park's acreage. Cultural Meadow is the most common map class in the park, covering 72 ha (178 ac). Other cultural map classes include Other Urban or Built-Up Land; Transportation, Communications, and Utilities; and Semipermanent Impoundment.

Early successional or transitional vegetation covers 19% of the land in the park. This vegetation has resulted from relatively recent (20–80 years) abandonment of pine plantations and fields or tree canopy removal by disturbances such as wind or silvicultural practices. This transitional vegetation occurs as fringes on the edges of fields and developed areas, and on former agricultural or silvicultural sites. These stands are dominated by early successional weedy tree species in the canopy and subcanopy and can have high cover of nonnative invasive plants in the shrub and herbaceous layers. Map classes representing early successional or transitional vegetation include Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest, Disturbed Calcareous Forest, Disturbed Acidic Slope Forest, Successional Red-cedar Forest, Successional Sweetgum Forest, and Successional Black Locust Forest. Associations in these map classes are described in Appendix H.

Wetland map classes account for 17% of the park area or about 39 ha (96 ac). These map classes include areas of open water in Pope's Creek and in ponds (15 ha [38 ac]), as well as tidal wetlands (16 ha [41 ac]), forested wetlands (7 ha [18 ac]), and other nontidal wetlands (0.4 ha [1 ac]). Tidal wetlands (including intertidal beaches) cover approximately 7% of the park area. Tidal vegetation is represented by the map classes Tidal Oligohaline Marsh, Tidal Mesohaline and Polyhaline Marsh (Low Salt marsh), and Tidal Shrub Swamp (Iva Type). Tidal Oligohaline Marsh occurs along Bridges Creek, Digwood Swamp, and in the upper reaches of Dancing Marsh and is dominated by species indicative of oligohaline conditions, where salt concentrations are between 0.5 and 5 ppt. The majority of this vegetation in the park is the association Tidal Oligohaline Marsh (Mixed Forbs Type) [CEGL006181] which can be variously dominated by narrowleaf cattail (*Typha angustifolia*), crimson-eyed rosemallow (*Hibiscus moscheutos*), or swamp loosestrife (*Decodon verticillatus*). When these species occur as patch dominants, they may reflect different environmental or disturbance regimes. Areas cut off from regular tidal flooding or areas further from the reach of tidal influence (upper stream reaches)

will have a more seasonally flooded or saturated hydrology and are strongly dominated by swamp loosestrife. Areas with regular tidal flooding are more strongly dominated by crimsoneyed rosemallow. Areas with more freshwater inputs or eutrophication (i.e. nutrient inputs, either natural or artificial) will have dominance by narrowleaf cattail. Other small areas of Tidal Oligohaline Marsh are dense stands of the invasive, nonnative grass common reed (*Phragmites australis*) or a single stand of big cordgrass (*Spartina cynosuroides*). Due to the difficulty of delineating these three associations separately over large areas, these associations were combined into a single map class that was used in all parks in this study. Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) is found as small pocket marshes opening into Pope's Creek at Longwood Swamp, Duck Hall Point, and Dancing Marsh, and along Bridges Creek near its confluence with the Potomac River. This tidal vegetation is characterized by plants associated with mesohaline or polyhaline conditions, where salt concentrations are between 5 and 18 ppt or 18 to 30 ppt, respectively. Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) has a shorter stature than Tidal Oligohaline Marsh and is dominated by smooth cordgrass (*Spartina alterniflora*) and/or saltmeadow cordgrass (*Spartina patens*). Tidal Shrub Swamp (Iva Type) covers about 4.5 ha (11 ac) in the park and is found on tidal islands in Pope's Creek at the mouth of Longwood Swamp. These dense shrublands are dominated by the shrub Jesuit's bark (*Iva frutescens*) and salt marsh herbs.

Nontidal forested wetlands include two map classes that cover just over 7.5 ha (18.5 ac) in the park. Disturbed examples of Coastal Plain / Piedmont Acidic Seepage Swamp are found at the heads of ravines above Dancing Marsh and Digwood Swamp where seepage discharged at the base of slopes is drained away as streamflow, creating small "headwater" wetlands. These two areas in the park may have nutrient inputs from the surrounding pasture lands as well as an altered hydrology. While they share many species in common with undisturbed examples of the Coastal Plain / Piedmont Acidic Seepage Swamp, they also have species indicative of nutrient-enriched soils (see description in Appendix H). Another forested wetland in the park, Non-Riverine Saturated Forest, is an example of a globally rare community. Non-Riverine Saturated Forest is restricted to extensive, flat terraces and very wide, ancient floodplains that are no longer subject to alluvial processes. These specialized wetland habitats were probably never common on the landscape. Non-Riverine Saturated Forest is only known from about 25 sites in 13 counties in Virginia and it may range into Maryland. Much of the suitable habitat for the association has been lost to agriculture, hydrologic alterations, and conversion of hardwood forests to silvicultural pine plantations. The example of Non-Riverine Saturated Forest at George Washington Birthplace National Monument is found on an ancient river terrace of the Potomac and has been impacted by historical anthropogenic activities. It is much smaller than other known occurrences of this association, occurring in two patches 1.4 and 4.5 ha (3.4 and 11.0 ac) in size. Hydric oaks such as cherrybark oak (*Quercus pagoda*), pin oak (*Quercus palustris*), willow oak (*Quercus phellos*), and swamp chestnut oak (*Quercus michauxii*) are typical of the association and can be found scattered throughout the stands in the park, but many other typical indicator species are missing and successional species (loblolly pine and sweetgum) predominate. Nonnative species are extensive in some areas, but not dominant over the native species component. These compositional differences are likely due to hydrologic alteration, past cutting of oaks, and the fact that the stand is surrounded by cultural and semi-natural vegetation and isolated from a functioning natural landscape.

Semipermanent Impoundments are nontidal wetlands associated with persistent man-made impoundments and ditching. The Semipermanent Impoundment map class covers less than 1 ha (2.5 ac) at George Washington Birthplace National Monument and includes an anthropogenic pond at the upper reaches of Dancing Marsh and the associated disturbed wetland south of the pond that extends outside the park boundary. The pond is in a natural drainageway that was artificially deepened and dammed in the past. This vegetation once may have been part of a natural freshwater marsh but has been highly disturbed within an agricultural landscape.

Two upland forest map classes that represent later-successional vegetation cover 36 ha (80.5 ac) or 16% of the park land. Loblolly Pine - Hardwood Forest is a middle- to late-successional pine forest that forms the forested matrix around Dancing Marsh, Pope's Creek Trail/Picnic area, and the area south of 'Muse Road.' Abrams and Black (2000) suggest that this area became forested after agricultural abandonment in the early 1800s and, although it has been forested since the mid-1800s, the forest has been selectively logged several times and subjected to other natural and artificial disturbances (e.g. southern pine bark beetle, ditching, windthrow). While the older pines in this forest are 60 to 100+ years old, there are areas of regeneration and much younger forest within this map class. Historically, portions of this association could have been a deciduous forest similar to Non-Riverine Saturated Forest, but hydrologic alterations from historic ditching and forest removal created conditions more favorable to the establishment of loblolly pine.

Another upland forest, Coastal Plain Dry Calcareous Forest, is found in two small patches totaling 1.7 ha (4.2 ac) in the vicinity of Bridges Creek Landing. Coastal Plain Dry Calcareous Forest is a globally rare association known from fewer than 30 scattered locations in the Coastal Plain of Virginia and Maryland. These forests develop on the steep, convex, south-facing slopes of deep ravines and stream-fronting bluffs that have downcut into Tertiary shell deposits or limesands. Warm aspects and dry, highly calcareous soils appear to be the principal environmental factors influencing this association. Due to their occurrence on short, steep slopes with unstable but highly calcareous soils, these forests are vulnerable to wind throw, soil erosion, and invasion by nonnative species. The example of this globally rare community at George Washington Birthplace National Monument has some of the largest, and perhaps oldest, trees in the park. The canopy supports large, old chinkapin oak (*Quercus muehlenbergii*) and bitternut hickory (*Cary cordiformis*), perhaps undisturbed for a century or more. The largest individual trees in this association measured 79 and 85 cm (31 and 33 in) diameter at breast height (1.4 m [4.5 ft] above the ground). The example of Coastal Plain Dry Calcareous Forest in the park has nonnative species in the shrub and herb strata and lacks some of the typical indicators of the association. It exists as an isolated forest fragment, almost entirely surrounded by agricultural land use and is vulnerable to further degradation by invasive, nonnative plants. The map class Disturbed Calcareous Forest occurs on areas that may have once supported Coastal Plain Dry Calcareous Forest, but are now structurally and compositionally altered by canopy removal and subsequent succession by weedy or nonnative plants.

Of the 19 map classes used to map the vegetation at George Washington Birthplace National Monument, six are natural communities as defined in the Natural Communities of Virginia (http://www.dcr.virginia.gov/natural_heritage/nctoc.shtml): Coastal Plain / Piedmont Acidic Seepage Swamp, Coastal Plain Dry Calcareous Forest, Non-Riverine Saturated Forest, Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh), Tidal Oligohaline Marsh, and Tidal Shrub

Swamp (Iva Type). Exemplary occurrences of these communities are tracked by the Virginia Division of Natural Heritage. In order to be considered an exemplary occurrence, stands have to meet strict type-specific criteria of size, condition, and landscape context. All globally rare (G1 or G2) communities are tracked, regardless of their size, condition, and landscape context. Two globally rare communities were documented at the park as part of this study, Coastal Plain Dry Calcareous Forest and Non-Riverine Saturated Forest. The other four natural communities 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.

Vegetation Map Production

The original formation-level vegetation map identified 15 vegetation formations and three 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 map for George Washington Birthplace National Monument depicts 19 map classes. Thirteen map classes are crosswalked to 16 USNVC vegetation associations, two are nonstandard, park-specific vegetation classes, and four are Anderson Level II land-use classes. Because of the difficulty of distinguishing some associations in the field or on photography, two map classes, Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest and Tidal Oligohaline Marsh, represent more than one association. Each polygon representing a USNVC association was attributed with the appropriate USNVC formation and alliance based on the hierarchy of the USNVC. The final map table includes eight formations and 10 alliances.

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

Restoration and management of the two globally rare natural communities at George Washington Birthplace National Monument would be difficult and costly and may conflict with historic resource management objectives. Both of the natural communities have very restricted ranges and very few high quality occurrences are known. Most known examples are not on protected lands and, thus, are vulnerable to destruction. While the examples of these associations at George Washington Birthplace National Monument are not pristine or exemplary, they do represent opportunities for restoration and management of some of the rarest natural communities in the mid-Atlantic region.

Restoration of the Non-Riverine Saturated Forest would require restoration of its natural hydrology (seasonally to permanently saturated) and restoration of the mainly deciduous physiognomy with a canopy dominated by hydric oaks. Attempts to restore the natural hydrology could include blocking historic colonial ditches. Canopy structure could be effected by selective removal of early successional species such as sweetgum and loblolly pine, and other

management to promote recruitment of existing oak species. Seedlings and saplings of hydric oak species like cherrybark oak, pin oak, willow oak, and swamp chestnut oak could be transplanted from other areas in the park. Carefully monitoring and control for invasive, nonnative species would be necessary in and around the restoration area.

The main threat to the Coastal Plain Dry Calcareous Forest at George Washington Birthplace National Monument is the establishment of nonnative plant species which compete with the native flora and alter the species composition of this globally rare community. Seven nonnative species were noted in the Coastal Plain Dry Calcareous Forest, and five of these are considered invasive by Virginia Department of Conservation and Recreation (Heffernan et al. 2001, VADCR 2003). Invasive nonnative plants oriental bittersweet (*Celastrus orbiculatus*), meadow ryegrass (*Lolium pratense*), English ivy (*Hedera helix*), Chinese privet (*Ligustrum sinense*), and Japanese honeysuckle (*Lonicera japonica*) were all noted in this forest. Efforts should be made to remove these species within and around the Coastal Plain Dry Calcareous Forest. Future invasions may be better controlled by creation of a shaded woodland buffer between the agricultural field and the forested slope. The appropriate species to plant in a buffer area include oaks, hickories, and eastern redcedar.

Other invasive nonnative plant species noted in the park include Russian olive (*Elaeagnus angustifolia*), Chinese lespedeza (*Lespedeza cuneata*), border privet (*Ligustrum obtusifolium*), creeping jenny (*Lysimachia nummularia*), beefsteakplant (*Perilla frutescens*), common sheep sorrel (*Rumex acetosella*), and Japanese bristlegrass (*Setaria faberi*). Continued monitoring and management of invasive species in and around all the natural communities in the park should be a priority for the park's resource managers. These species were not present in the colonial Virginia landscape; thus, represent elements that are historically inaccurate in the contemporary depiction of this site.

Literature Cited

- Abrams, M. D., and B. A. Black. 2000. Dendroecological analysis of mature loblolly pine-hardwood forest at the George Washington Birthplace National Monument, Eastern Virginia. *Journal of the Torrey Botanical Society* 127(2):139–148.
- Anderson, J. R., E. E. Hardy, and J. T. Roach. 1976. Land use and land cover classification system for use with remote sensing data. Geological Survey Professional Paper 964. United States Government Printing Office. Washington, DC.
- Anderson, L. E. 1990. A checklist of *Sphagnum* in North America north of Mexico. *The Bryologist* 93:500–501.
- Anderson, L. E., H. A. Crum, and W. R. Buck. 1990. List of mosses of North America north of Mexico. *The Bryologist* 93:448–499.
- Beals, E. W. 1984. Bray-Curtis ordination: an effective strategy for analysis of multivariate ecological data. *Advances in Ecological Research* 14:1–55.
- Beers, T. W., P. E. Dress, and L. C. Wensel. 1966. Aspect transformation in site productivity research. *Journal of Forestry* 64:691–692.
- Bray, J. R., and J. T. Curtis. 1957. An ordination of the upland forest communities of southern Wisconsin. *Ecological Monographs* 27:325–349.
- Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service. FWS/OBS-79/31. 103 pp.
- Curtis, J. T. 1959. The vegetation of Wisconsin: an ordination of plant communities. University of Wisconsin Press. Madison, WI. 657 pp.
- Dodge, J. M. 2000. A Floristic Survey of the Potomac River Watershed in Westmoreland County, Virginia, from Bridges Creek to Currioman Bay. George Mason University. Fairfax, VA. 127 pp.
- Driscoll, R. S., D. L. Merkel, D. L. Radloff, D. E. Snyder, and J. S. Hagihara. 1984. An ecological land classification framework for the United States. USDA Forest Service. Miscellaneous Publication 1439. USDA Forest Service. Washington, DC.
- Egan, R. S. 1987. A fifth checklist of the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada. *The Bryologist* 90:77–173.
- Egan, R. S. 1989. Changes to the Fifth checklist of the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada, edition I. *The Bryologist* 92:68–72.

- Egan, R. S. 1990. Changes to the Fifth checklist of the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada, edition II. *The Bryologist* 93:211–219.
- Egan, R. S. 1991. Changes to the Fifth checklist of the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada, edition III. *The Bryologist* 94:396–400.
- Environmental Systems Research Institute, Inc (ESRI). 1992–2002. ArcView 3.3. Environmental Systems Research Institute, Inc. Redlands, CA.
- Esslinger, T. L., and R. S. Egan. 1995. A sixth checklist of the lichen-forming, lichenicolous, and allied fungi of the continental United States and Canada. *The Bryologist* 98:467–549.
- Federal Geographic Data Committee (FGDC). 1997. Vegetation classification standard (FGDC-STD-005). Retrieved March 2007. http://www.fgdc.gov/standards/standards_publications.
- Federal Geographic Data Committee (FGDC). 1998a. Content standard for digital geospatial metadata (FGDC-STD-001-1998). Retrieved March 2007 from http://www.fgdc.gov/standards/standards_publications.
- Federal Geographic Data Committee (FGDC). 1998b. Geospatial positioning accuracy standards, Part 3: National Standard for Spatial Data Accuracy. (FGDC-STD-007.3-1998). Retrieved March 2007 from http://www.fgdc.gov/standards/standards_publications.
- Fleming, G. P. 2001. Preliminary Classification Of Piedmont And Inner Coastal Plain Vegetation Types In Virginia. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Natural Heritage Technical Report 02-14. Richmond, VA. 29 pp.
- Fleming, G. P., P. P. Coulling, K. D. Patterson, and K. Taverna. 2006. The natural communities of Virginia: classification of ecological community groups. Second approximation. Version 2.2. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, VA. http://www.dcr.virginia.gov/natural_heritage/nctoc.shtml. Last accessed 13 April 2007
- Gauch, H. G. 1982. Multivariate analysis in community ecology. Cambridge University Press. New York, NY. 298 pp.
- Grossman, D. H., D. Faber-Langendoen, A. S. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K. D. Patterson, M. Pyne, M. Reid, and L. Sneddon. 1998. International classification of ecological communities: terrestrial vegetation of the United States. Volume I. The National Vegetation Classification System: development, status, and applications. The Nature Conservancy. Arlington, VA.

- Heffernan, K. E., P. P. Coulling, J. F. Townsend, and C. J. Hutto. 2001. Ranking invasive exotic plant species in Virginia. Natural Heritage Technical Report 01-13. VADCR. Division of Natural Heritage. Richmond, VA. 27 pp.
- Kartesz, J. T. 1999. A Synonymized Checklist and Atlas with Biological Attributes for the Vascular Flora of the United States, Canada, and Greenland. First Edition. *In* Kartesz, J. T., and C. A. Meacham. Synthesis of North American Flora, Version 1.0. North Carolina Botanical Garden. Chapel Hill, NC.
- Keys, J. E., Jr., C. A. Carpenter, S. Hooks, F. Koenig, W. H. McNab, W. E. Russell, and M. L. Smith. 1995. Ecological units of the eastern United States - first approximation (map and booklet of map unit tables). U.S. Department of Agriculture, Forest Service, presentation scale 1:3,500,000, colored. Atlanta, GA.
- Kruskal, J. B. 1964. Nonmetric multidimensional scaling: a numerical method. *Psychometrika* 29:115–129.
- Lam, G. E. 1985. The Flora of George Washington's Birthplace National Park. Unpublished student report. George Mason University. Fairfax, VA. 7 pp.
- Lance, G. N., and W. T. Williams. 1966. A generalized sorting strategy for computer classifications. *Nature* 212:218.
- Lance, G. N., and W. T. Williams. 1967. A general theory of classification sorting strategies. I. Hierarchical systems. *Computer Journal* 9:373–380.
- Ludwig, J. C., and C. A. Pague. 1993. A Natural Heritage Inventory of Mid-Atlantic Region National Parks in Virginia George Washington Birthplace National Monument. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Natural Heritage Technical Report 93-10. Richmond, VA. 11 pp.
- McCune, B., and J. B. Grace. 2002. Analysis of Ecological Communities. Gleneden Beach, OR. 300 pp.
- McCune, B., and M. J. Mefford. 1999. PC-ORD. Multivariate analysis of ecological data. Version 5.04. MjM Software Design. Gleneden Beach, OR.
- Mehlich, A. 1984. Mehlich III soil test extraction modification of Mehlich II extractant. *Communications in Soil Science and Plant Analysis* 15:1409–1416.
- Mercer J. L. 1978. Westmoreland County Tidal Marsh Inventory. Special Report No. 59 *in* Applied Marine Science and Ocean Engineering. Virginia Institute of Marine Science. Gloucester Point, VA. 108 pp.
- Minchin, P. R. 1987. An evaluation of the relative robustness of techniques for ecological ordination. *Vegetatio* 69:89–107.

- Mitchell, J. T. 1995. Applications of Geographic Information Systems to Urban Forestry: Analyzing the Forests Dynamics of Cary, North Carolina. Masters Thesis. North Carolina State University.
- National Park Service (NPS). 2003. Resource Inventories. Last accessed 11 December 2006. <http://www.nature.nps.gov/protectingrestoring/IM/resourceinventories.html>.
- National Park Service (NPS). 2006. NPS Database Metadata Extractor MS Access Add-in Version 1.0 documentation. Natural Resource Program Center, Natural Resource GIS Program. Fort Collins, CO. 14 pp.
- NatureServe. 2003. A Working Classification of Terrestrial Ecological Systems in the Conterminous United States. International Terrestrial Ecological Systems Classification. NatureServe. Arlington, VA. 61 pp.
- NatureServe. 2004. PLOTS Database Version 2.0, incorporating USDA, NCRS, 2004, The PLANTS Database, Version 3.5. NatureServe. Arlington, VA. <http://biology.usgs.gov/npsveg/tools/plotsdatabase.html>.
- NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. Data current as of September 26, 2007.
- Palmer, M. W. 1993. Putting things in even better order: the advantages of canonical correspondence analysis. *Ecology* 74:2215–2230.
- Parker, A. J. 1982. The topographic relative moisture index: an approach to soil-moisture assessment in mountain terrain. *Physical Geography* 3:160–168.
- Peet R. K., T. R. Wentworth, and P. S. White. 1998. A Flexible, Multipurpose Method for Recording Vegetation Composition and Structure. *Castanea* 63:262–274.
- Schweitzer, P. N. 1995. MP: A compiler for formal metadata 2.9.3, U.S. Geological Survey. Reston, VA. Retrieved March 2007 from <http://geology.usgs.gov/tools/metadata/>.
- Siberhorn, G. M., and J. Shields. 1995. Change Detection Study of Vegetation and Area of Popes Creek Tidal Marsh Complex. GEWA: Virginia Institute of Marine Science Contract Report CA 4000 1-2-21. 9 pp.
- Southeast Regional Climate Center. 2007. Historical Climate Summaries for Virginia. www.sercc.com accessed 20 July 2007.
- Stotler, R., and B. Crandall-Stotler. 1977. A checklist of liverworts and hornworts of North America. *The Bryologist* 80:405–428.
- The Nature Conservancy and Environmental Systems Research Institute (TNC and ESRI). 1994a. NBS/NPS Vegetation Mapping Program: Standardized National Vegetation Classification System. Report to the National Biological Survey and the National Park

- Service. Arlington, VA and Redlands, CA. 188 pp. Last accessed 17 March 2005.
<http://biology.usgs.gov/npsveg/standards.html>.
- The Nature Conservancy and Environmental Systems Research Institute (TNC and ESRI).
 1994b. NBS/NPS Vegetation Mapping Program: Field Methods for Vegetation Mapping. Report to the National Biological Survey and the National Park Service. Arlington, VA and Redlands, CA. 92 pp. Last accessed 17 March 2005.
<http://biology.usgs.gov/npsveg/standards.html>.
- The Nature Conservancy and Environmental Systems Research Institute. 1994c. NBS/NPS Vegetation Mapping Program: Accuracy Assessment Procedures. 71pp. Report to the National Biological Survey and the National Park Service. Arlington, VA and Redlands, CA. <<http://biology.usgs.gov/npsveg/standards.html>> Last accessed 17 March 2005.
- The Nature Conservancy and Environmental Systems Research Institute (TNC and ESRI).
 1994d. NBS/NPS Vegetation Mapping Program: Methodology for Assessing the Utility of Data for Vegetation Mapping. Report to the National Biological Survey and the National Park Service. Arlington, VA and Redlands, CA. Last accessed 17 March 2005.
<http://biology.usgs.gov/npsveg/standards.html>.
- Townsend, J. F. 2007. Natural Heritage Resources of Virginia: Rare Plants. Unpublished report. Natural Heritage Technical Report 07-13. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, VA.
- United Nations Educational, Scientific, and Cultural Organization (UNESCO). 1973. International Classification and Mapping of Vegetation, Series 6, Ecology and conservation. Paris, France: United Nations Educational, Scientific and Cultural Organization. 32 pp.
- United States Department of Agriculture, National Resources Conservation Service (USDA, NRCS). 2004. The PLANTS Database, Version 3.5. <http://plants.usda.gov>. Data compiled from various sources by Mark W. Skinner. National Plant Data Center. Baton Rouge, LA.
- United States Department of Agriculture, Natural Resources Conservation Service (USDA, NRCS). 2006. Soil Survey Geographic (SSURGO) database for Westmoreland County, Virginia, Fort Worth, TX. <http://SoilDataMart.nrcs.usda.gov/>.
- United States Geological Survey (USGS). 2004. Tools for creation of formal metadata, a compiler for formal metadata. Retrieved October 2001 from
<http://geology.usgs.gov/tools/metadata/tools/doc/mp.html>.
- Virginia Department of Conservation and Recreation (VADCR). 2003. List of Invasive Alien Plant Species in Virginia. VADCR, Division of Natural Heritage. Richmond, Virginia.
http://www.dcr.virginia.gov/natural_heritage/invspdflist.shtml.
- Virginia Division of Mineral Resources. 1993. Geologic Map of Virginia. Virginia Division of Mineral Resources. Scale 1:500,000.

- Virginia Geographic Information Network. Spring 2002. Virginia Base Mapping Program Digital Orthophotography. 1:1200 to 1:4800. Department of Technology Planning, Commonwealth of Virginia.
- Ward, J. H. 1963. Hierarchical groupings to optimize an objective function. *Journal of the American Statistical Association*. 58:236–244.
- Wieboldt, T. F., G. P. Fleming, C. E. Stevens, J. F. Townsend, D. M. E. Ware, and R. A. S. Wright. 2005. Digital Atlas of the Virginia Flora. http://www.biol.vt.edu/digital_atlas/. Virginia Botanical Associates, c/o Massey Herbarium. Department of Biological Sciences. Virginia Tech. Blacksburg, VA.
- Wilcox, J. K. 1989. Recent vegetation and area changes in a tidal marsh located at Pope's Creek, Virginia. [M.A.]. Gloucester Point, VA: College of William and Mary. 41 pp.
- Wishart, D. 1979. An algorithm for hierarchical classifications. *Biometrics* 22:165–170.

Appendix A. Quantitative vegetation plot sampling form.

VA DEPT. OF CONSERVATION AND RECREATION - DIV. OF NATURAL HERITAGE

rev. 2004-05-03 KDP

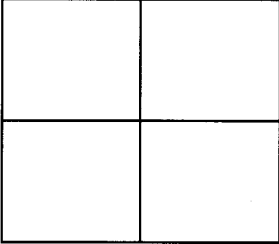
P.1

GENERAL INFORMATION PLOT: _____ Project: <u>Mid atlantic Veg mapping</u> Date: _____ Surveyors: _____ Plot dimensions: _____ by _____ m Sample area _____ sq. m PLOT DOCUMENTATION Source Code: _____ Film Roll: _____ Frames: _____ Description of pic(s): _____ Relative Stand Size A - extensive (> 100x plot size) B - large (10-100x plot size) C - small (3-10x plot size) D - very small (1-3x plot size) U - Unknown		PLOT LOCATION Managed Area (Park): _____ Survey Site: _____ Quad: _____ County: _____ GPS unit: Garmin GPSMAP76 UTM zone: _____ Datum: <u>WGS 84</u> GPS pointname or file: _____ est accuracy: _____ m/ft # of sats fixed: _____ Reciever status: 2D / 3D / 2D WAAS / 3D WAAS Field UTM X _____ E Y _____ N LAT _____ Long _____ Marked est. location on toposheet _____ yes	
SITE CHARACTERISTICS compass: magnetic corrected			
Elevation _____ m/ft via GPS _____ map _____ altimeter _____			
Slope (o) _____ single measure. _____ avg of _____ or: A - 0-3% (level or nearly so) B - 3-8% (gentle/undulating) C - 8-16% (sloping/rolling) D - 16-30% (moderate/hilly) E - 30-65% (steep) F - 65-75% (very steep) G - 75+% (extremely steep)		Slope Shape (V w/ slope) VERTICALLY HORIZONTALLY C - concave C - concave X - convex X - convex S - straight S - straight H - hummock (____%) and hollow (____%) microtopography I - irregular craggy/ bouldery microtopography	
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: _____ P - flat plain D - dune OF - overwash flat I - interdune TF - tidal flat R - ravine S - seep/swale A - alluvial plain L - levee CS - channel shelf BS - backswamp B - basin/sag pond	
Soil Drainage Class A - very poorly drained B - poorly drained C - somewhat poorly drained D - moderately well drained E - well drained F - rapidly drained Inundation A - never B - infrequently C - regularly: for <6 mos. D - regularly: for >6 mos. E - always submerged by shallow water (<30cm) F - always submerged by deep water (>30cm)		Soil Moisture Regime A - very xeric (moist for neqlq. 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 - subhydic (wet for siancant part of growing season; mottles <20cm) G - hydic (wet for most of growing season; permanent seepage/mottling) H - subhydic (water table at or near surface for most of the year) I - hydic (water table at or above surface year round) - ephemeral seepage/subsurface water present locally in plot	
Hydrologic Regime _____ Terrestrial(i.e. not a wetland) Tidal A - Irregularly exposed B - Regularly flooded C - Irregularly flooded D - Wind tidally flooded Non-Tidal A - Permanently flooded B - Semipermanently flooded C - Seasonally flooded D - Intermittently flooded E - Temporarily flooded F - Saturated Salinity/Halinity A - Saltwater B - Brackish C - Oligohaline D - Freshwater Refractometer Measurement: _____		Surface Substrate bedrock boulders and stones gravel and cobbles litter / organic matter decaying wood water mineral soil / sand other (bryophytes and lichens) TOTAL 100%	
Cowardin System Upland _____ Riverine _____ Lacustrine _____ Estuarine _____ Palustrine _____			
Soil Sample _____ Single Sample _____ Composite Sample _____ Mean of _____			
Soil Profile Description Horizon/ Depth(cm) Description (texture, structure, consistency) 0- _____			

PLOT CONFIGURATION, MAP SKETCH, AND DIRECTIONS FOR RELOCATING PLOT

P.2

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

 20 x 20 m	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50px; text-align: center; vertical-align: middle;">  </td> <td style="padding: 5px;">GPS position</td> </tr> <tr> <td style="text-align: center; vertical-align: middle;">  </td> <td style="padding: 5px;">centerline with bearing</td> </tr> <tr> <td style="text-align: center; vertical-align: middle;">  </td> <td style="padding: 5px;"></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		

PLOT . P.3

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

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

Record species cover in the following cover classes:

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

57

Appendix B. Vascular plants observed in quantitative vegetation plots and qualitative observation points in George Washington Birthplace National Monument during 2002 and 2003.

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

Family	Scientific Name	Common name
Acanthaceae	<i>Ruellia caroliniensis</i>	Carolina wild petunia*
Aceraceae	<i>Acer rubrum</i>	red maple
Agavaceae	<i>Yucca filamentosa</i>	Adam's needle*
Alismataceae	<i>Sagittaria latifolia</i>	broadleaf arrowhead*
Amaranthaceae	<i>Amaranthus cannabinus</i>	tidalmarsh amaranth*
Anacardiaceae	<i>Toxicodendron radicans</i>	eastern poison ivy
Annonaceae	<i>Asimina triloba</i>	pawpaw
Apiaceae	<i>Hydrocotyle verticillata</i>	whorled marshpennywort*
	<i>Lilaeopsis chinensis</i>	eastern grasswort*
	<i>Sanicula canadensis</i>	Canadian blacksnakeroot
Apocynaceae	<i>Apocynum cannabinum</i>	Indianhemp*
Aquifoliaceae	<i>Ilex opaca</i> var. <i>opaca</i>	American holly
	<i>Ilex verticillata</i>	common winterberry
Araceae	<i>Peltandra virginica</i>	green arrow arum*
Araliaceae	<i>Aralia spinosa</i>	devil's walkingstick
	<i>Hedera helix</i>	English ivy ^{c#}
Aspleniaceae	<i>Asplenium platyneuron</i>	ebony spleenwort
Asteraceae	<i>Achillea millefolium</i>	common yarrow*
	<i>Ambrosia artemisiifolia</i>	annual ragweed*
	<i>Artemisia vulgaris</i>	common wormwood ^{c#}
	<i>Baccharis halimifolia</i>	eastern baccharis*
	<i>Bidens bipinnata</i>	Spanish needles
	<i>Bidens coronata</i>	crowned beggarticks*
	<i>Cirsium pumilum</i>	pasture thistle
	<i>Conoclinium coelestinum</i>	blue mistflower*
	<i>Conyza canadensis</i>	Canadian horseweed*
	<i>Eclipta prostrata</i>	false daisy*
	<i>Elephantopus carolinianus</i>	Carolina elephantsfoot
	<i>Eupatorium capillifolium</i>	dogfennel*
	<i>Iva frutescens</i>	Jesuit's bark*
	<i>Pluchea odorata</i>	sweetscent
	<i>Smallanthus uvedalius</i>	hairy leafcup
	<i>Solidago canadensis</i> var. <i>scabra</i> (= <i>Solidago altissima</i>)	Canada goldenrod
	<i>Solidago juncea</i>	early goldenrod*
	<i>Solidago sempervirens</i>	seaside goldenrod*
	<i>Solidago speciosa</i> var. <i>erecta</i> (= <i>Solidago erecta</i>)	showy goldenrod
	<i>Symphyotrichum lateriflorum</i>	calico aster
	<i>Symphyotrichum subulatum</i>	eastern annual saltmarsh aster*
	<i>Symphyotrichum tenuifolium</i>	perennial saltmarsh aster*

Family	Scientific Name	Common name
Asteraceae (cont.)	<i>Symphotrichum undulatum</i>	waxyleaf aster [*]
	<i>Taraxacum officinale</i>	common dandelion ^{*e}
	<i>Verbesina alternifolia</i>	wingstem [*]
	<i>Verbesina occidentalis</i>	yellow crownbeard
Balsaminaceae	<i>Impatiens capensis</i>	jewelweed [*]
Bignoniaceae	<i>Campsis radicans</i>	trumpet creeper
Blechnaceae	<i>Woodwardia virginica</i>	Virginia chainfern
Brassicaceae	<i>Arabis laevigata</i> var. <i>laevigata</i>	smooth rockcress
	<i>Barbarea vulgaris</i>	garden yellowrocket ^e
Caprifoliaceae	<i>Lonicera japonica</i>	Japanese honeysuckle ^{e#}
	<i>Viburnum dentatum</i>	southern arrowwood [*]
	<i>Viburnum nudum</i>	possumhaw
	<i>Viburnum prunifolium</i>	blackhaw
Celastraceae	<i>Celastrus orbiculatus</i> (= <i>Celastrus orbiculata</i>)	oriental bittersweet ^{e#}
Chenopodiaceae	<i>Atriplex patula</i>	spear saltbush ^{*e}
Clusiaceae	<i>Hypericum punctatum</i>	spotted St. Johnswort [*]
Commelinaceae	<i>Commelina communis</i>	Asiatic dayflower ^{*e#}
Cornaceae	<i>Cornus florida</i>	flowering dogwood
Cucurbitaceae	<i>Melothria pendula</i> var. <i>pendula</i>	Guadeloupe cucumber
Cupressaceae	<i>Juniperus virginiana</i> var. <i>virginiana</i>	eastern redcedar
Cyperaceae	<i>Carex albicans</i> var. <i>australis</i>	stellate sedge
	<i>Carex blanda</i>	eastern woodland sedge
	<i>Carex crinita</i>	fringed sedge
	<i>Carex hyalinolepis</i>	shoreline sedge [*]
	<i>Carex laxiflora</i> var. <i>laxiflora</i>	broad looseflower sedge
	<i>Carex lurida</i>	shallow sedge
	<i>Carex swanii</i>	Swan's sedge
	<i>Cyperus esculentus</i>	chufa flatsedge [*]
	<i>Cyperus filicinus</i>	fern flatsedge
	<i>Cyperus odoratus</i>	fragrant flatsedge
	<i>Cyperus strigosus</i>	strawcolored flatsedge [*]
	<i>Eleocharis fallax</i>	creeping spikerush [*]
	<i>Schoenoplectus americanus</i>	chairmaker's bulrush
	<i>Schoenoplectus robustus</i>	sturdy bulrush [*]
Dennstaedtiaceae	<i>Dennstaedtia punctilobula</i>	eastern hayscented fern [*]
Dryopteridaceae	<i>Athyrium filix-femina</i>	common ladyfern
	<i>Onoclea sensibilis</i>	sensitive fern
Ebenaceae	<i>Diospyros virginiana</i>	common persimmon
Elaeagnaceae	<i>Elaeagnus angustifolia</i>	Russian olive ^{*e#}
Ericaceae	<i>Rhododendron periclymenoides</i>	pink azalea
	<i>Vaccinium formosum</i>	southern blueberry
Euphorbiaceae	<i>Acalypha virginica</i>	Virginia threeseed mercury
	<i>Chamaesyce polygonifolia</i>	seaside sandmat [*]
Fabaceae	<i>Amorpha fruticosa</i>	desert false indigo [*]
	<i>Cercis canadensis</i> var. <i>canadensis</i>	eastern redbud
	<i>Gleditsia triacanthos</i>	honeylocust [*]
	<i>Lespedeza cuneata</i>	Chinese lespedeza ^{*e#}

Family	Scientific Name	Common name
Fabaceae (cont.)	<i>Melilotus officinalis</i>	yellow sweetclover ^{*c#}
	<i>Robinia pseudoacacia</i>	black locust
Fagaceae	<i>Fagus grandifolia</i>	American beech [*]
	<i>Quercus alba</i>	white oak
	<i>Quercus falcata</i>	southern red oak [*]
	<i>Quercus michauxii</i>	swamp chestnut oak
	<i>Quercus muehlenbergii</i>	chinkapin oak
	<i>Quercus nigra</i>	water oak [*]
	<i>Quercus pagoda</i>	cherrybark oak
	<i>Quercus palustris</i>	pin oak
	<i>Quercus phellos</i>	willow oak
	<i>Quercus prinus</i>	chestnut oak [*]
	<i>Quercus rubra</i>	northern red oak [*]
	<i>Quercus velutina</i>	black oak [*]
Hamamelidaceae	<i>Liquidambar styraciflua</i>	sweetgum
Juglandaceae	<i>Carya cordiformis</i>	bitternut hickory
	<i>Juglans nigra</i>	black walnut
Juncaceae	<i>Juncus effusus</i>	common rush [*]
Lamiaceae	<i>Lycopus virginicus</i>	Virginia water horehound
	<i>Perilla frutescens</i>	beefsteakplant ^{*c#}
	<i>Scutellaria lateriflora</i>	blue skullcap
	<i>Teucrium canadense</i>	Canada germander [*]
Lauraceae	<i>Lindera benzoin</i>	northern spicebush
	<i>Sassafras albidum</i>	sassafras
Lemnaceae	<i>Lemna valdiviana</i>	valdivia duckweed [*]
Liliaceae	<i>Allium vineale</i>	wild garlic ^{*c#}
Lythraceae	<i>Ammannia latifolia</i>	pink redstem
	<i>Decodon verticillatus</i>	swamp loosestrife [*]
	<i>Lythrum lineare</i>	wand lythrum
Magnoliaceae	<i>Liriodendron tulipifera</i>	tuliptree [*]
Malvaceae	<i>Hibiscus moscheutos</i> ssp. <i>moscheutos</i>	crimsoneyed rosemallow
	<i>Kosteletzkya virginica</i>	Virginia saltmarsh mallow
Menispermaceae	<i>Menispermum canadense</i>	common moonseed
Moraceae	<i>Morus rubra</i>	red mulberry
Myricaceae	<i>Morella cerifera</i>	wax myrtle [*]
Nymphaeaceae	<i>Nuphar lutea</i> ssp. <i>advena</i>	yellow pond-lily [*]
Nyssaceae	<i>Nyssa sylvatica</i>	blackgum
Oleaceae	<i>Ligustrum obtusifolium</i>	border privet [#]
	<i>Ligustrum sinense</i>	Chinese privet ^{e#}
Onagraceae	<i>Circaea lutetiana</i> ssp. <i>canadensis</i>	broadleaf enchanter's nightshade
Osmundaceae	<i>Osmunda regalis</i> var. <i>spectabilis</i>	royal fern [*]
Oxalidaceae	<i>Oxalis stricta</i>	common yellow oxalis
Passifloraceae	<i>Passiflora lutea</i>	yellow passionflower [*]
Phytolaccaceae	<i>Phytolacca americana</i>	American pokeweed [*]
Pinaceae	<i>Pinus strobus</i>	eastern white pine [*]
	<i>Pinus taeda</i>	loblolly pine

Family	Scientific Name	Common name
Poaceae	<i>Andropogon virginicus</i>	broomsedge bluestem*
	<i>Chasmanthium sessiliflorum</i>	longleaf woodoats*
	<i>Cinna arundinacea</i>	sweet woodreed
	<i>Cynodon dactylon</i>	Bermudagrass* ^e
	<i>Dactylis glomerata</i>	orchardgrass* ^{e#}
	<i>Danthonia spicata</i>	poverty oatgrass
	<i>Deschampsia flexuosa</i> var. <i>flexuosa</i>	wavy hairgrass*
	<i>Dichanthelium clandestinum</i>	deertongue
	<i>Digitaria sanguinalis</i>	hairy crabgrass*
	<i>Distichlis spicata</i>	inland saltgrass
	<i>Echinochloa crus-galli</i>	barnyardgrass* ^e
	<i>Echinochloa walteri</i>	coast cockspur grass*
	<i>Elymus hystrix</i> var. <i>hystrix</i>	eastern bottlebrush grass
	<i>Elymus villosus</i>	hairy wildrye
	<i>Elymus virginicus</i>	Virginia wildrye*
	<i>Eragrostis spectabilis</i>	purple lovegrass*
	<i>Glyceria striata</i>	fowl mannagrass
	<i>Leersia oryzoides</i>	rice cutgrass*
	<i>Leersia virginica</i>	whitegrass*
	<i>Lolium pratense</i>	meadow ryegrass* ^{e#}
	<i>Panicum virgatum</i>	switchgrass*
	<i>Phragmites australis</i>	common reed*
	<i>Poa compressa</i>	Canada bluegrass
	<i>Setaria faberi</i>	Japanese bristlegrass* ^{e#}
	<i>Spartina alterniflora</i>	smooth cordgrass
	<i>Spartina cynosuroides</i>	big cordgrass
	<i>Spartina patens</i>	saltmeadow cordgrass
	<i>Tridens flavus</i> var. <i>flavus</i>	purpletop tridens*
	<i>Tripsacum dactyloides</i>	eastern gamagrass*
	<i>Zizania aquatica</i> var. <i>aquatica</i>	annual wildrice*
Polygonaceae	<i>Polygonum punctatum</i>	dotted smartweed
	<i>Polygonum virginianum</i>	jumpseed
	<i>Rumex acetosella</i>	common sheep sorrel* ^{e#}
	<i>Rumex verticillatus</i>	swamp dock*
Primulaceae	<i>Lysimachia nummularia</i>	creeping jenny* ^{e#}
Pyrolaceae	<i>Chimaphila maculata</i>	striped prince's pine
Ranunculaceae	<i>Aquilegia canadensis</i>	red columbine
Rosaceae	<i>Amelanchier arborea</i>	common serviceberry*
	<i>Duchesnea indica</i>	Indian strawberry* ^e
	<i>Geum virginianum</i>	cream avens
	<i>Prunus serotina</i> var. <i>serotina</i>	black cherry
	<i>Rubus</i>	blackberry
Rubiaceae	<i>Rubus argutus</i>	sawtooth blackberry
	<i>Galium obtusum</i>	bluntleaf bedstraw
	<i>Galium triflorum</i>	fragrant bedstraw
	<i>Mitchella repens</i>	partridgeberry

Family	Scientific Name	Common name
Salicaceae	<i>Populus grandidentata</i>	bigtooth aspen*
Saxifragaceae	<i>Heuchera americana</i>	American alumroot
Scrophulariaceae	<i>Gratiola virginiana</i>	roundfruit hedgehyssop
	<i>Verbascum thapsus</i>	common mullein ^e
Smilacaceae	<i>Smilax bona-nox</i>	saw greenbrier
	<i>Smilax glauca</i>	cat greenbrier
	<i>Smilax rotundifolia</i>	roundleaf greenbrier
Thelypteridaceae	<i>Thelypteris noveboracensis</i>	New York fern
	<i>Thelypteris palustris</i> var. <i>pubescens</i>	eastern marsh fern*
Tiliaceae	<i>Tilia americana</i>	American basswood
Typhaceae	<i>Typha angustifolia</i>	narrowleaf cattail*
Ulmaceae	<i>Celtis occidentalis</i>	common hackberry
Urticaceae	<i>Boehmeria cylindrica</i>	smallspike false nettle
	<i>Pilea pumila</i>	Canadian clearweed
Verbenaceae	<i>Phryma leptostachya</i>	American lopseed
Vitaceae	<i>Parthenocissus quinquefolia</i>	Virginia creeper
	<i>Vitis rotundifolia</i>	muscadine
	<i>Vitis vulpina</i>	frost grape

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

^e Species 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 George Washington Birthplace 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

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

Appendix 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 George Washington Birthplace 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	% NonVasc
Oak / Heath Forests													
Coastal Plain Mixed Oak / Heath Forest	CEGL006269	flat to SW	gentle to moderate	lower to middle slope	26.7	0	0	0	6	91	3	0	1
Piedmont / Low Elevation Mixed Oak / Heath Forest	CEGL008521	S	gentle	upper slope	24.6	0	0	1	1	94	4	0	0
Pine - Oak Forests													
Coastal Plain Loblolly Pine - Oak Forest	CEGL004766	flat	level to gentle	plain/level/bottom - lower slope	31.5	0	0	0	1	96	4	0	1
Eastern White Pine - Hardwood Forest	CEGL008539	NNW	moderate to steep	middle slope	25.9	<1	2	<1	1	95	2	0	3
Mesic Acidic Forests													
Mesic Mixed Hardwood Forest	CEGL006075	NNE	moderate	lower to middle slope	29.7	0	1	0	2	94	3	0	1
Piedmont / Coastal Plain Oak - Beech / Heath Forest	CEGL006919	N	steep	middle slope	26.4	0	0	0	2	95	3	0	4
Oak - Hickory Forests													
Acidic Oak - Hickory Forest	CEGL008475	WSW	moderate	middle slope	25.5	0	2	1	3	91	3	0	3
Basic Oak - Hickory Forest	CEGL007232	S	gentle to moderate	lower to middle slope	26.5	0	3	0	7	87	3	0	1
Basic Mesic and Calcareous Forests													
Inner Piedmont / Lower Blue Ridge Basic Mesic Forest	CEGL006186	ESE	steep	middle slope	32.6	1	10	0	2	82	5	0	7
Coastal Plain Mesic Calcareous Ravine Forest	CEGL007181	NE	moderate to steep	lower to middle slope	27.2	0	0	0	9	89	2	0	4
Coastal Plain Dry Calcareous Forest	CEGL007748	S	moderate to steep	middle to upper slope	19.4	0	0	0	15	79	5	1	0
Seepage Wetlands													
Coastal Plain / Piedmont Acidic Seepage Swamp	CEGL006238	flat	level to gentle	plain/level/bottom	38.2	0	0	0	3	85	3	9	13
Northern Piedmont / Lower New England Basic Seepage Swamp	CEGL006406	flat	level to gentle	plain/level/bottom - toe slope	37.6	0	2	0	15	68	3	6	1
Coastal Plain Calcareous Seepage Swamp	CEGL006413	flat	level	plain/level/bottom	40.8	1	0	0	5	89	2	4	2
Alluvial Forests													
Coastal Plain / Piedmont Small-Stream Floodplain Forest	CEGL004418	flat	level	plain/level/bottom	40.5	0	0	0	2	93	3	2	1
Piedmont / Mountain Alluvial Forest	CEGL006492	flat	level	plain/level/bottom	41.2	0	0	0	14	82	4	0	0
Piedmont / Mountain Floodplain Forest	CEGL006217	flat	level to gentle	plain/level/bottom	41.6	0	<1	0	39	58	3	0	<1

Table E1. Environmental variable averages by association - topographic variables and percentage substrate (continued).

	USNVC code	Aspect	Slope Inclination	Topographic Position	TRMI	% Bedrock	% Large Rocks	% Small Rocks	% Min. Soil	% Litter & Duff	% Wood	% Water	% NonVasc
Swamp Forests													
Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak - Red Maple Type)	CEGL006605	flat	level to basin / depression	plain/level/bottom	40.0	0	0	0	7	88	4	1	2
Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type)	CEGL006606	flat	level to basin / depression	plain/level/bottom	40.4	0	0	0	15	72	2	11	1
Nonriverine Forests													
Upland Depression Swamp	CEGL007403	flat	level to basin / depression	various	35.1	1	0	0	1	92	5	2	3
Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type)	CEGL006110	flat	level to basin / depression	various	37.1	0	0	0	4	86	4	6	16
Coastal Plain Depression Wetland (Swamp Tupelo Type)	CEGL006223	flat	level to basin / depression	basin/depression	40.0	0	0	0	1	98	2	0	0
Non-Riverine Saturated Forest	CEGL004644	flat	level	plain/level/bottom	40.0	0	0	0	1	89	7	3	4
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	CaMg Ratio	Fertility
Oak / Heath Forests																				
Coastal Plain Mixed Oak / Heath Forest	CEGL006269	4.2	79	31	31	132	31	28	12	0.60	282	10	0.41	1.1	634	8.1	19.2	3.3	4.3	1.0
Piedmont / Low Elevation Mixed Oak / Heath Forest	CEGL008521	4.2	90	14	31	135	28	35	12	0.41	295	14	0.57	1.4	764	10.3	12.1	4.6	4.7	1.1
Pine - Oak Forests																				
Coastal Plain Loblolly Pine - Oak Forest	CEGL004766	4.1	90	25	40	165	52	34	11	0.80	324	64	0.59	1.5	697	12.1	13.5	4.1	3.3	1.4
Eastern White Pine - Hardwood Forest	CEGL008539	4.2	95	13	35	205	44	47	12	0.5	297	43	0.6	1.6	852	14.4	10.2	6.1	5.0	1.5
Mesic Acidic Forests																				
Mesic Mixed Hardwood Forest	CEGL006075	4.4	92	28	34	303	68	55	14	0.46	186	66	0.90	2.3	776	11.4	23.3	4.6	4.9	2.3
Piedmont / Coastal Plain Oak - Beech / Heath Forest	CEGL006919	4.2	88	19	29	155	39	39	12	0.40	279	9	0.53	1.3	746	11.2	15.2	4.2	5.6	1.2
Oak - Hickory Forests																				
Acidic Oak - Hickory Forest	CEGL008475	4.6	99	18	33	320	80	60	13	0.39	204	80	1.69	2.4	908	10.1	27.1	5.6	4.3	2.5
Basic Oak - Hickory Forest	CEGL007232	5.3	106	32	29	1508	241	108	12	0.62	175	215	2.03	3.0	740	14.3	63.5	6.4	7.3	9.9
Basic Mesic and Calcareous Forests																				
Inner Piedmont / Lower Blue Ridge Basic Mesic Forest	CEGL006186	5.5	110	29	30	1712	281	139	11	0.72	149	172	2.24	4.0	774	15.2	69.9	8.9	6.0	11.2
Coastal Plain Mesic Calcareous Ravine Forest	CEGL007181	5.7	93	34	34	2246	96	75	18	0.76	131	78	0.86	2.9	538	14.7	81.5	4.5	24.1	12.3
Coastal Plain Dry Calcareous Forest	CEGL007748	6.5	100	40	39	4707	116	113	31	1.10	158	67	1.10	3.7	403	27.4	86.3	5.9	40.7	24.9
Seepage Wetlands																				
Coastal Plain / Piedmont Acidic Seepage Swamp	CEGL006238	4.6	96	19	45	318	90	38	30	0.52	343	13	0.95	3.6	470	34.1	34.0	8.0	4.0	2.5
Northern Piedmont / Lower New England Basic Seepage Swamp	CEGL006406	5.2	110	24	88	1071	195	58	33	0.74	417	64	2.50	7.1	425	13.0	56.5	7.3	6.4	7.3
Coastal Plain Calcareous Seepage Swamp	CEGL006413	6.1	114	29	104	3327	93	56	52	1.23	554	31	1.29	9.82	222	21.4	83.5	15	46.6	17.8
Alluvial Forests																				
Coastal Plain / Piedmont Small-Stream Floodplain Forest	CEGL004418	4.5	88	20	35	603	119	62	25	0.54	264	82	1.51	3.7	585	10.9	42.4	4.4	5.5	4.1
Piedmont / Mountain Alluvial Forest	CEGL006492	5.3	94	32	23	1127	180	62	25	0.67	204	119	3.02	5.8	520	11.1	69.0	4.8	6.3	7.4
Piedmont / Mountain Floodplain Forest	CEGL006217	6.7	79	44	42	2570	169	63	19	0.8	242	106	3.0	14.4	309	14.9	97.8	3.8	16.8	14.2
Swamp Forests																				
Coastal Plain / Piedmont Floodplain Swamp Forest (Mixed Oak - Red Maple Type)	CEGL006605	4.5	91	27	47	388	82	53	18	0.57	381	67	1.57	4.5	668	11.6	27.3	4.7	5.5	2.8
Coastal Plain / Piedmont Floodplain Swamp Forest (Green Ash - Red Maple Type)	CEGL006606	5.2	101	28	99	1471	155	55	44	0.58	343	70	1.87	7.2	447	14.1	62.8	6.6	11.9	9.0

Table E2. Environmental variable averages by association - soil chemistry variables (continued).

	USNVC code	pH	N	P	S	Ca	Mg	K	Na	B	Fe	Mn	Cu	Zn	Al	CEC	TBS	OM	CaMg Ratio	Fertility
Nonriverine Forests																				
Upland Depression Swamp	CEGL007403	4.3	110	47	61	501	130	55	39	0.52	395	23	1.29	4.3	1052	16.0	29.2	7.3	3.8	3.0
Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type)	CEGL006110	4.1	109	48	56	193	68	53	17	0.53	297	30	0.90	2.4	890	17.3	10.9	7.0	3.1	1.7
Coastal Plain Depression Wetland (Swamp Tupelo Type)	CEGL006223																			
Non-Riverine Saturated Forest	CEGL004644	4.3	99	32	53	288	62	43	26	0.72	333	6	0.60	2.0	614	14.3	17.8	4.3	6.1	2.3
Tidal 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 five major vegetation groups present at George Washington Birthplace National Monument.

Major vegetation groups are presented as follows:

Basic Mesic and Calcareous Forests (Figures F1–F3)

Seepage Wetlands (Figures F4–F6)

Nonriverine Forests (Figures F7–F9)

Tidal Herbaceous Marshes (Figures F10–F12)

Tidal Forests and Shrublands (Figures F13–F14)

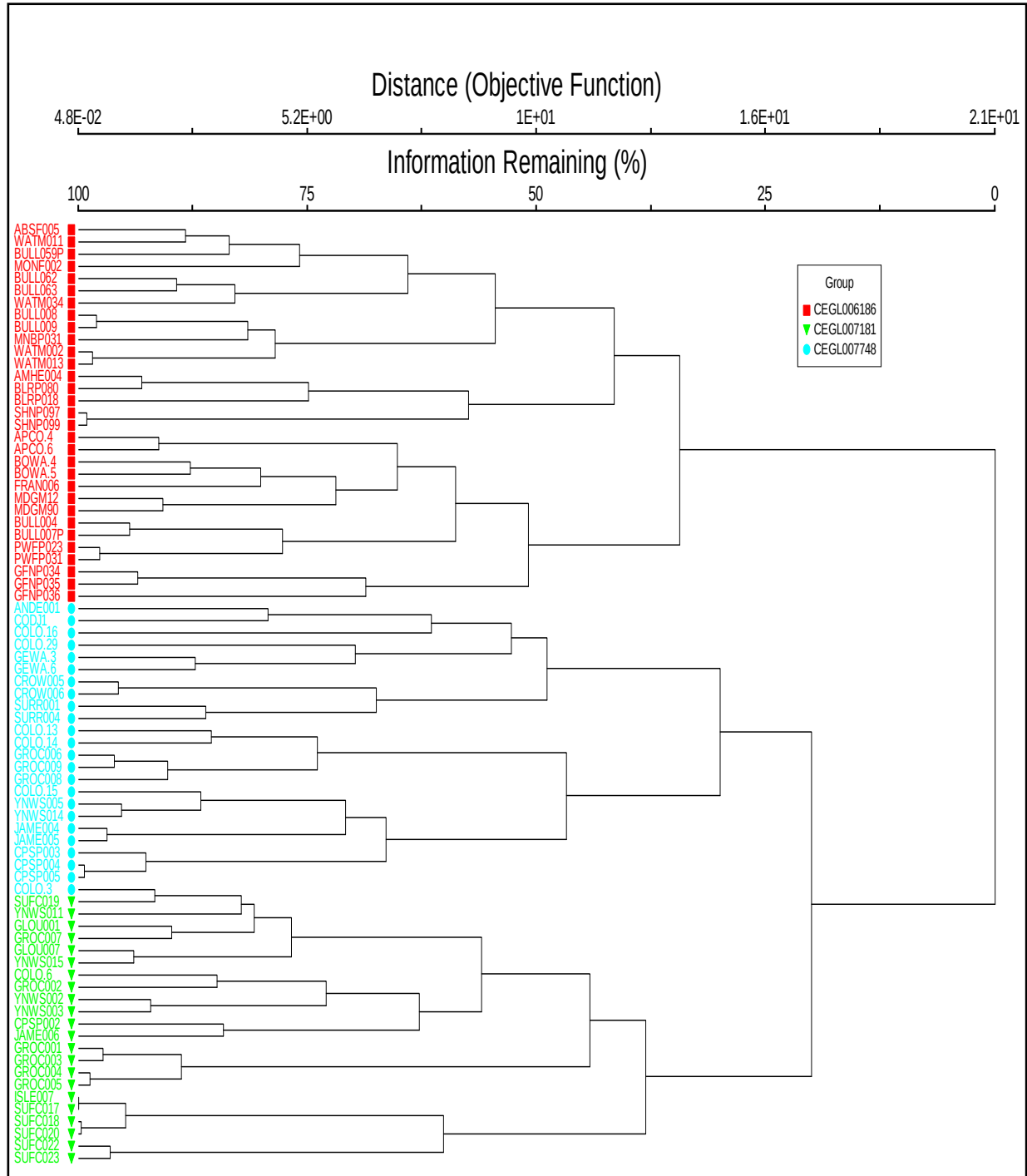


Figure F1. Dendrogram resulting from cluster analysis of species coverage data from 77 basic mesic and calcareous forest plots. Plot membership in three basic mesic and calcareous forest associations is shown. CEGl006186 = Inner Piedmont / Lower Blue Ridge Basic Mesic Forest; CEGl007181 = Coastal Plain Mesic Calcareous Ravine Forest; CEGl007748 = Coastal Plain Dry Calcareous Forest. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

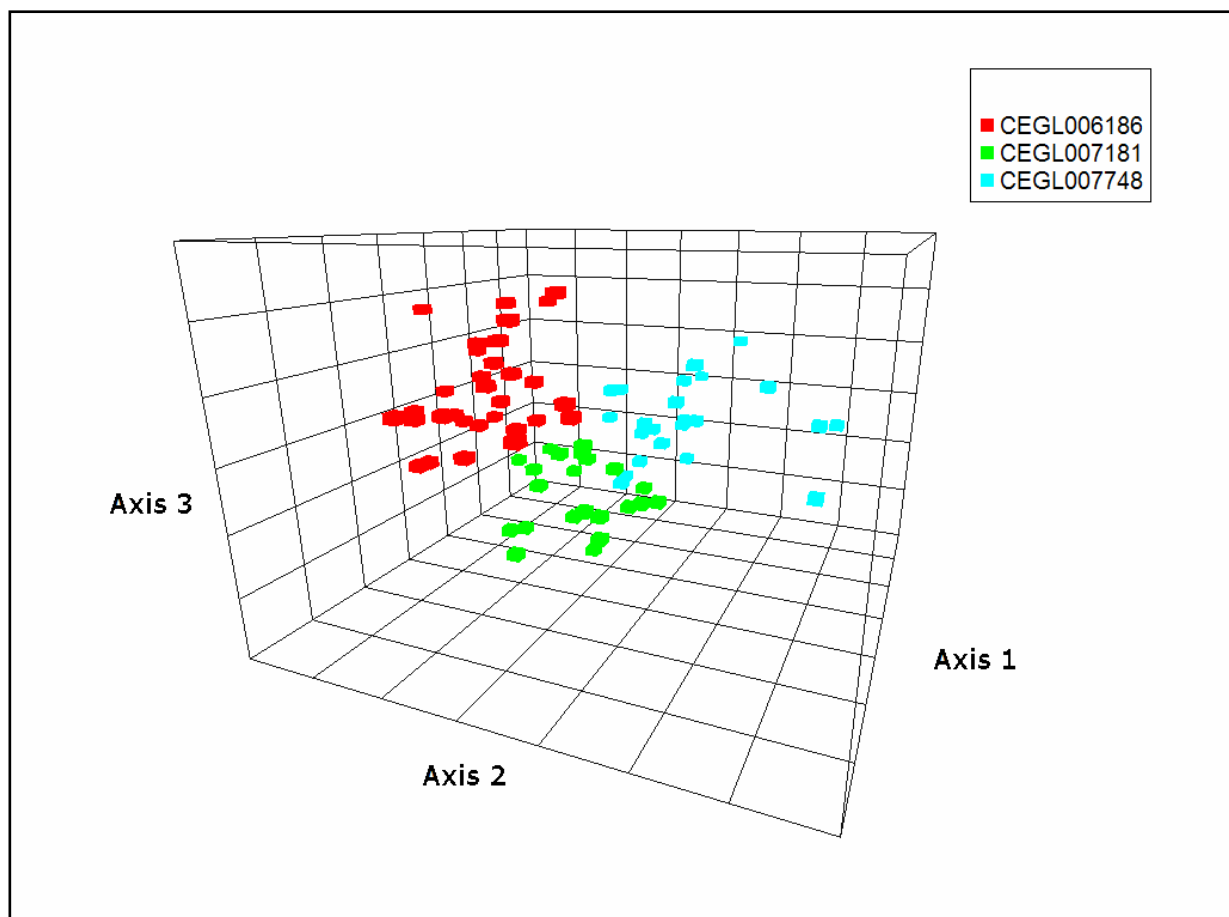


Figure F2. Scatterplot diagram for three-dimensional NMDS ordination of 76 basic mesic and calcareous forest plots. Plot membership in three basic mesic and calcareous forest associations is based on cluster analysis. CEGL006186 = Inner Piedmont / Lower Blue Ridge Basic Mesic Forest; CEGL007181 = Coastal Plain Mesic Calcareous Ravine Forest; CEGL007748 = Coastal Plain Dry Calcareous Forest. One plot was determined to be an outlier and eliminated from the dataset prior to ordination.

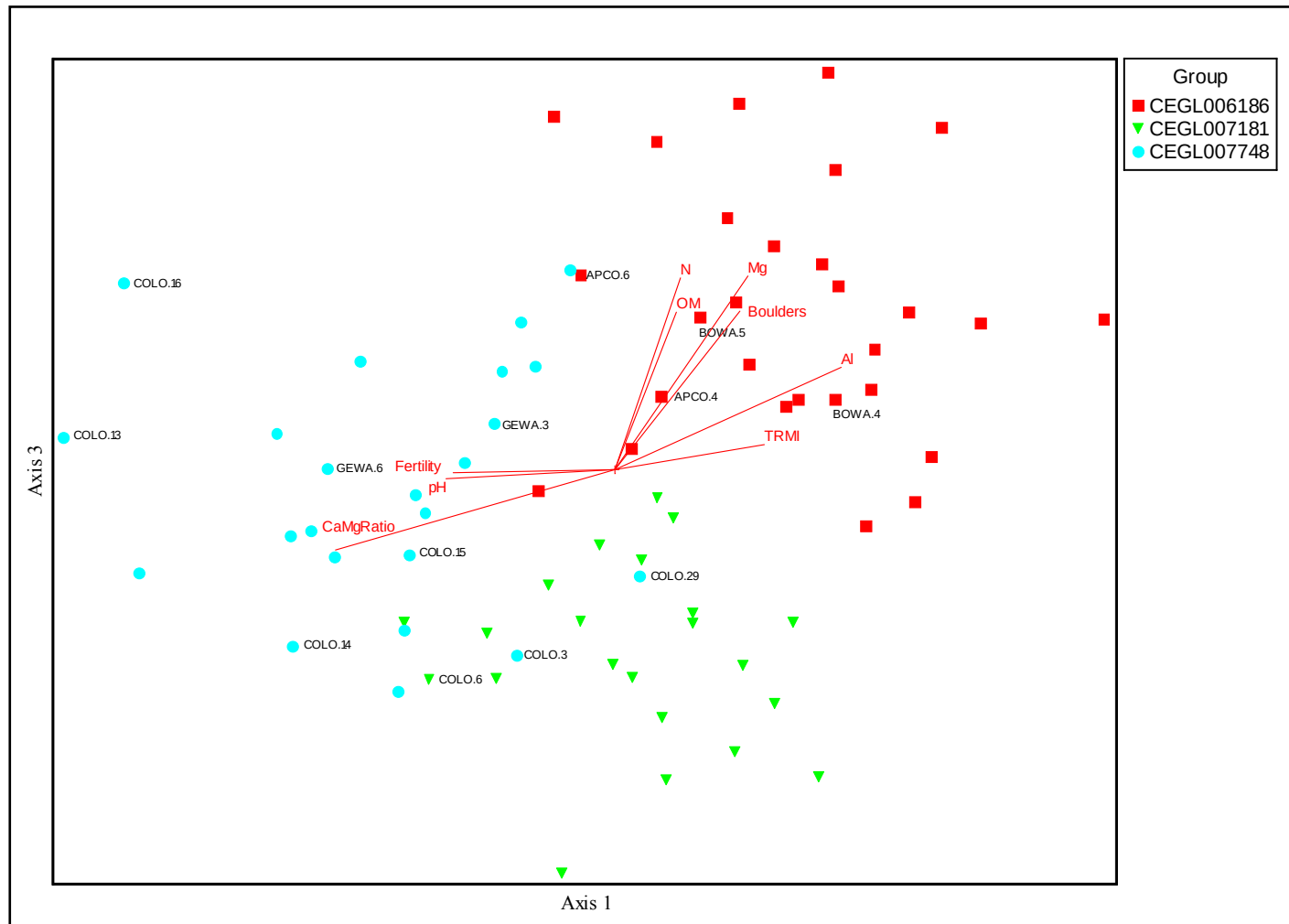


Figure F3. Joint plot showing significant correlations ($r^2 = 0.290$) of environmental variables with ordination scores for 73 basic mesic and calcareous forest plots on Axis 1 and Axis 3 of the NMDS ordination. The angles and lengths of the radiating lines indicate the direction and strength of the 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.

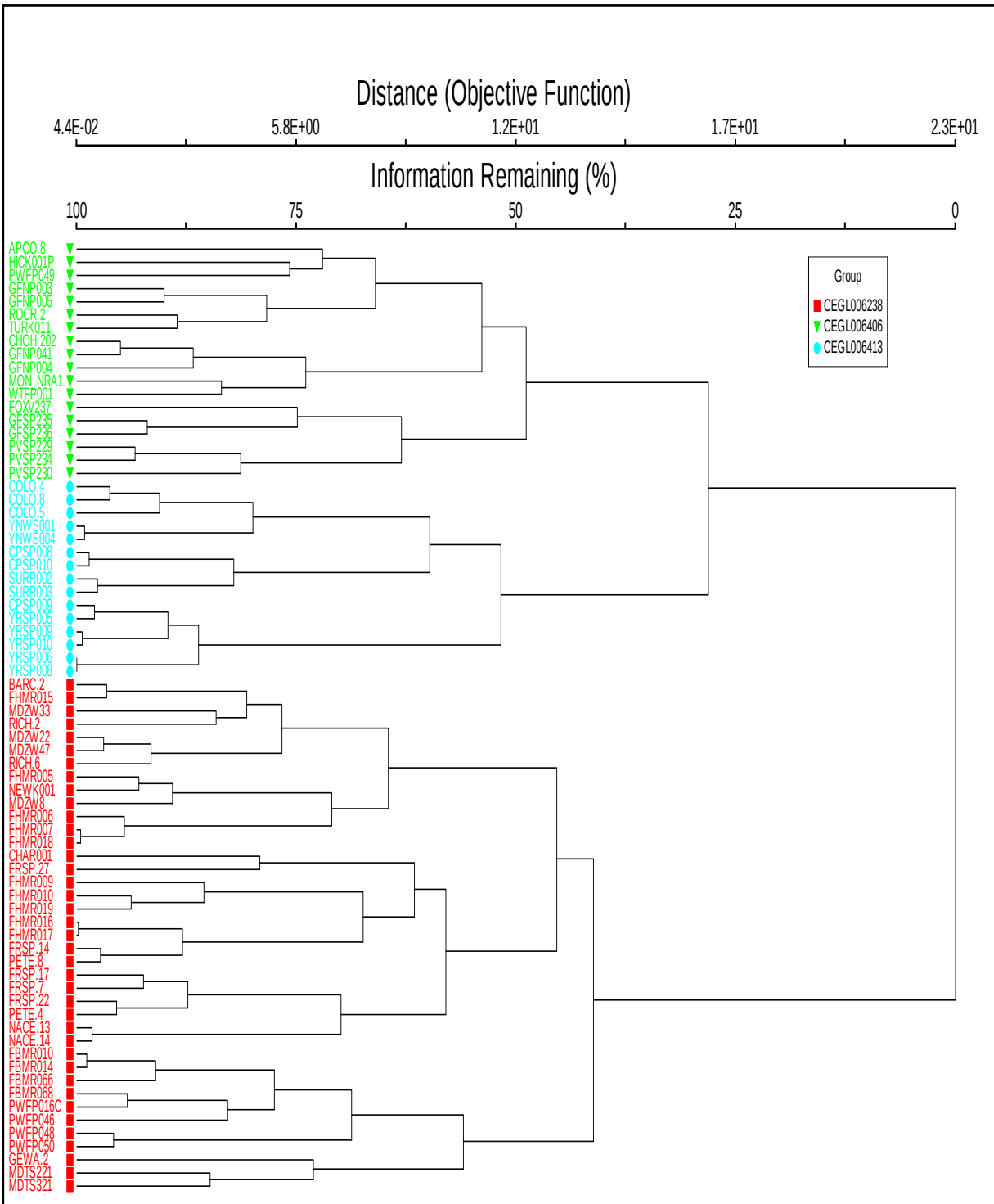


Figure F4. Dendrogram resulting from cluster analysis of species coverage data from 72 seepage wetland plots. Plot membership in three seepage wetland associations is shown. CEGL006238 = Coastal Plain / Piedmont Acidic Seepage Swamp; CEGL006406 = Northern Piedmont / Lower New England Basic Seepage Swamp; CEGL006413 = Coastal Plain Calcareous Seepage Swamp. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

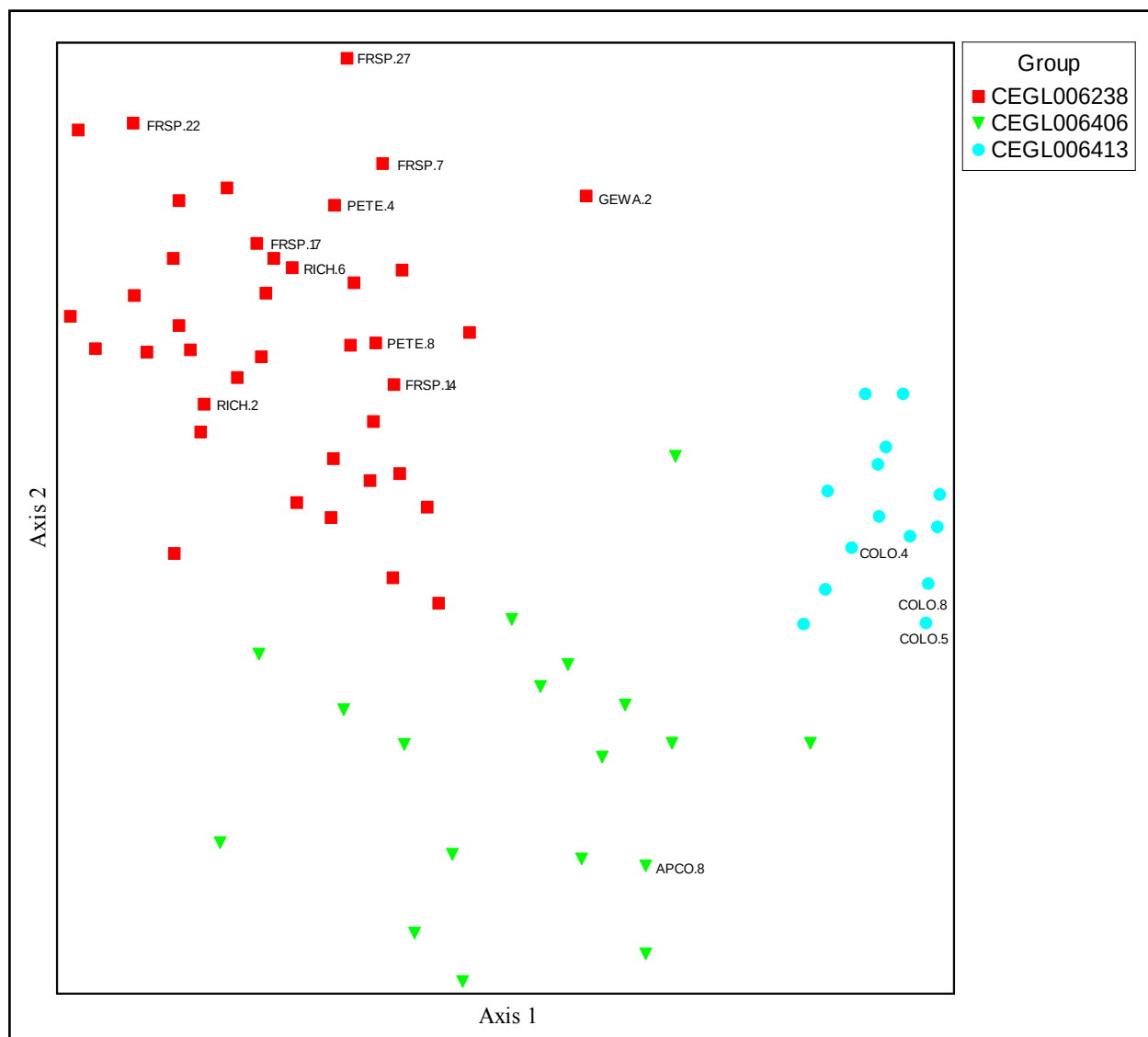


Figure F5. Scatterplot diagram for two-dimensional NMDS ordination of 71 seepage wetland plots. Plot membership in three seepage wetland associations is based on cluster analysis. CEGL006238 = Coastal Plain / Piedmont Acidic Seepage Swamp; CEGL006406 = Northern Piedmont / Lower New England Basic Seepage Swamp; CEGL006413 = Coastal Plain Calcareous Seepage Swamp. Plots from seven Virginia national parks are labeled to the right of or below the symbol. One plot was determined to be an outlier and was eliminated from the dataset prior to ordination.

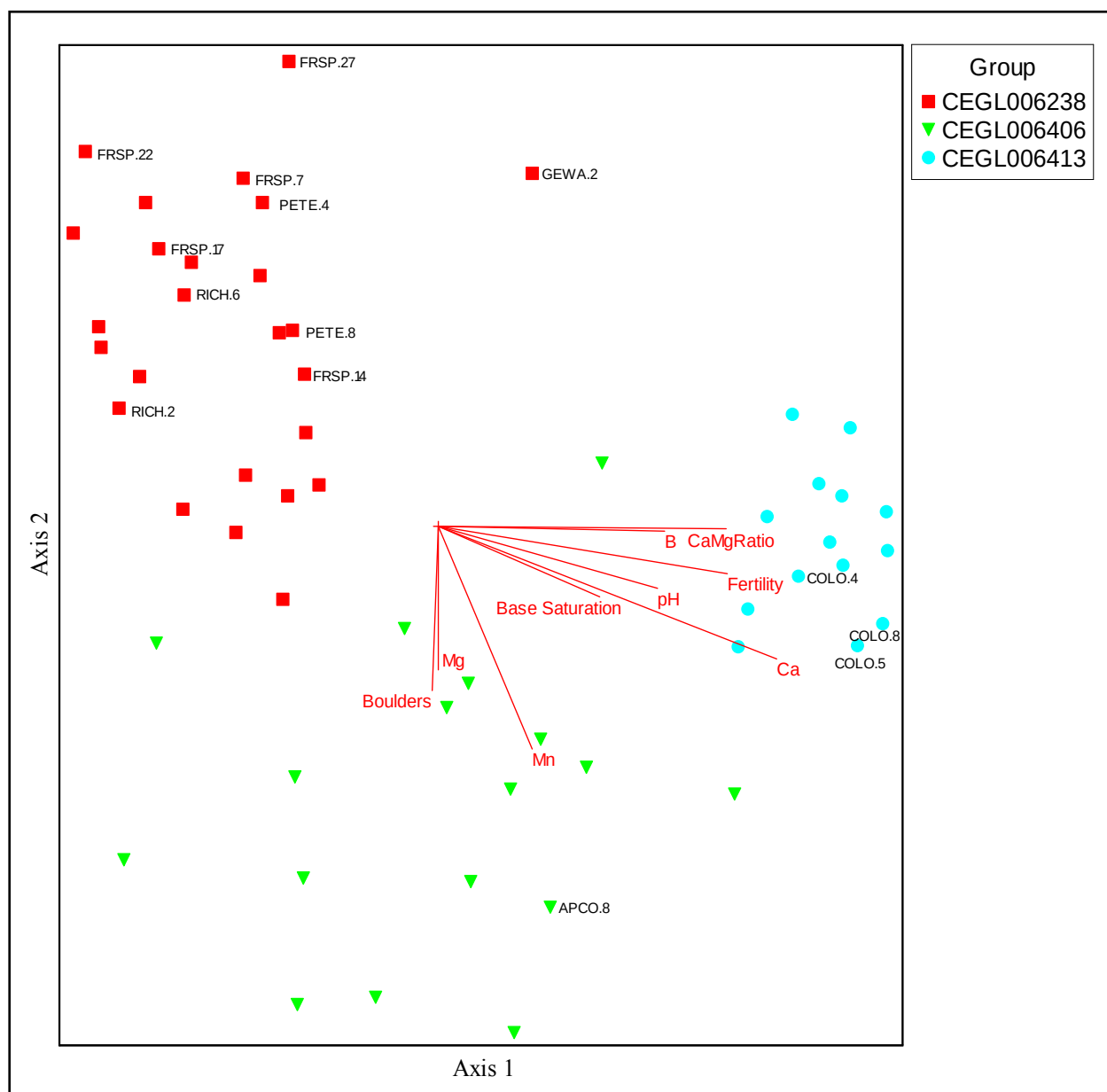


Figure F6. Joint plot showing significant correlations ($r^2 = 0.290$) of environmental variables with ordination scores for 56 seepage wetland plots on Axis 1 and Axis 2 of the NMDS ordination. The angles and lengths of the radiating lines indicate the direction and strength of the relationship. Environmental variables used in joint plots are listed in Table 5. Plots from seven Virginia national parks are labeled to the right of or below the symbol. Only the 56 plots in this group with complete environmental data were included in the ordination.

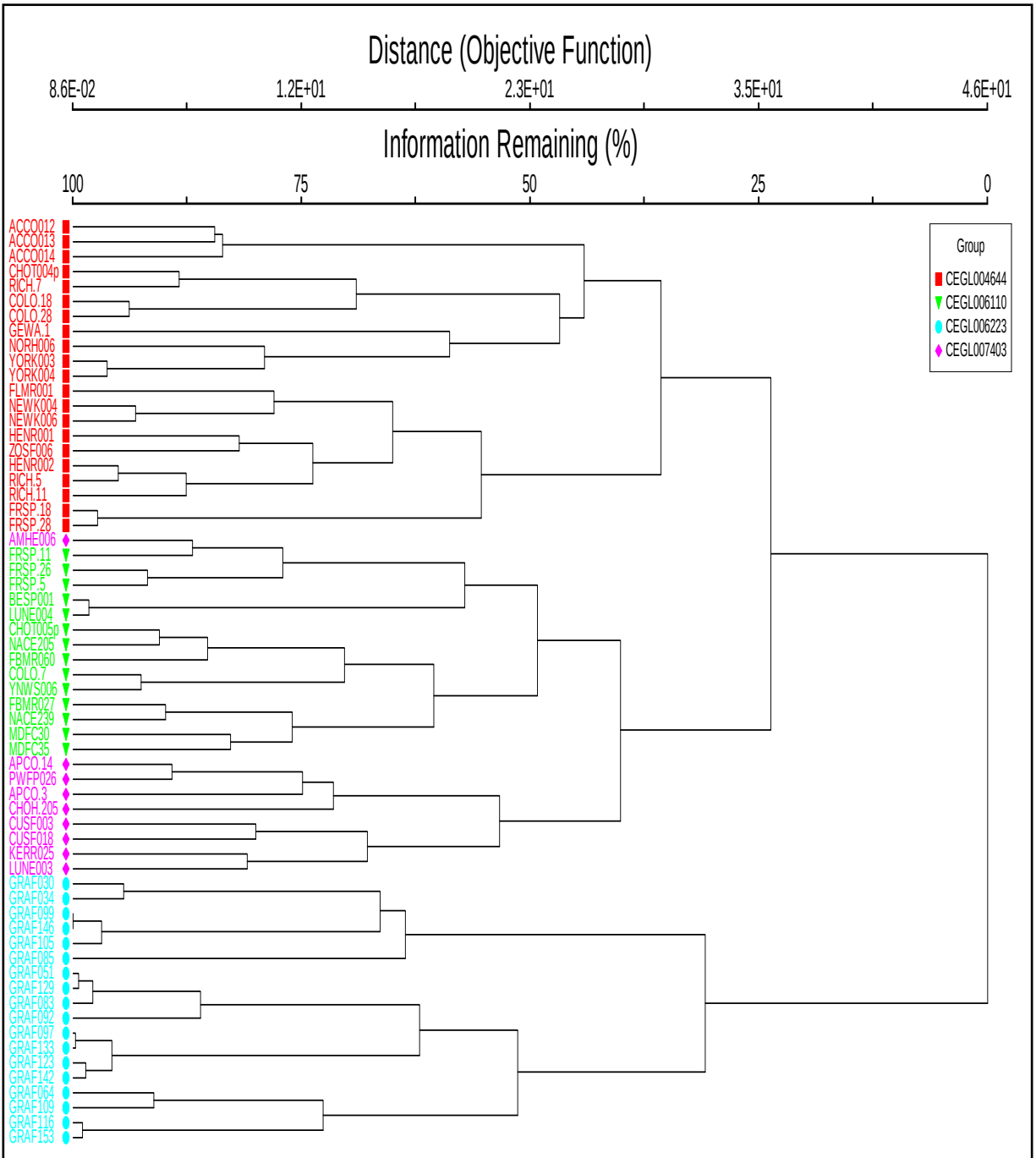


Figure F7. Dendrogram resulting from cluster analysis of species coverage data from 62 nonriverine forest plots. Plot membership in four nonriverine forest associations is shown. CEGL004644 = Non-Riverine Saturated Forest; CEGL006110 = Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type); CEGL006223 = Coastal Plain Depression Wetland (Swamp Tupelo Type); CEGL007403 = Upland Depression Swamp. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

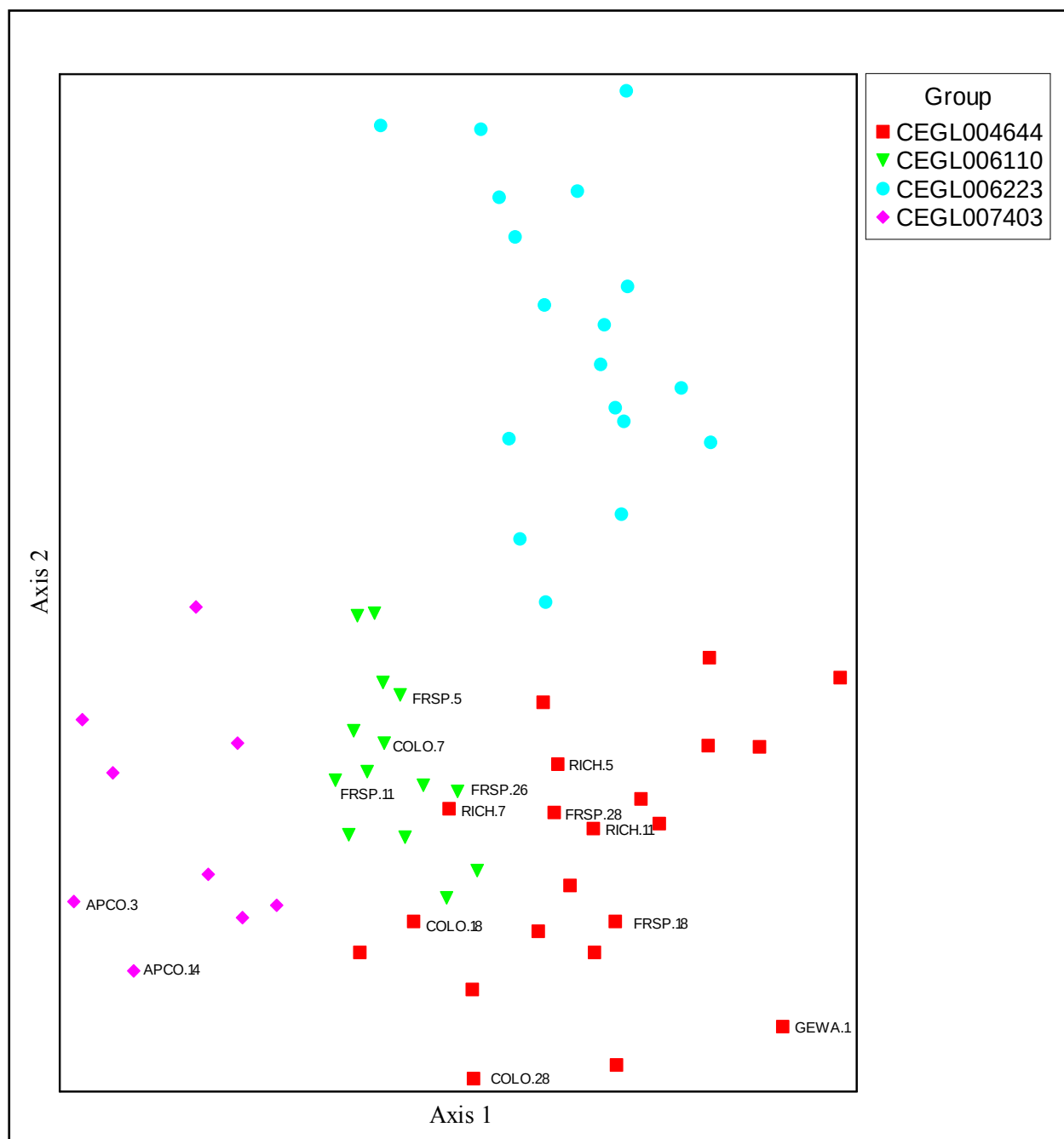


Figure F8. Scatterplot diagram for two-dimensional NMDS ordination of 62 nonriverine forest plots. Plot membership in four nonriverine forest associations is based on cluster analysis. CEG004644 = Non-Riverine Saturated Forest; CEG006110 = Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type); CEG006223 = Coastal Plain Depression Wetland (Swamp Tupelo Type); CEG007403 = Upland Depression Swamp. Plots from seven Virginia national parks are labeled to the right of or below the symbol.

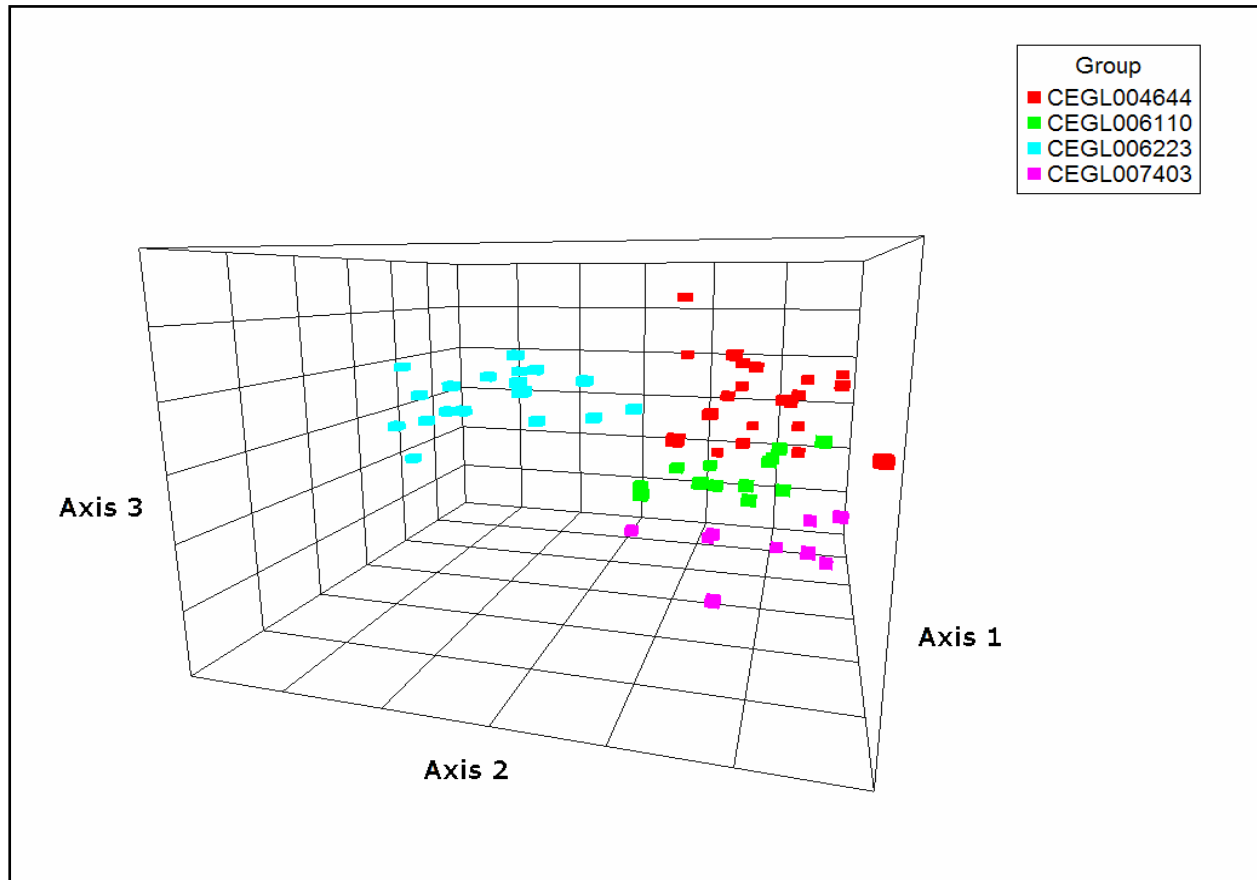
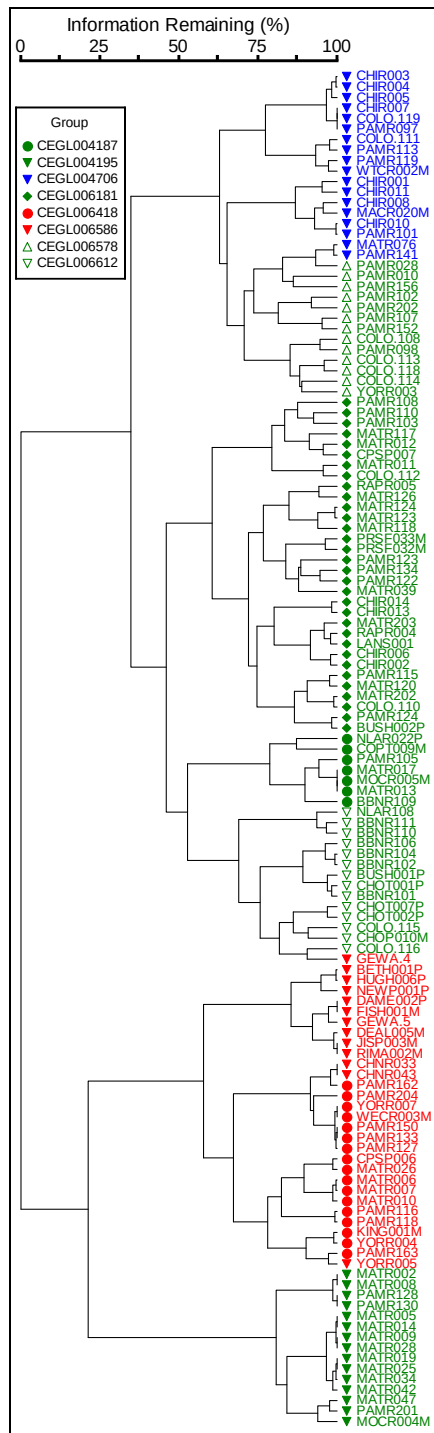


Figure F9. Scatterplot diagram for three-dimensional NMDS ordination of 62 nonriverine forest plots. Plot membership in four nonriverine forest associations is based on cluster analysis. C EGL004644 = Non-Riverine Saturated Forest; C EGL006110 = Coastal Plain Depression Wetland (Red Maple - Sweetgum - Willow Oak Type); C EGL006223 = Coastal Plain Depression Wetland (Swamp Tupelo Type); C EGL007403 = Upland Depression Swamp.



Tidal Freshwater Marshes

CEGL004706 – Tidal Freshwater Marsh

Tidal Oligohaline Marshes

CEGL006578 – Tidal Oligohaline Marsh (Interior Depression Marsh)

CEGL006181 – Tidal Oligohaline Marsh (Mixed Forbs Type)

CEGL004187 – Tidal Oligohaline Marsh (Common Reed Tidal Marsh)

CEGL006612 – Tidal Oligohaline Marsh (Saltmeadow Cordgrass – Olney Three-Square Low Interior Marsh Type)

CEGL004195 – Tidal Oligohaline Marsh (Big Cordgrass Type)

Tidal Mesohaline and Polyhaline Marshes

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

CEGL006418 – Tidal Mesohaline and Polyhaline Marsh (Transitional Marsh)

Figure F10. Dendrogram resulting from cluster analysis of species coverage data from 129 tidal herbaceous marsh plots. Plot membership in eight tidal herbaceous marsh associations is shown. Tidal herbaceous marsh map classes are color coded and represent groupings of associations with similar ecological contexts used to map herbaceous tidal vegetation. Distance on the dendrogram scale is Wishart's objective function (Wishart 1979).

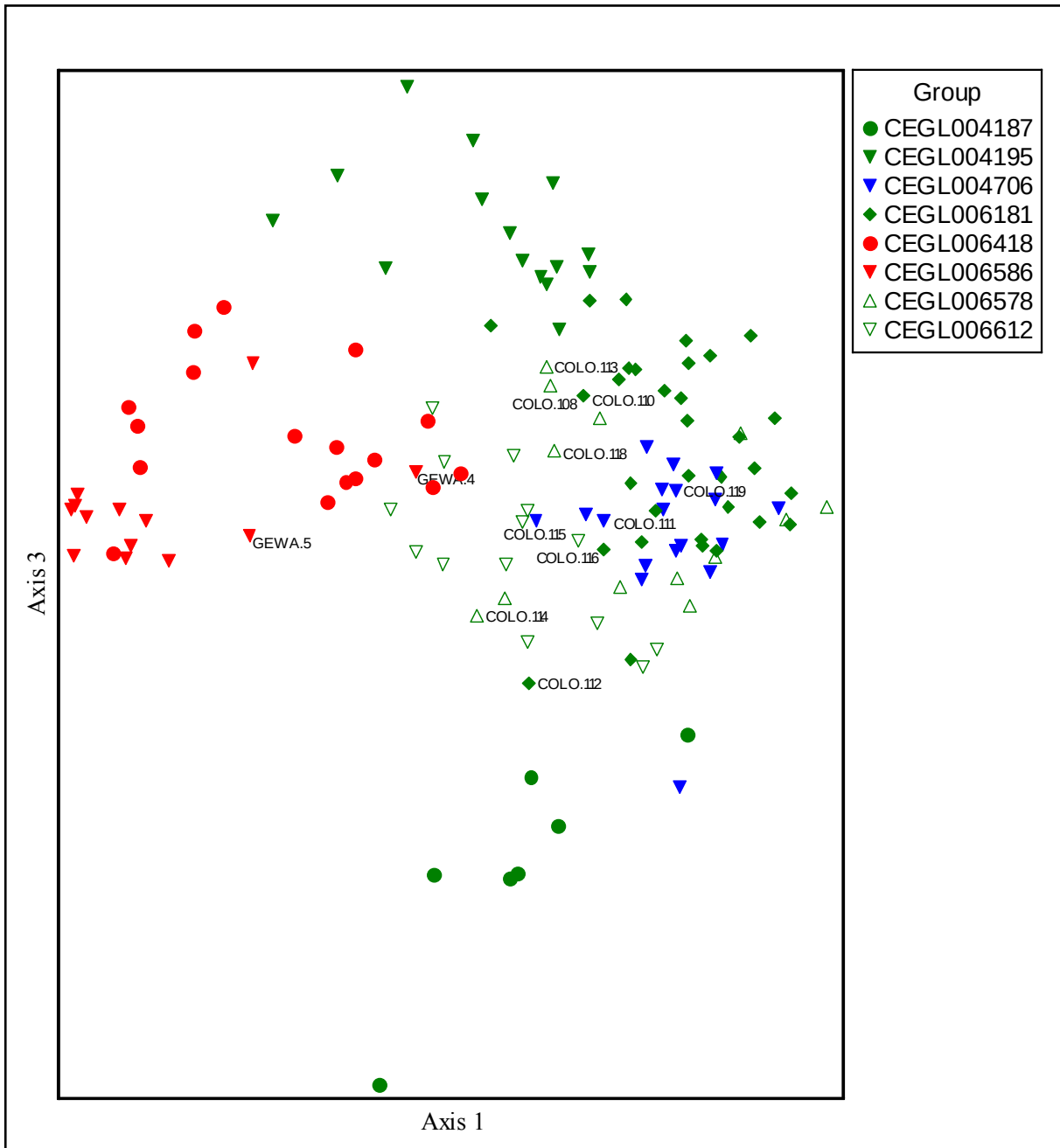


Figure F11. Scatterplot diagram for three-dimensional NMDS ordination of 129 tidal herbaceous marsh plots, showing Axis 1 and 3. Plot membership in eight tidal herbaceous marsh associations is based on cluster analysis. C EGL004187 = Tidal Oligohaline Marsh (Common Reed Tidal Marsh); C EGL004195 = Tidal Oligohaline Marsh (Big Cordgrass Type); C EGL004706 = Tidal Freshwater Marsh; C EGL006181 = Tidal Oligohaline Marsh (Mixed Forbs Type); C EGL006418 = Tidal Mesohaline and Polyhaline Marsh (Transitional Marsh); C EGL006578 = Tidal Oligohaline Marsh (Interior Depression Marsh); C EGL006586 = Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh); C EGL006612 = Tidal Oligohaline Marsh (Saltmeadow Cordgrass - Olney Three-Square Low Interior Marsh Type). Plots from the seven Virginia national parks are labeled to the right of or below the symbol.

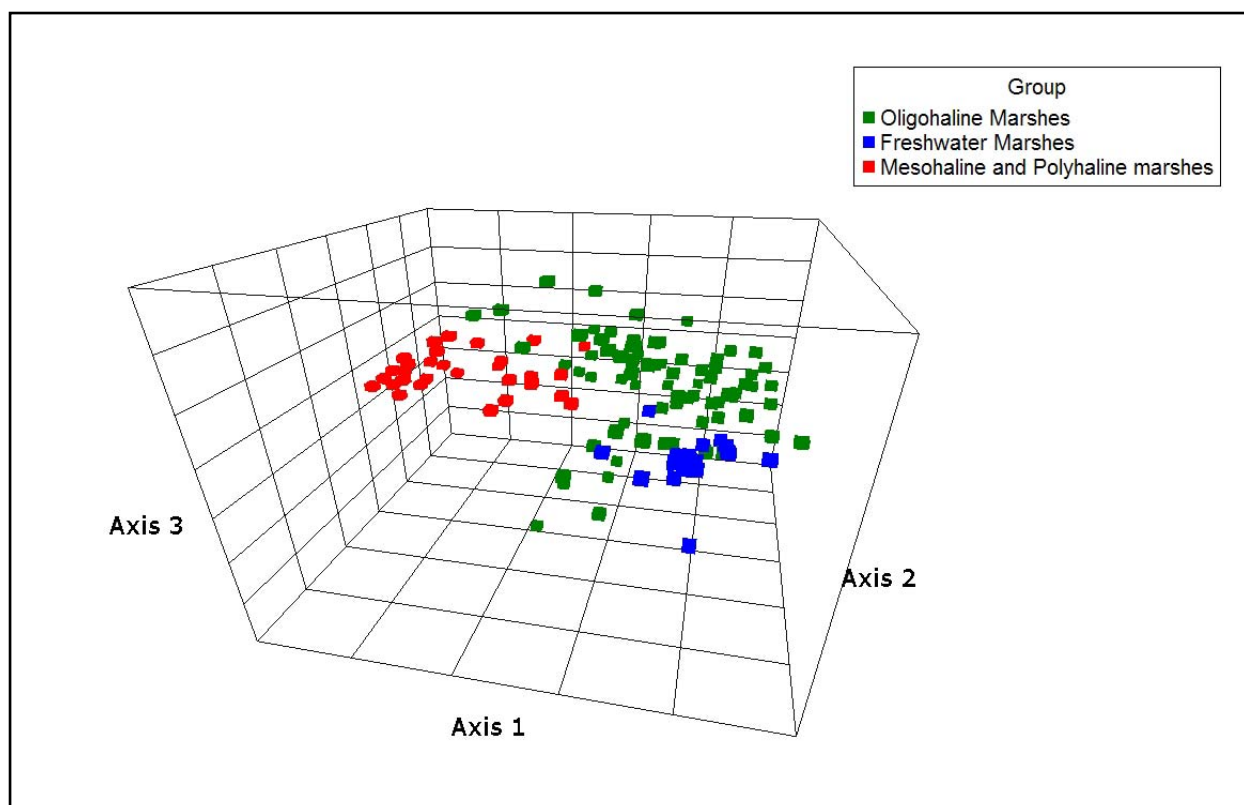


Figure F12. Scatterplot diagram for three-dimensional NMDS ordination of 129 tidal herbaceous marsh plots. Plot membership in three tidal marsh groups (map classes) is shown.

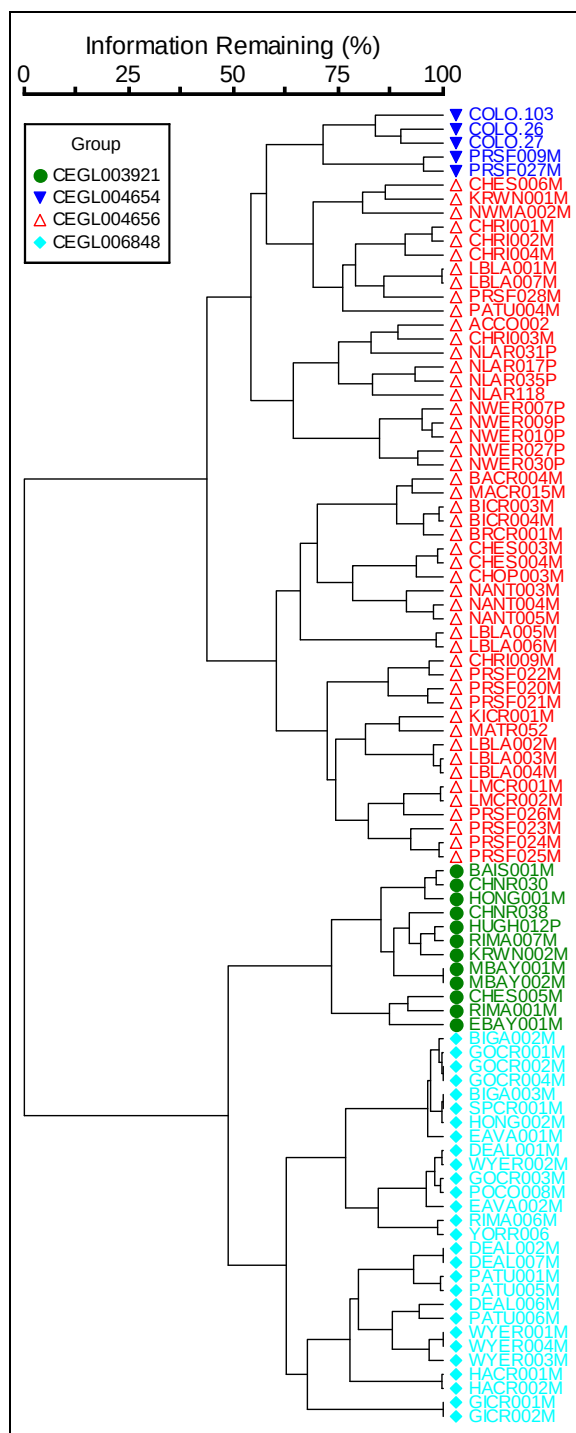


Figure F13. Dendrogram resulting from cluster analysis of species coverage data from 94 tidal forest and shrubland plots. Plot membership in four tidal forest and shrubland associations is shown. CEGL003921 = Salt Scrub; CEGL004654 = Tidal Bald Cypress Forest / Woodland; CEGL004656 = Tidal Shrub Swamp (Wax Myrtle Type); CEGL006848 = Tidal Shrub Swamp (Iva Type). Distance on the dendrogram scale is Wishart's objective function (Wishart 1979). Two plots were determined to be outliers and were eliminated from the dataset prior to ordination.

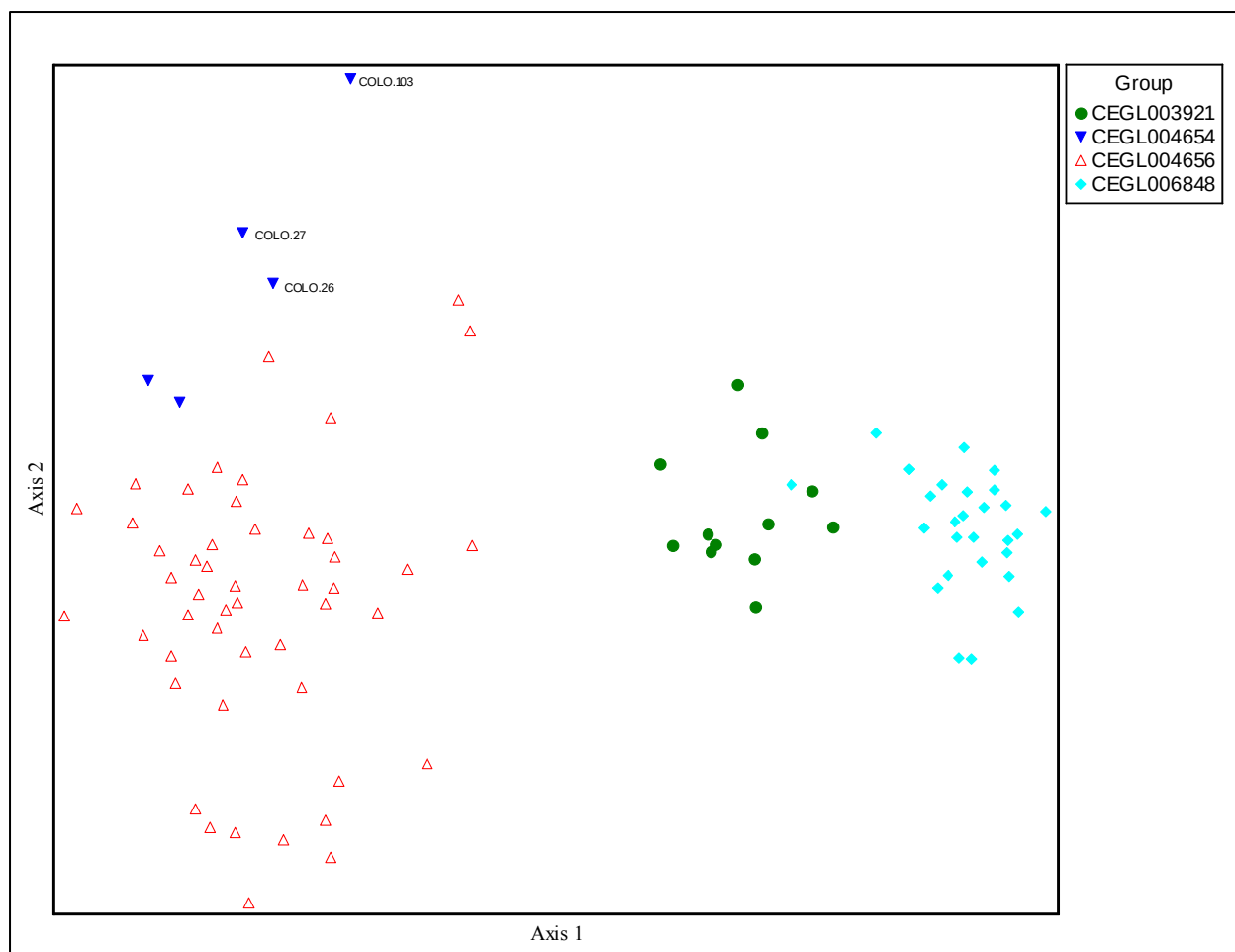


Figure F14. Scatterplot diagram for two-dimensional NMDS ordination of 94 tidal forest and shrubland plots. Plot membership in four tidal forest and shrubland associations is based on cluster analysis results. C EGL003921 = Salt Scrub; C EGL004654 = Tidal Bald Cypress Forest / Woodland; C EGL004656 = Tidal Shrub Swamp (Wax Myrtle Type); C EGL006848 = Tidal Shrub Swamp (Iva Type). Plots from seven Virginia national parks are labeled to the right of or below the symbol. Two plots were determined to be outliers and were eliminated from the dataset prior to ordination.

Appendix G: Compositional summary statistics for vegetation associations within George Washington Birthplace 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, except for those associations where mean species richness is less than or equal to 10 species. Prevalence is an attribute assigned to a portion of the species within a vegetation type (Curtis 1959). Prevalence is determined by ranking the species of a vegetation type in order of descending constancy, then, beginning with the most constant species, selecting as prevalent a number of species equal to the mean species richness for the vegetation type. Species shaded in green were chosen as primary nominals in the association name, while those in blue are parenthetical nominals.

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

Vegetation associations are presented as follows:

Coastal Plain Dry Calcareous Forest	Table G1
Coastal Plain / Piedmont Acidic Seepage Swamp	Table G2
Non-Riverine Saturated Forest	Table G3
Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh)	Table G4
Tidal Oligohaline Marsh (Common Reed Tidal Marsh)	Table G5
Tidal Oligohaline Marsh (Big Cordgrass Type)	Table G6
Tidal Oligohaline Marsh (Mixed Forbs Type)	Table G7
Tidal Shrub Swamp (Iva Type)	Table G8

Table G1. Compositional summary statistics from the regional analysis of Coastal Plain Dry Calcareous Forest (CEGL007748).

Mean Species Richness	67
Homoteneity	0.595
Number of Plots	24

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

Table G1. Compositional summary statistics from the regional analysis of Coastal Plain Dry Calcareous Forest (CEGL007748) (continued).

Species	Total Freq	Total Mean Cover	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
<i>Asplenium platyneuron</i>	156	1	2	+	50	8	4	1	8
<i>Mitchella repens</i>	396	2	2	0	50	3	2	0	2
<i>Sassafras albidum</i>	521	3	2	-	50	2	1	0	1
<i>Arisaema triphyllum</i>	405	2	4	++	46	3	1	1	5
<i>Arnoglossum atriplicifolium</i>	14	1	2	+	46	79	36	8	72
<i>Aquilegia canadensis</i>	24	1	2	+	46	46	21	5	42
<i>Cynoglossum virginianum</i> var. <i>virginianum</i>	50	1	2	+	46	22	10	2	20
<i>Galium triflorum</i>	258	2	2	0	46	4	2	0	2
<i>Symphyotrichum lateriflorum</i>	309	2	2	0	46	4	2	0	2
<i>Smallanthus uvedalius</i>	12	1	3	++	42	83	35	12	139
<i>Dichanthelium commutatum</i>	113	1	2	+	42	9	4	1	7
<i>Sanguinaria canadensis</i>	116	2	2	0	42	9	4	1	4
<i>Ageratina altissima</i> var. <i>altissima</i>	128	2	2	0	42	8	3	1	3
<i>Solidago caesia</i>	233	2	2	0	42	4	2	0	2
<i>Amphicarpaea bracteata</i>	262	2	2	0	42	4	2	0	2
<i>Chimaphila maculata</i>	412	2	2	0	42	2	1	0	1
<i>Euonymus americanus</i>	434	2	2	0	42	2	1	0	1
<i>Quercus velutina</i>	429	4	2	- -	42	2	1	0	0
<i>Quercus rubra</i>	669	5	4	-	38	1	1	0	0
<i>Anemone virginiana</i> var. <i>virginiana</i>	16	1	2	+	38	56	21	5	42
<i>Desmodium pauciflorum</i>	18	1	2	+	38	50	19	4	38
<i>Ruellia caroliniensis</i>	31	1	2	+	38	29	11	2	22
<i>Oxalis dillenii</i>	120	1	2	+	38	8	3	1	6
<i>Packera aurea</i>	68	2	2	0	38	13	5	1	5
<i>Juglans nigra</i>	98	2	2	0	38	9	3	1	3
<i>Viola sororia</i>	253	2	2	0	38	4	1	0	1

Table G2. Compositional summary statistics from the regional analysis of Coastal Plain / Piedmont Acidic Seepage Swamp (CEGL006238).

Mean Species Richness	43
Homogeneity	0.589
Number of Plots	38

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

Table G3. Compositional summary statistics from the regional analysis of Non-Riverine Saturated Forest (CEGL004644).

Mean Species Richness	35
Homogeneity	0.574
Number of Plots	21

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

Table G4. Compositional summary statistics from the regional analysis of Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) (CEGL006586).

Mean Species Richness	4
Homoteneity	0.688
Number of Plots	13

Species	Total Freq	Total Mean Cover	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
<i>Spartina alterniflora</i>	108	4	7	+++	100	11	11	9	89
<i>Distichlis spicata</i>	102	4	6	++	92	11	10	7	40
<i>Spartina patens</i>	142	5	5	0	50	4	2	1	2
<i>Limonium carolinianum</i>	28	1	2	+	33	14	5	1	10
<i>Schoenoplectus pungens</i> var. <i>pungens</i>	54	2	2	0	25	6	1	0	1
<i>Pluchea odorata</i>	70	2	3	+	17	3	0	0	1
<i>Kosteletzkya virginica</i>	88	2	2	0	17	2	0	0	0
<i>Juncus roemerianus</i>	58	4	2	--	17	3	1	0	0
<i>Salicornia virginica</i>	6	1	1	0	17	33	6	1	6
<i>Iva frutescens</i>	94	4	1	---	17	2	0	0	0
<i>Lythrum lineare</i>	40	1	2	+	8	3	0	0	0
<i>Solidago sempervirens</i>	61	2	2	0	8	2	0	0	0
<i>Schoenoplectus americanus</i>	108	4	2	--	8	1	0	0	0
<i>Spartina cynosuroides</i>	156	4	2	--	8	1	0	0	0
<i>Salicornia bigelovii</i>	2	1	1	0	8	50	4	0	4
<i>Symphyotrichum tenuifolium</i>	18	1	1	0	8	6	0	0	0
<i>Cyperus odoratus</i>	22	1	1	0	8	5	0	0	0
<i>Amaranthus cannabinus</i>	193	2	1	-	8	1	0	0	0
<i>Hibiscus moscheutos</i> ssp. <i>moscheutos</i>	298	3	1	--	8	0	0	0	0

Table G5. Compositional summary statistics from the regional analysis of Tidal Oligohaline Marsh (Common Reed Tidal Marsh) (CEGL004187).

Mean Species Richness	6
Homogeneity	0.405
Number of Plots	7

Species	Total Freq	Total Mean Cover	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
<i>Phragmites australis</i>	84	3	9	+++++	100	8	8	8	533
<i>Hibiscus moscheutos</i> ssp. <i>moscheutos</i>	298	3	2	-	43	1	0	0	0
<i>Phyla lanceolata</i>	36	2	2	0	29	6	2	0	2
<i>Amaranthus cannabinus</i>	193	2	2	0	29	1	0	0	0
<i>Peltandra virginica</i>	444	5	2	---	29	0	0	0	0
<i>Schoenoplectus robustus</i>	60	3	4	+	14	2	0	0	0
<i>Typha angustifolia</i>	181	4	3	-	14	1	0	0	0
<i>Hydrocotyle verticillata</i>	44	2	2	0	14	2	0	0	0
<i>Polygonum hydropiperoides</i>	56	2	2	0	14	2	0	0	0
<i>Pluchea odorata</i>	70	2	2	0	14	1	0	0	0
<i>Myrica cerifera</i> var. <i>cerifera</i>	158	4	2	--	14	1	0	0	0
<i>Osmunda regalis</i> var. <i>spectabilis</i>	172	4	2	--	14	1	0	0	0
<i>Ammannia latifolia</i>	7	1	1	0	14	14	2	0	2
<i>Typha x glauca</i>	7	1	1	0	14	14	2	0	2
<i>Lemna minor</i>	8	1	1	0	14	13	2	0	2
<i>Eleocharis olivacea</i>	14	2	1	-	14	7	1	0	1
<i>Cyperus haspan</i>	26	2	1	-	14	4	1	0	0
<i>Ptilimnium capillaceum</i>	71	1	1	0	14	1	0	0	0
<i>Panicum virgatum</i> var. <i>virgatum</i>	78	2	1	-	14	1	0	0	0
<i>Sagittaria lancifolia</i> ssp. <i>media</i>	82	2	1	-	14	1	0	0	0
<i>Kosteletzkya virginica</i>	88	2	1	-	14	1	0	0	0
<i>Decodon verticillatus</i>	99	2	1	-	14	1	0	0	0
<i>Galium obtusum</i>	137	2	1	-	14	1	0	0	0
<i>Thelypteris palustris</i> var. <i>pubescens</i>	160	2	1	-	14	1	0	0	0
<i>Boehmeria cylindrica</i>	172	2	1	-	14	1	0	0	0
<i>Mikania scandens</i>	215	2	1	-	14	0	0	0	0
<i>Eleocharis fallax</i>	111	4	1	---	14	1	0	0	0
<i>Pontederia cordata</i>	253	4	1	---	14	0	0	0	0
<i>Leersia oryzoides</i>	287	4	1	---	14	0	0	0	0
<i>Polygonum arifolium</i>	329	4	1	---	14	0	0	0	0
<i>Polygonum punctatum</i>	401	4	1	---	14	0	0	0	0

Table G6. Compositional summary statistics from the regional analysis of Tidal Oligohaline Marsh (Big Cordgrass Type) (CEGL004195).

Mean Species Richness	5
Homoteneity	0.578
Number of Plots	18

Species	Total Freq	Total Mean Cover	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
<i>Spartina cynosuroides</i>	156	4	9	+++++	100	12	12	12	369
<i>Peltandra virginica</i>	444	5	3	--	67	3	2	1	0
<i>Polygonum punctatum</i>	401	4	3	-	50	2	1	0	1
<i>Hibiscus moscheutos</i> ssp. <i>moscheutos</i>	298	3	3	0	39	2	1	0	1
<i>Polygonum arifolium</i>	329	4	2	--	33	2	1	0	0
<i>Mikania scandens</i>	215	2	4	++	28	2	1	0	3
<i>Kosteletzkya virginica</i>	88	2	2	0	17	3	1	0	1
<i>Spartina alterniflora</i>	108	4	2	--	17	3	0	0	0
<i>Rumex verticillatus</i>	71	2	1	-	17	4	1	0	0
<i>Schoenoplectus pungens</i> var. <i>pungens</i>	54	2	2	0	11	4	0	0	0
<i>Amaranthus cannabinus</i>	193	2	2	0	11	1	0	0	0
<i>Impatiens capensis</i>	239	4	2	--	11	1	0	0	0
<i>Pontederia cordata</i>	253	4	2	--	11	1	0	0	0
<i>Teucrium canadense</i>	17	1	2	+	6	6	0	0	1
<i>Typha latifolia</i>	62	2	2	0	6	2	0	0	0
<i>Carex hyalinolepis</i>	36	3	2	-	6	3	0	0	0
<i>Panicum virgatum</i> var. <i>virgatum</i>	78	2	2	0	6	1	0	0	0
<i>Phragmites australis</i>	84	3	2	-	6	1	0	0	0
<i>Iva frutescens</i>	94	4	2	--	6	1	0	0	0
<i>Typha angustifolia</i>	181	4	2	--	6	1	0	0	0
<i>Sagittaria graminea</i>	5	1	1	0	6	20	1	0	1
<i>Bidens aristosa</i>	12	1	1	0	6	8	0	0	0
<i>Eryngium aquaticum</i> var. <i>aquaticum</i>	13	1	1	0	6	8	0	0	0
<i>Leersia virginica</i>	11	2	1	-	6	9	1	0	0
<i>Vernonia noveboracensis</i>	24	1	1	0	6	4	0	0	0
<i>Schoenoplectus fluvialis</i>	27	2	1	-	6	4	0	0	0
<i>Sium suave</i>	103	1	1	0	6	1	0	0	0
<i>Schoenoplectus tabernaemontani</i>	80	2	1	-	6	1	0	0	0
<i>Sagittaria lancifolia</i> ssp. <i>media</i>	82	2	1	-	6	1	0	0	0
<i>Baccharis halimifolia</i>	71	3	1	--	6	1	0	0	0
<i>Schoenoplectus americanus</i>	108	4	1	---	6	1	0	0	0
<i>Zizania aquatica</i> var. <i>aquatica</i>	229	4	1	---	6	0	0	0	0
<i>Spartina patens</i>	142	5	1	----	6	1	0	0	0

Table G7. Compositional summary statistics from the regional analysis of Tidal Oligohaline Marsh (Mixed Forbs Type) (CEGL006181).

Mean Species Richness	15
Homogeneity	0.546
Number of Plots	32

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

Table G8. Compositional summary statistics from the regional analysis of Tidal Shrub Swamp (Iva Type) (CEGL006848).

Mean Species Richness	8
Homoteneity	0.633
Number of Plots	30

Species	Total Freq	Total Mean Cover	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
<i>Iva frutescens</i>	94	4	8	++++	100	32	32	28	511
<i>Spartina patens</i>	142	5	7	++	93	20	18	14	74
<i>Distichlis spicata</i>	102	4	6	++	83	25	20	14	82
<i>Spartina alterniflora</i>	108	4	6	++	67	19	12	8	49
<i>Solidago sempervirens</i>	61	2	4	++	63	31	20	9	79
<i>Limonium carolinianum</i>	28	1	2	+	37	39	14	3	29
<i>Lythrum lineare</i>	40	1	2	+	33	25	8	2	17
<i>Atriplex patula</i>	23	1	2	+	30	39	12	3	23
<i>Cuscuta gronovii</i> var. <i>gronovii</i>	132	2	2	0	30	7	2	0	2
<i>Baccharis halimifolia</i>	71	3	4	+	27	11	3	1	6
<i>Phragmites australis</i>	84	3	4	+	23	8	2	1	4
<i>Juncus roemerianus</i>	58	4	4	0	23	12	3	1	3
<i>Kosteletzkya virginica</i>	88	2	2	0	23	8	2	0	2
<i>Schoenoplectus americanus</i>	108	4	2	--	23	6	2	0	0
<i>Pluchea odorata</i>	70	2	2	0	20	9	2	0	2
<i>Symphyotrichum tenuifolium</i>	18	1	2	+	17	28	5	1	9
<i>Spartina cynosuroides</i>	156	4	2	--	17	3	1	0	0
<i>Amaranthus cannabinus</i>	193	2	1	-	10	2	0	0	0
<i>Juncus gerardii</i> var. <i>gerardii</i>	5	2	4	++	7	40	3	1	11
<i>Juniperus virginiana</i> var. <i>virginiana</i>	36	2	2	0	7	6	0	0	0
<i>Mikania scandens</i>	215	2	2	0	7	1	0	0	0
<i>Pluchea camphorata</i>	5	1	1	0	7	40	3	0	3
<i>Eleocharis parvula</i>	14	1	1	0	7	14	1	0	1
<i>Rumex verticillatus</i>	71	2	1	-	7	3	0	0	0
<i>Panicum virgatum</i> var. <i>virgatum</i>	78	2	1	-	7	3	0	0	0
<i>Schoenoplectus robustus</i>	60	3	1	--	7	3	0	0	0
<i>Eleocharis fallax</i>	111	4	1	---	7	2	0	0	0
<i>Lonicera japonica</i>	98	2	2	0	3	1	0	0	0
<i>Myrica cerifera</i> var. <i>cerifera</i>	158	4	2	--	3	1	0	0	0
<i>Polygonum ramosissimum</i> var. <i>prolificum</i>	1	1	1	0	3	100	3	0	3
<i>Suaeda maritima</i> ssp. <i>maritima</i>	1	1	1	0	3	100	3	0	3
<i>Asparagus officinalis</i>	2	1	1	0	3	50	2	0	2
<i>Juncus tenuis</i>	2	1	1	0	3	50	2	0	2
<i>Fimbristylis caroliniana</i>	3	1	1	0	3	33	1	0	1
<i>Juncus biflorus</i>	8	1	1	0	3	13	0	0	0
<i>Cyperus strigosus</i>	19	1	1	0	3	5	0	0	0
<i>Cyperus filicinus</i>	15	2	1	-	3	7	0	0	0
<i>Juncus effusus</i>	36	1	1	0	3	3	0	0	0
<i>Phyla lanceolata</i>	36	2	1	-	3	3	0	0	0
<i>Asclepias incarnata</i>	82	1	1	0	3	1	0	0	0
<i>Cinna arundinacea</i>	149	2	1	-	3	1	0	0	0
<i>Toxicodendron radicans</i>	253	3	1	--	3	0	0	0	0

Table G8. Compositional summary statistics from the regional analysis of Tidal Shrub Swamp (Iva Type) (CEGL006848) (continued).

Species	Total Freq	Total Mean Cover	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
<i>Hibiscus moscheutos</i> ssp. <i>moscheutos</i>	298	3	1	- -	3	0	0	0	0
<i>Polygonum punctatum</i>	401	4	1	- -	3	0	0	0	0

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

This appendix contains detailed local descriptions for the vegetation associations and other map classes present at George Washington Birthplace National Monument based on information collected within the park boundary. Of the 19 map classes used to map George Washington Birthplace National Monument, 13 were crosswalked to the finest level of the USNVC (association), two were described as nonstandard, park-specific vegetation classes, and four were crosswalked to Anderson (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 September 26, 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 associations are provided after the descriptions, except for Tidal Oligohaline Marsh (Big Cordgrass Type), where an acceptable photograph was not obtained. Photographs were taken by VADNH staff unless otherwise indicated. Sources cited in the 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 USNVC 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 USNVC associations are managed within the Virginia Division of Natural Heritage, and the state/subnational conservation rank (SRank) and global conservation rank (GRank) for all associations are provided in Appendix 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 George Washington Birthplace National Monument map classes is presented in Appendix J. The key should be used in conjunction with the detailed descriptions.

Copyright © 2007 NatureServe, 1101 Wilson Blvd, 15th floor
Arlington, VA 22209, U.S.A. All Rights Reserved.

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 26 September 2007.

Restrictions on Use: Permission to use, copy and distribute these data is hereby granted under the following conditions:

1. The above copyright notice must appear in all documents and reports;
2. Any use must be for informational purposes only and in no instance for commercial purposes;
3. Some data may be altered in format for analytical purposes, however the data should still be referenced using the citation above.

Any rights not expressly granted herein are reserved by NatureServe. Except as expressly provided above, nothing contained herein shall be construed as conferring any license or right under any NatureServe copyright.

Information Warranty Disclaimer: All data are provided as is without warranty as to the currentness, completeness, or accuracy of any specific data. The absence of data in any particular geographic area does not necessarily mean that species or ecological communities of concern are not present. NatureServe hereby disclaims all warranties and conditions with regard to these data, including but not limited to all implied warranties and conditions of merchantability, fitness for a particular purpose, and non-infringement. In no event shall NatureServe be liable for any special, indirect, incidental, consequential damages, or for damages of any kind arising out of or in connection with the use of these data. Because the data in the NatureServe Central Databases are continually being updated, it is advisable to refresh data at least once a year after receipt.

NatureServe
1101 Wilson Blvd, 15th floor
Arlington, VA 22209

These data are extracted from:

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 26 September 2007.

FORESTED UPLANDS

Coastal Plain Dry Calcareous Forest	149
Loblolly Pine - Hardwood Forest	123
Loblolly Pine Plantation	117
Early-Successional Loblolly Pine Forest	127
Disturbed Acidic Slope Forest	139
Disturbed Calcareous Forest	199
Successional Red-cedar Forest	133
Successional Black Locust Forest	155
Successional Sweetgum Forest	145

FORESTED WETLANDS

Non-Riverine Saturated Forest	159
Coastal Plain / Piedmont Acidic Seepage Swamp	165

TIDAL WETLANDS

Tidal Shrub Swamp (Iva Type)	171
Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh)	185
Tidal Oligohaline Marsh (Common Reed Tidal Marsh)	181
Tidal Oligohaline Marsh (Mixed Forbs Type)	193
Tidal Oligohaline Marsh (Big Cordgrass Type)	189

**CULTURAL VEGETATION & LAND-USE CLASSES (ANDERSON
LEVEL II)**

Beaches	205
Cultural Meadow	177
Other Urban or Built-up Land	207
Semipermanent Impoundment	203

Transportation, Communications, and Utilities	209
Water	211

COMMON NAME (PARK-SPECIFIC): LOBLOLLY PINE PLANTATION

SYNONYMS

USNVC English Name: Loblolly Pine Planted Forest

USNVC Scientific Name: *Pinus taeda* Planted Forest

USNVC Identifier: CEGLO07179

LOCAL INFORMATION

Environmental Description: Loblolly Pine Plantation occurs on areas where *Pinus taeda* (loblolly pine) has been planted. In George Washington Birthplace National Monument, these forests occur on level to gently sloping, poorly drained soils.

Vegetation Description: Loblolly Pine Plantation includes planted evergreen forests with canopies dominated by *Pinus taeda* (loblolly pine). Polygons of this association are dominated by *Pinus taeda* (loblolly pine) planted in discernable rows with little or no other tree or shrub species. Litter typically dominates the ground layer with no or very sparse herbaceous/woody seedling cover.

Most Abundant Species:

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

Characteristic Species: *Parthenocissus quinquefolia* (Virginia creeper), *Phytolacca americana* (American pokeweed).

Other Noteworthy Species:

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

Subnational Distribution with Crosswalk Data:

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

Local Range: Loblolly Pine Plantation occurs on the north side of the road to the Muse Property and in the vicinity of Longwood Swamp, just east of the Muse Property. It is included in the map class "Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest" which includes two associations and is mapped as 11 polygons ranging from 0.4 to 9.4 hectares (1 to 23.2 acres) and covers a total of 29.2 hectares (72.2 acres) in the park.

Classification Comments: Loblolly Pine Plantation is distinguished from other vegetation in George Washington Birthplace National Monument by having a canopy dominated by *Pinus taeda* (loblolly pine) planted in discernable rows. Deciduous trees may be in the understory/shrub layers but do not break into the canopy.

Other Comments: Because abandoned Loblolly Pine Plantation may be difficult to distinguish from Early-Successional Loblolly Pine Forest, these two associations were combined into one map class: "Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest." Seven of the 11 polygons of "Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest" are in discernible rows and are tagged as "plantation" in the attribute table of the vegetation map. The remaining polygons in this map class are successional loblolly pine of uncertain origin, perhaps from natural regeneration or the result of "failed" or abandoned plantations.

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace National Monument Inventory Notes: All polygons of Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest were observed in the field.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
Physiognomic Subgroup	Planted/Cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.)
Formation	Planted/cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.x.)
Alliance	<i>Pinus taeda</i> Planted Forest Alliance (A.99)
Alliance (English name)	Loblolly Pine Planted Forest Alliance
Association	<i>Pinus taeda</i> Planted Forest
Association (English name)	Loblolly Pine Planted Forest
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

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

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

Vegetation Description: There is considerable local variation among stands of this planted vegetation type across its broad range (from the Interior Highlands to the Coastal Plain, including areas outside the natural range of the species). In the Ouachita Mountains planted loblolly is found with a variable amount of *Quercus alba* (white oak), *Quercus falcata* (southern red oak), *Quercus marilandica* (blackjack oak), *Quercus stellata* (post oak), and *Quercus velutina* (black oak); on drier sites *Pinus echinata* (shortleaf pine), *Carya alba* (mockernut hickory), and *Carya texana* (black hickory); and *Acer rubrum* (red maple), *Liquidambar styraciflua* (sweetgum), and *Quercus nigra* (water oak) on wetter sites. The understory can be

thick especially after thinning and/or burning. Common understory species are *Vaccinium pallidum* (Blue Ridge blueberry), *Vaccinium arboreum* (farkleberry), *Vaccinium stamineum* (deerberry), *Cornus florida* (flowering dogwood), *Ulmus alata* (winged elm), and others. Vines are an important component, including *Berchemia scandens* (Alabama supplejack), *Lonicera japonica* (Japanese honeysuckle), *Parthenocissus quinquefolia* (Virginia creeper), *Vitis* spp. (grapes), *Smilax* spp. (greenbriers), and *Toxicodendron radicans* (eastern poison ivy). In dense stands the herbaceous layer is suppressed by dense needle litter. In thinned and burned stands the plantations are often grazed. Herbaceous species can include *Solidago ulmifolia* (elmleaf goldenrod), *Chasmanthium sessiliflorum* (longleaf woodoats), *Schizachyrium scoparium* (little bluestem), *Danthonia spicata* (poverty oatgrass), *Tephrosia virginiana* (Virginia tephrosia), *Lespedeza* spp. (lespedezas), *Symphotrichum patens* (late purple aster), *Eupatorium* spp. (thoroughworts), and others. In Oklahoma, associates include *Rhus copallinum* (flameleaf sumac), *Hypericum densiflorum* (bushy St. Johnswort), *Liquidambar styraciflua* (sweetgum) and *Toxicodendron radicans* (eastern poison ivy) (Hoagland 2000). Additional data on several stands on the Croatan National Forest can be found in Doyle and Allard (1990).

Most Abundant Species: Information not available.

Characteristic Species: Information not available.

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association is found throughout the southeastern United States.

States/Provinces: AL, AR, DE, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA.

Federal Lands: DOD (Arnold, Fort Benning, Fort Bragg, Fort Gordon, Fort Stewart); DOE (Savannah River Site); NPS (Appomattox Court House, Chickamauga-Chattanooga?, Colonial, Fredericksburg-Spotsylvania, George Washington Birthplace, Natchez Trace, Obed, Petersburg, Richmond, Vicksburg); USFS (Angelina, Bankhead?, Bienville, Cherokee, Conecuh, Croatan, Davy Crockett, De Soto, Delta, Francis Marion, Holly Springs, Kisatchie, Land Between the Lakes, Oconee, Ouachita, Ouachita (Coastal Plain), Ouachita (Mountains), Ozark, Sabine, Sam Houston, St. Francis?, Sumter, Sumter (Mountains), Sumter (Piedmont), Talladega, Talladega (Oakmulgee), Talladega (Talladega), Tombigbee, Tuskegee); USFWS (Blackwater, Chesapeake Marshlands, Eufaula, Prime Hook).

CONSERVATION STATUS

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

Reasons: This community represents vegetation which has been planted in its current location by humans and/or is treated with annual tillage, a modified conservation tillage, or other intensive management or manipulation. It is not a conservation priority and does not receive a conservation rank.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

Comments: At Arnold Air Force Base, Coffee and Franklin counties, Tennessee, *Pinus taeda* (loblolly pine) is near the edge of its putative natural range and was apparently absent prior to being planted there between 1945 and 1950 on abandoned agricultural land and along roadsides. Older plantings have not been intensively managed, and many have become "modified" vegetation (e.g., CEG007109) and are no longer regarded as plantations. More recently (1998–

2001) some of these older pine stands have been harvested and replaced with true *Pinus taeda* (loblolly pine) plantations. *Pinus taeda* (loblolly pine) also invades seasonally wet hardwood depressions, but these stands remain recognizable as to their natural identity (e.g., CEGL007364). Associations occur as plantations and on old fields on Kisatchie and Sumter national forests and after blowdowns on the Kisatchie. South Carolina information after Jones et al. (1981). In the Coastal Plain of South Carolina, there are mature loblolly plantations, often with *Prunus serotina* var. *serotina* (black cherry) in the understory, that have been prescribed burned (based on seven plots at Savannah River Site) - such stands are presumably better covered under *Pinus taeda* (loblolly pine) Forest Alliance (A.130). Plantations occur in obvious rows in the aerial photos of the Delmarva Peninsula in Maryland.

Similar Associations:

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

Related Concepts:

- Loblolly Pine: 81 (Eyre 1980) B

SOURCES

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

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



Figure H1. Loblolly Pine Plantation at George Washington Birthplace National Monument. May 2004. NAD 1983 / UTM easting 332241, northing 4229561.

COMMON NAME (PARK-SPECIFIC): LOBLOLLY PINE - HARDWOOD FOREST**SYNONYMS****USNVC English Name:** Loblolly Pine - Sweetgum Semi-natural Forest**USNVC Scientific Name:** *Pinus taeda* - *Liquidambar styraciflua* Semi-natural Forest**USNVC Identifier:** CEGLO08462**LOCAL INFORMATION**

Environmental Description: Loblolly Pine - Hardwood Forest is a mid- to late-successional pine forest occurring on gentle slopes and upland flats at George Washington Birthplace National Monument. It is found on a variety of soil types at 1.5 to 6 m (5–20 feet) above sea level. These forests may have resulted from clearing or hydrologic alteration (ditching) of the mainly deciduous forests that once occurred here.

Vegetation Description: This forest has a canopy dominated by *Pinus taeda* (loblolly pine) or *Pinus taeda* (loblolly pine) with *Liquidambar styraciflua* (sweetgum). Other hardwood species that may occur in the canopy and subcanopy include *Acer rubrum* (red maple), *Liriodendron tulipifera* (tuliptree), *Prunus serotina* var. *serotina* (black cherry), and *Ilex opaca* var. *opaca* (American holly). The hydric oaks *Quercus phellos* (willow oak) and *Quercus michauxii* (swamp chestnut oak) may occur with low frequency. There is little to no cover of plants in the field layer, usually woody vines such as *Vitis vulpina* (frost grape) or *Lonicera japonica* (Japanese honeysuckle).

Polygons mapped as this association can have areas where the canopy is mostly evergreen, but overall the polygons have a mixed canopy composition, with greater than 25% of canopy composed of deciduous trees. Canopy openings may have small areas (less than 0.5 hectare) with heavy *Liquidambar styraciflua* (sweetgum) regeneration.

Most Abundant Species:

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

Characteristic Species: *Liquidambar styraciflua* (sweetgum), *Pinus taeda* (loblolly pine).

Other Noteworthy Species:

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

Subnational Distribution with Crosswalk Data:

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

Local Range: Loblolly Pine - Hardwood Forest is the main forest habitat type on George Washington Birthplace National Monument, covering 34.2 hectares (85.6 acres), or nearly 15% of the total acreage. It forms the forested matrix around Dancing Marsh, Pope's Creek Trail/ Picnic Area, and the area south of 'Muse Road.' Five polygons ranging from 1 to 23 hectares (2.5 to 57 acres) in size are mapped as Loblolly Pine - Hardwood Forest.

Classification Comments: This association can occur adjacent to and grade into both Early-Successional Loblolly Pine Forest and Non-Riverine Saturated Forest. It is similar in species composition to Early-Successional Loblolly Pine Forest but is generally a more mature forest, with larger trees and with hardwood species mixing with pine in the canopy and subcanopy. It is

distinguished from Non-Riverine Saturated Forest by lacking a high frequency of hydric oaks in the canopy (*Quercus pagoda* (cherrybark oak), *Quercus palustris* (pin oak), *Quercus phellos* (willow oak), and *Quercus michauxii* (swamp chestnut oak)).

Other Comments: Historically, portions of this association could have been a deciduous forest similar to Non-Riverine Saturated Forest, but hydrologic alterations from historic ditching and forest removal created conditions more favorable to the establishment of *Pinus taeda* (loblolly pine).

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace National Monument Inventory Notes: All polygons of Loblolly Pine - Hardwood Forest were observed in the field.

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 taeda</i> Forest Alliance (A.130)
Alliance (English name)	Loblolly Pine Forest Alliance
Association	<i>Pinus taeda</i> - Liquidambar styraciflua Semi-natural Forest
Association (English name)	Loblolly Pine - Sweetgum Semi-natural Forest
Ecological System(s):	East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest (CES203.506)

GLOBAL DESCRIPTION

Concept Summary: This community type is broadly defined to accommodate mid- to late-successional upland forests strongly codominated by *Pinus taeda* (loblolly pine) and *Liquidambar styraciflua* (sweetgum), resulting from past disturbance (such as agricultural or other land clearing). Understory composition differs based on edaphic site and on age and history. This broadly defined type occupies a variety of edaphic sites, ranging from mesic through dry-mesic sites on a wide variety of (generally acidic) soils. If left unmanaged or undisturbed, this can be a short-lived forest type, which is likely to succeed with greater age into various oak- and oak-pine-dominated forests.

Environmental Description: Stands of this community type are strongly codominated by *Pinus taeda* (loblolly pine) and *Liquidambar styraciflua* (sweetgum), resulting from past disturbance followed by forest succession. This community type is more influenced by past land-use history than by specific soil differences. However, this community type tends to occur on poorly drained and low-nutrient soils, especially in areas that were farmed heavily in the past. Stands on poorly drained sites have often been subjected to ditching activities.

Vegetation Description: Stands of this community type are strongly codominated by *Pinus taeda* (loblolly pine) and *Liquidambar styraciflua* (sweetgum). Some other species which may be present in stands of this association include *Quercus phellos* (willow oak), *Quercus nigra* (water

oak), *Ulmus alata* (winged elm), *Acer rubrum* (red maple), *Quercus michauxii* (swamp chestnut oak), *Nyssa sylvatica* (blackgum), and *Prunus serotina* var. *serotina* (black cherry), along with *Vitis rotundifolia* (muscadine), *Toxicodendron radicans* (eastern poison ivy), *Rubus argutus* (sawtooth blackberry), *Smilax rotundifolia* (roundleaf greenbrier), *Eupatorium capillifolium* (dogfennel), *Eupatorium hyssopifolium* (hyssopleaf thoroughwort), *Erigeron strigosus* (prairie fleabane), *Solidago gigantea* (giant goldenrod), *Ambrosia artemisiifolia* (annual ragweed), *Juncus effusus* (common rush), *Juncus subcaudatus* (woodland rush), and the exotics *Lespedeza cuneata* (Chinese lespedeza) and *Ligustrum sinense* (Chinese privet). Examples of this association in low-lying areas may also have a dense herbaceous layer of *Microstegium vimineum* (Nepalese browntop).

Most Abundant Species:

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

Characteristic Species: Information not available.

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This altered forest type is widespread in the lowland portions of the southeastern to mid-Atlantic United States, particularly on the Coastal Plain, but also on adjacent inland provinces.

States/Provinces: AL, AR, DE, GA, LA, MD, MS, NC, OK, SC, TN, TX, VA.

Federal Lands: DOD (Fort Benning?); NPS (Chickamauga-Chattanooga, George Washington Birthplace, Guilford Courthouse, Kings Mountain, Little River Canyon?, Natchez Trace, Ninety Six, Petersburg, Richmond, Shiloh); USFS (Angelina, Bienville, Conecuh?, Croatan, Davy Crockett, Kisatchie, Oconee, Ouachita, Ouachita (Coastal Plain), Ouachita (Mountains), Sabine, Sam Houston, Talladega, Talladega (Oakmulgee), Talladega (Talladega), Tuskegee?, Uwharrie); USFWS (Blackwater, Chesapeake Marshlands, Prime Hook).

CONSERVATION STATUS

Rank: GNA (modified/managed) (20-Oct-2000).

Reasons: This forest represents early successional or silviculturally managed vegetation and is thus not of conservation concern and does not receive a conservation status rank.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 1 - Strong.

Comments: This community likely occurs along the northern periphery of the Gulf Coast Prairies and Marshes Ecoregion of eastern Texas. The similarity of this association with *Pinus taeda* / *Liquidambar styraciflua* - *Acer rubrum* var. *rubrum* / *Vaccinium stamineum* Forest (CEGL006011) suggests that a merge with that type should be considered.

Similar Associations:

- *Liriodendron tulipifera* - *Pinus taeda* Forest (CEGL007521)--with greater dominance by *Liriodendron*.
- *Pinus echinata* Early-Successional Forest (CEGL006327).
- *Pinus taeda* - (*Pinus echinata*) - *Quercus falcata* - *Carya texana* / *Vaccinium arboreum* Forest (CEGL007528)--overlaps only in the western part of the range of this type.

- *Pinus taeda* / *Liquidambar styraciflua* - *Acer rubrum* var. *rubrum* / *Vaccinium stamineum* Forest (CEGL006011)--is an earlier successional stage of this association and is distinguished by a lack of *Liquidambar styraciflua* in the canopy and a well-developed hardwood understory.
- *Pinus taeda* / *Saccharum alopecuroidum* - (*Andropogon* spp.) Forest (CEGL007109)--a related *Pinus taeda*-dominated type placed in evergreen.
- *Pinus virginiana* Successional Forest (CEGL002591).

Related Concepts:

- IF3a. Recently Harvested Timber Land (Allard 1990) B
- IF3b. Plantation (Hardwood or Conifer) (Allard 1990) B
- Loblolly Pine - Hardwood (13) (USFS 1988) ?
- Loblolly Pine - Hardwood: 82 (Eyre 1980) B
- T1B3aIII6a. *Pinus taeda* - *Liquidambar styraciflua* (Foti et al. 1994) ?

SOURCES

Description Authors: A. S. Weakley, mod. R. White and E. Largay.

References: Allard 1990, Eyre 1980, Foti 1994b, Foti et al. 1994, Harcombe and Neaville 1977, Hoagland 2000, NatureServe Ecology - Southeastern U.S. unpubl. data, Peet et al. unpubl. data 2002, Schotz pers. comm., Southeastern Ecology Working Group n.d., USFS 1988, Zanoni et al. 1979.



Figure H2. Loblolly Pine - Hardwood Forest at George Washington Birthplace National Monument. August 2002. NAD 1983 / UTM easting 331802, northing 4228807. Photo by NCSU-CEO.

COMMON NAME (PARK-SPECIFIC): **EARLY-SUCCESSIONAL LOBLOLLY PINE FOREST**

SYNONYMS

USNVC English Name: **Loblolly Pine / Sweetgum - Red Maple / Deerberry Forest**

USNVC Scientific Name: ***Pinus taeda* / *Liquidambar styraciflua* - *Acer rubrum* var. *rubrum* / *Vaccinium stamineum* Forest**

USNVC Identifier: **CEGL006011**

LOCAL INFORMATION

Environmental Description: Early-Successional Loblolly Pine Forest occurs on areas where forests have been recently (less than 15 years) cleared and allowed to naturally regenerate, leaving a dense shrubby mixture of *Pinus taeda* (loblolly pine) and hardwood species. This association also includes abandoned plantations which, after a time with no active management, develop an understory of hardwood species. In George Washington Birthplace National Monument, these forests occur on level to gently sloping, poorly drained soils.

Vegetation Description: Early-Successional Loblolly Pine Forest includes early-successional evergreen forests with canopies dominated by *Pinus taeda* (loblolly pine). Early-Successional Loblolly Pine Forest can also occur as dense young stands of *Pinus taeda* (loblolly pine) resulting from natural regeneration after clearing. Hardwood species that can occur in the understory as small trees or shrubs or (rarely) break into the canopy include *Liquidambar styraciflua* (sweetgum), *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Diospyros virginiana* (common persimmon), and *Morella cerifera* (wax myrtle). Litter typically dominates the ground layer with no or very sparse herbaceous/woody seedling cover.

Within George Washington Birthplace National Monument, Early-Successional Loblolly Pine Forest varies in structure and composition. Stands mapped as this unit can range from stands of small-diameter *Pinus taeda* (loblolly pine) with a subcanopy of young hardwood trees to dense, shrubby stands of *Pinus taeda* (loblolly pine) mixed with shrubby hardwood species.

Most Abundant Species:

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

Characteristic Species: *Liquidambar styraciflua* (sweetgum), *Parthenocissus quinquefolia* (Virginia creeper), *Phytolacca americana* (American pokeweed).

Other Noteworthy Species:

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

Subnational Distribution with Crosswalk Data:

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

Local Range: Early-Successional Loblolly Pine Forest occurs along the road to the Muse Property and in the vicinity of Longwood Swamp, just east of the Muse Property. It is included in the map class "Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest" which includes two associations and is mapped as 11 polygons ranging from 0.4 to 9.4 hectares (1 to 23.2 acres) and covers a total of 29.2 hectares (72.2 acres) in the park.

Classification Comments: Early-Successional Loblolly Pine Forest is distinguished from other vegetation in George Washington Birthplace National Monument by having a canopy dominated by *Pinus taeda* (loblolly pine). Deciduous trees may be in the understory/shrub layers but do not break into the canopy. These forests are distinguished from Loblolly Pine - Hardwood Forest by being younger, with a canopy and subcanopy (if present) composed of young, small-diameter trees (less than 30 cm dbh). The aerial photography signature of Early-Successional Loblolly Pine Forest will have a finer texture, with smaller tree crowns than those of Loblolly Pine - Hardwood Forest and lack large deciduous crowns in the overstory.

Other Comments: Because Early-Successional Loblolly Pine Forest may be difficult to distinguish from abandoned Loblolly Pine Plantation, these two associations were combined into one map class: "Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest." Seven of the 11 polygons of "Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest" are in discernible rows and are tagged as "plantation" in the attribute table of the map. The remaining polygons in this map class are successional loblolly pine of uncertain origin, perhaps from natural regeneration or the result of "failed" or abandoned plantations.

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace National Monument Inventory Notes: All polygons of Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest were observed in the field.

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 taeda</i> Forest Alliance (A.130)
Alliance (English name)	Loblolly Pine Forest Alliance
Association	<i>Pinus taeda</i> / <i>Liquidambar styraciflua</i> - <i>Acer rubrum</i> var. <i>rubrum</i> / <i>Vaccinium stamineum</i> Forest
Association (English name)	Loblolly Pine / Sweetgum - Red Maple / Deerberry Forest
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This association represents stands in which *Pinus taeda* (loblolly pine) is the monospecific dominant tree in the overstory. These are generally early- to mid-successional forests where the pines have reached tree size (as opposed to saplings) and have been established for a long enough period to have developed a closed canopy. Below the canopy of *Pinus taeda* (loblolly pine), a well-developed subcanopy of hardwoods is present. *Acer rubrum* var. *rubrum* (red maple) and *Liquidambar styraciflua* (sweetgum) are often the dominant species in the subcanopy. If significant numbers of these species enter the canopy, the stand would be covered by another association (e.g., CEG008462). Although this forest may result from a planted stand [see CEG007179], it is distinguished from young pine plantations by tree height and the

formation of distinct stratal layers, especially a well-developed subcanopy. This type may also develop following site preparation, with or without site conversion, and also following agriculture. It is a wide ranging type, most common from the Piedmont of Virginia, through North Carolina, South Carolina, Georgia and Alabama, likely extending throughout the adjacent Coastal Plain. A large amount of variability exists in species composition and density due to geographic and disturbance factors. Stands typically have more-or-less closed canopies, understories dominated by fire-intolerant hardwoods, and shrub-dominated lower strata.

Environmental Description: This forest follows agricultural cropping or silvicultural site preparation on a variety of sites, and presumably is more likely on moderately dissected topography where fire is a rare occurrence. This community usually is not present on steep slopes and does not occur on wet soils. It occurs on well- to moderately well-drained soils, usually Ultisols, on sites that formerly were under hardwood cover or subjected to agriculture.

Vegetation Description: The tree canopy of *Pinus taeda* (loblolly pine) is at least 60% but may be considerably more dense, up to and including closed canopies. Tree subcanopy density varies with stand disturbance history but generally is <50%. Shrub and herb layer coverages do not exceed 25% and decrease with increasing age of the stand. Other species of pine, especially *Pinus echinata* (shortleaf pine) and *Pinus virginiana* (Virginia pine) may be sparingly present in the canopy. Other species that may be present in the subcanopy in addition to *Liquidambar styraciflua* (sweetgum) and *Acer rubrum* var. *rubrum* (red maple) include *Quercus coccinea* (scarlet oak), *Quercus velutina* (black oak), *Quercus alba* (white oak), *Quercus falcata* (southern red oak), *Nyssa sylvatica* (blackgum), *Carya glabra* (pignut hickory), *Carya alba* (mockernut hickory), *Diospyros virginiana* (common persimmon), *Prunus serotina* var. *serotina* (black cherry), *Cornus florida* (flowering dogwood), *Liriodendron tulipifera* (tuliptree), and *Sassafras albidum* (sassafras) (NatureServe Ecology unpubl. data). Other species in addition to *Vaccinium stamineum* (deerberry) that may be present in the shrub stratum include *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Vaccinium arboreum* (farkleberry), *Rhus copallinum* (flameleaf sumac), *Gaylussacia baccata* (black huckleberry), *Callicarpa americana* (American beautyberry), and probably others. The herbaceous layer usually forms <5% cover and contains such species as *Gelsemium sempervirens* (evening trumpetflower), *Chimaphila maculata* (striped prince's pine), *Polystichum acrostichoides* (Christmas fern), and *Potentilla canadensis* (dwarf cinquefoil). An example from Oconee National Forest has a thinned canopy and grassy herbaceous layer.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Pinus taeda</i> (loblolly pine)
Tree subcanopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple), <i>Liquidambar styraciflua</i> (sweetgum)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Vaccinium stamineum</i> (deerberry)

Characteristic Species: Information not available.

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This forest ranges from the Piedmont of Virginia, through North Carolina, South Carolina, Georgia and Alabama, extending into the adjacent eastern end of the Upper East Gulf Coastal Plain (e.g., Talladega National Forest).

States/Provinces: AL, GA, LA, MD, MS, NC, SC, TN, TX, VA.

Federal Lands: NPS (Colonial, Cowpens, George Washington Birthplace, Little River Canyon?, Natchez Trace, Petersburg, Richmond, Shiloh); USFS (Land Between the Lakes?, Oconee, Sumter, Sumter (Piedmont), Talladega, Talladega (Oakmulgee), Talladega (Talladega), Uwharrie?); USFWS (Chesapeake Marshlands).

CONSERVATION STATUS

Rank: GNA (modified/managed) (8-Aug-2002).

Reasons: This is a successional forest composed of species native to the southeastern United States; it is not of conservation concern and does not receive a conservation status rank.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 - Weak.

Comments: The similarity of this association with *Pinus taeda* - *Liquidambar styraciflua* Forest (CEGL008462) suggests that a merge with that type should be considered.

Similar Associations:

- *Pinus echinata* Early-Successional Forest (CEGL006327)--occurs in the same region but is dominated by *Pinus echinata* instead of *Pinus taeda*.
- *Pinus taeda* - *Liquidambar styraciflua* Semi-natural Forest (CEGL008462)--is a related late-successional type with hardwoods in the canopy.
- *Pinus taeda* - *Liriodendron tulipifera* / *Acer saccharum* Successional Forest (CEGL007105)--of the Ridge and Valley.
- *Pinus taeda* - *Quercus (alba, falcata, stellata)* Successional Coastal Plain Forest [Provisional] (CEGL004766).
- *Pinus taeda* - *Quercus (falcata, hemisphaerica, nigra)* - *Liquidambar styraciflua* / *Rhus copallinum* - *Vaccinium stamineum* Forest (CEGL008450).
- *Pinus taeda* / *Rhus copallinum* Managed Forest (CEGL007108).
- *Pinus taeda* Planted Forest (CEGL007179)--applies to young dense monospecific stands with plantation structure.
- *Pinus virginiana* Successional Forest (CEGL002591).

Related Concepts:

- IF3b. Plantation (Hardwood or Conifer) (Allard 1990) B
- Loblolly Pine (21) (USFS 1988) ?
- Loblolly Pine - Hardwood: 82 (Eyre 1980) B
- Loblolly Pine: 81 (Eyre 1980) B

SOURCES

Description Authors: S. Landaal, mod. L. A. Sneddon.

References: Allard 1990, Eyre 1980, Felix et al. 1983, Harrison 2004, NatureServe Ecology - Southeastern U.S. unpubl. data, Schotz pers. comm., Southeastern Ecology Working Group n.d., TDNH unpubl. data, USFS 1988.



Figure H3. Early-Successional Loblolly Pine Forest at George Washington Birthplace National Monument. August 2002. NAD 1983 / UTM easting 331918, northing 4228983. Photo by NCSU-CEO.

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

SYNONYMS

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

LOCAL INFORMATION

Environmental Description: Successional Red-cedar Forest occurs on upland flats over various soil types at 1.5 to 3 m (5–10 feet) above sea level. It is typically found on abandoned fields or other clearings.

Vegetation Description: Successional Red-cedar Forest includes stands characterized by *Juniperus virginiana* var. *virginiana* (eastern redcedar), typically on former fields or other clearings. The canopy is of low stature and trees may be widely spaced. This forest may have stems of other successional species in the tree and shrub strata, such as *Baccharis halimifolia* (eastern baccharis), *Diospyros virginiana* (common persimmon), *Elaeagnus angustifolia* (Russian olive), *Liquidambar styraciflua* (sweetgum), *Pinus strobus* (eastern white pine), *Pinus taeda* (loblolly pine), and *Prunus serotina* var. *serotina* (black cherry), but always has *Juniperus virginiana* var. *virginiana* (eastern redcedar) as the main evergreen tree component. The field layer is often dominated by grasses, such as *Andropogon virginicus* (broomsedge bluestem) and *Lolium pratense* (meadow ryegrass), with mixtures of exotic species and other species typical of open disturbed areas: *Conyza canadensis* (Canadian horseweed), *Eupatorium capillifolium* (dogfennel), *Lonicera japonica* (Japanese honeysuckle), *Parthenocissus quinquefolia* (Virginia creeper), *Phytolacca americana* (American pokeweed), and *Taraxacum officinale* (common dandelion).

In George Washington Birthplace National Monument, this association can vary in structure from dense stands of *Juniperus virginiana* var. *virginiana* (eastern redcedar) to open, shrubby vegetation with scattered *Juniperus virginiana* var. *virginiana* (eastern redcedar) occurring with other successional or exotic species. This association includes areas formerly planted with the invasive exotic *Elaeagnus angustifolia* (Russian olive), which has since been manually removed and is now succeeding to Successional Red-cedar Forest.

Most Abundant Species:

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

Characteristic Species: *Diospyros virginiana* (common persimmon), *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Phytolacca americana* (American pokeweed).

Other Noteworthy Species:

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

Subnational Distribution with Crosswalk Data:

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

Local Range: Successional Red-cedar Forest covers nearly 3 hectares (7.3 acres) in an area just north of the Muse residence. It occurs in two polygons, 0.9 and 2 hectares (2.3 to 5 acres) in size.

Classification Comments: Information not available.

Other Comments: Information not available.

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace National Monument Inventory Notes: All three polygons of Successional Red-cedar Forest were observed in the field.

GLOBAL INFORMATION

USNVC CLASSIFICATION

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

GLOBAL DESCRIPTION

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

stands may eventually succeed to other forest types as mid- and late-successional canopy species colonize and subsequently overtop the *Juniperus* (juniper).

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

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

Most Abundant Species:

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

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

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

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

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

Federal Lands: NPS (Appomattox Court House, Boston Harbor Islands, Cape Cod, Delaware Water Gap, Fire Island, Fredericksburg-Spotsylvania, George Washington Birthplace, Richmond).

CONSERVATION STATUS

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

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

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 - Weak.

Comments: This association is currently very generally defined.

Similar Associations: Information not available.

Related Concepts: Information not available.

SOURCES

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

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



Figure H4. Successional Red-cedar Forest photographed at Appomattox Court House National Historical Park. August 2007. Photo by Robert Tillotson.

COMMON NAME (PARK-SPECIFIC): DISTURBED ACIDIC SLOPE FOREST**SYNONYMS**

USNVC English Name: Sweetgum - (Water Oak, Willow Oak) - Loblolly Pine / Mayberry - Wax-myrtle Forest

USNVC Scientific Name: *Liquidambar styraciflua* - *Quercus (nigra, phellos)* - *Pinus taeda* / *Vaccinium elliottii* - *Morella cerifera* Forest

USNVC Identifier: CEGLO07726

LOCAL INFORMATION

Environmental Description: Disturbed Acidic Slope Forest occurs as a narrow fringe along marshes and swamps on north-facing, moderate to very steep slopes. The well-drained, sandy loam soils are eroded and acidic. These stands are small and linear and occur between wetlands and agricultural fields. Many trees are girdled by beaver. Dead and dying *Juniperus virginiana* var. *virginiana* (eastern redcedar) are common in the stand around Digwood Swamp.

Vegetation Description: This association is a mostly deciduous forest that occurs as a fringe around marshes and swamps. The canopy varies somewhat from site to site but is dominated by very large, older trees always with very large *Ilex opaca* var. *opaca* (American holly) in the subcanopy. The most abundant tree species are *Quercus alba* (white oak) or *Liquidambar styraciflua* (sweetgum) and *Quercus phellos* (willow oak). *Liquidambar styraciflua* (sweetgum) and *Quercus phellos* (willow oak) are consistent in the canopy, with associated trees varying from site to site. Other canopy trees can include *Acer rubrum* (red maple), *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Liriodendron tulipifera* (tuliptree), *Pinus taeda* (loblolly pine), *Prunus serotina* var. *serotina* (black cherry), *Quercus falcata* (southern red oak), *Quercus michauxii* (swamp chestnut oak), and *Quercus pagoda* (cherrybark oak). The subcanopy includes large *Ilex opaca* var. *opaca* (American holly) and sometimes *Cornus florida* (flowering dogwood). There is little to no shrub or herb strata development. The herb layer is bare or very sparse. Herbs noted in this association include *Carex swanii* (Swan's sedge), *Chimaphila maculata* (striped prince's pine), *Danthonia spicata* (poverty oatgrass), *Elymus hystrix* (eastern bottlebrush grass), and *Smilax glauca* (cat greenbrier).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree subcanopy	Broad-leaved evergreen tree	<i>Ilex opaca</i> var. <i>opaca</i> (American holly)

Characteristic Species: *Ilex opaca* var. *opaca* (American holly), *Liquidambar styraciflua* (sweetgum).

Other Noteworthy Species:

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

Subnational Distribution with Crosswalk Data:

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

Local Range: Disturbed Acidic Slope Forest covers a total of 4.5 hectares (11.3 acres) and is mapped as three polygons ranging in size from 0.56 to 2.5 hectares (1.4 to 6 acres). It is found on slopes over Digwood Swamp, Dancing Marsh and Longwood Swamp.

Classification Comments: Information not available.

Other Comments: This forest occurs as small stands in a disturbed landscape. Their origin is uncertain, but they are likely the result of past disturbance such as grazing or clearing.

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace National Monument Inventory Notes: All polygons of Disturbed Acidic Slope Forest were observed in the field.

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>Liquidambar styraciflua</i> Forest Alliance (A.234)
Alliance (English name)	Sweetgum Forest Alliance
Association	<i>Liquidambar styraciflua</i> - <i>Quercus (nigra, phellos)</i> - <i>Pinus taeda</i> / <i>Vaccinium elliotii</i> - <i>Morella cerifera</i> Forest
Association (English name)	Sweetgum - (Water Oak, Willow Oak) - Loblolly Pine / Mayberry - Wax-myrtle Forest
Ecological System(s):	East Gulf Coastal Plain Interior Upland Longleaf Pine Woodland (CES203.496)

GLOBAL DESCRIPTION

Concept Summary: This southeastern Coastal Plain forest contains a mixture of upland and lowland species that typically occur together in uplands following cessation of agriculture. It is primarily dominated by hardwood trees, particularly *Quercus* spp. (oaks) and *Liquidambar styraciflua* (sweetgum). This community type occurs in two phases: one with an emergent canopy of large *Pinus taeda* (loblolly pine) trees, and the other without the emergent canopy. Coverage by *Pinus taeda* (loblolly pine) in the *Pinus taeda* (loblolly pine) phase ranges from 10 to greater than 60%. The closed canopy is codominated by *Liquidambar styraciflua* (sweetgum) with *Quercus* spp. (oaks), especially *Quercus nigra* (water oak) and *Quercus phellos* (willow oak), or possibly *Quercus pagoda* (cherrybark oak). *Nyssa sylvatica* (blackgum) is also typical in the canopy or subcanopy, along with *Liriodendron tulipifera* (tuliptree) in some cases. The moderately well-developed subcanopy is dominated by canopy species with *Ilex longipes* (Georgia holly), *Sassafras albidum* (sassafras), *Acer rubrum* (red maple), *Cornus florida* (flowering dogwood), *Prunus serotina* var. *serotina* (black cherry), *Vaccinium arboreum* (farkleberry), *Carpinus caroliniana* (American hornbeam), and others. The shrub stratum is often sparse, and is primarily composed of canopy and subcanopy species. Occasionally a rather dense cover of *Morella cerifera* (wax myrtle) may be present. Other species that may occur include *Euonymus americanus* (strawberry bush), *Rubus* sp. (blackberry), *Callicarpa americana* (American beautyberry), *Vaccinium elliotii* (Elliott's blueberry), *Gaylussacia frondosa* (blue huckleberry), and *Gaylussacia dumosa* (dwarf huckleberry). The vine/liana stratum is sparse to moderate, and species present include *Bignonia capreolata* (crossvine), *Vitis rotundifolia* (muscadine), *Smilax bona-nox* (saw greenbrier), *Smilax rotundifolia* (roundleaf greenbrier), *Wisteria frutescens* (American wisteria), *Gelsemium sempervirens* (evening trumpetflower),

Toxicodendron radicans (eastern poison ivy), *Ampelopsis arborea* (peppervine), and others. The herbaceous layer ranges from moderate to fairly dense. Typical species include *Chasmanthium sessiliflorum* (longleaf woodoats), *Scleria triglomerata* (whip nutrush), *Carex abscondita* (thicket sedge), *Dichanthelium boscii* (Bosc's panicgrass), *Mitchella repens* (partridgeberry), *Juncus coriaceus* (leathery rush), *Chimaphila maculata* (striped prince's pine), *Asplenium platyneuron* (ebony spleenwort), *Malaxis unifolia* (green adder's-mouth orchid), and others. The exotic *Lonicera japonica* (Japanese honeysuckle) is common in occurrences of this community. This forest type is documented in the Mid-Atlantic Coastal Plain, but is possible in adjacent regions; global distribution needs assessment.

Environmental Description: This forest occurs in uplands of the Coastal Plain following cessation of agriculture.

Vegetation Description: The closed canopy is codominated by *Liquidambar styraciflua* (sweetgum) with *Quercus* spp. (oaks), especially *Quercus nigra* (water oak) and *Quercus phellos* (willow oak), or possibly *Quercus pagoda* (cherrybark oak). *Nyssa sylvatica* (blackgum) is also typical in the canopy or subcanopy, along with *Liriodendron tulipifera* (tuliptree) in some cases. One phase has an emergent canopy of large *Pinus taeda* (loblolly pine). The moderately well-developed subcanopy is dominated by canopy species with *Ilex longipes* (Georgia holly), *Sassafras albidum* (sassafras), *Acer rubrum* (red maple), *Cornus florida* (flowering dogwood), *Prunus serotina* var. *serotina* (black cherry), *Vaccinium arboreum* (farkleberry), *Carpinus caroliniana* (American hornbeam), and others. The shrub stratum is often sparse, and is primarily composed of canopy and subcanopy species. Occasionally a rather dense cover of *Morella cerifera* (wax myrtle) may be present. Other species that may occur include *Euonymus americanus* (strawberry bush), *Rubus* sp. (blackberry), *Callicarpa americana* (American beautyberry), *Vaccinium elliotii* (Elliott's blueberry), *Gaylussacia frondosa* (blue huckleberry), and *Gaylussacia dumosa* (dwarf huckleberry). The vine/liana stratum is sparse to moderate and species present include *Bignonia capreolata* (crossvine), *Vitis rotundifolia* (muscadine), *Smilax bona-nox* (saw greenbrier), *Smilax rotundifolia* (roundleaf greenbrier), *Wisteria frutescens* (American wisteria), *Gelsemium sempervirens* (evening trumpetflower), *Toxicodendron radicans* (eastern poison ivy), *Ampelopsis arborea* (peppervine), and others. The herbaceous layer ranges from moderate to fairly dense. Typical species include *Chasmanthium sessiliflorum* (longleaf woodoats), *Scleria triglomerata* (whip nutrush), *Carex abscondita* (thicket sedge), *Dichanthelium boscii* (Bosc's panicgrass), *Mitchella repens* (partridgeberry), *Juncus coriaceus* (leathery rush), *Chimaphila maculata* (striped prince's pine), *Asplenium platyneuron* (ebony spleenwort), *Malaxis unifolia* (green adder's-mouth orchid), and others. The exotic *Lonicera japonica* (Japanese honeysuckle) is common in occurrences of this community.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Pinus taeda</i> (loblolly pine)
Tree canopy	Broad-leaved deciduous tree	<i>Liquidambar styraciflua</i> (sweetgum), <i>Quercus nigra</i> (water oak), <i>Quercus phellos</i> (willow oak)
Tree subcanopy	Broad-leaved deciduous tree	<i>Ilex longipes</i> (Georgia holly), <i>Sassafras albidum</i> (sassafras)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Vaccinium elliotii</i> (Elliott's blueberry)
Herb (field)	Forb	<i>Mitchella repens</i> (partridgeberry)

Herb (field)

Graminoid

Carex abscondita (thicket sedge),
Chasmanthium sessiliflorum (longleaf
wudoats), *Dichanthelium boscii* (Bosc's
panicgrass)

Characteristic Species: Information not available.

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Brickellia cordifolia</i> (flyr's brickell-bush)	G2G3	plant	

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This forest type is documented in the Mid-Atlantic Coastal Plain, but is possible in adjacent regions from the Chesapeake to the Upper East Gulf Coastal Plain. Its global distribution needs assessment.

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

Federal Lands: DOD (Fort Benning); NPS (Congaree Swamp, George Washington Birthplace); USFS (Bienville?, Conecuh?, De Soto?, Francis Marion?, Homochitto?); USFWS (Eufaula).

CONSERVATION STATUS

Rank: GNA (modified/managed) (30-Apr-1998).

Reasons: This is a successional vegetation type composed of native species. Its conservation value is limited, but it may cover large portions of the landscape, and mature examples provide buffer for communities of greater conservation value.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 - Weak.

Comments: This association was described in 1998 based on data from the Congaree Swamp National Monument, where it is the most extensive natural community in the upland zone. This forest type is documented in the Mid-Atlantic Coastal Plain, but is possible in adjacent regions; global distribution needs assessment. Vegetation dominated by *Liquidambar styraciflua* (sweetgum) and *Quercus nigra* (water oak) is reported from the Upper East Gulf Coastal Plain of Fort Benning, Georgia. It seems to be compatible with this association.

Similar Associations:

- *Liquidambar styraciflua* - *Quercus (alba, falcata)* Forest (CEGL007217)--of more interior provinces.
- *Liquidambar styraciflua* Forest (CEGL007216).

Related Concepts: Information not available.

SOURCES

Description Authors: S. Landaal.

References: ALNHP 2002, Peet et al. unpubl. data 2002, Schotz pers. comm., Southeastern Ecology Working Group n.d., TNC 1998b.



Figure H5. Disturbed Acidic Slope Forest at George Washington Birthplace National Monument. August 2002. NAD 1983 / UTM easting 331502, northing 4229353. Photo by NCSU-CEO.

COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL SWEETGUM FOREST**SYNONYMS**

USNVC English Name: Sweetgum Forest
USNVC Scientific Name: *Liquidambar styraciflua* Forest
USNVC Identifier: CEGLO07216

LOCAL INFORMATION

Environmental Description: Successional Sweetgum Forest develops after clearing and occurs on various upland soil types.

Vegetation Description: Successional Sweetgum Forest is dominated by young *Liquidambar styraciflua* (sweetgum). It may be short and scrubby or an early- to mid-successional forest with a well-developed canopy of trees. Other species in the tree and shrub layers may include *Diospyros virginiana* (common persimmon), *Robinia pseudoacacia* (black locust), and *Quercus phellos* (willow oak). The field layer is composed of weedy herbs and vines such as *Lonicera japonica* (Japanese honeysuckle), *Toxicodendron radicans* (eastern poison ivy), and *Campsis radicans* (trumpet creeper).

Most Abundant Species:

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

Characteristic Species: *Liquidambar styraciflua* (sweetgum).

Other Noteworthy Species:

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

Subnational Distribution with Crosswalk Data:

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

Local Range: This forest is mapped as two polygons, covering less than 3 hectares (7 acres). It occurs in the vicinity of Digwood Swamp, along the road to the maintenance facility, and in the vicinity of Longwood Swamp.

Classification Comments: Information not available.

Other Comments: Successional Sweetgum Forest may occur as less than 0.5 hectare inclusions within areas mapped as Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest.

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace National Monument Inventory Notes: Both polygons mapped as Successional Sweetgum Forest were observed in the field.

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>Liquidambar styraciflua</i> Forest Alliance (A.234)
Alliance (English name)	Sweetgum Forest Alliance
Association	<i>Liquidambar styraciflua</i> Forest
Association (English name)	Sweetgum Forest
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

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

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

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

Most Abundant Species:

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

Characteristic Species: Information not available.

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association may be found throughout the southeastern United States, in the coastal plains and interior ecoregions. It is also attributed to New Jersey with the merger of CEG006927. The status in intervening states (e.g., Delaware, Maryland) needs to be assessed.

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

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

CONSERVATION STATUS

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

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

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 - Weak.

Comments: Information not available.

SIMILAR ASSOCIATIONS:

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

Related Concepts:

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

SOURCES

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

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

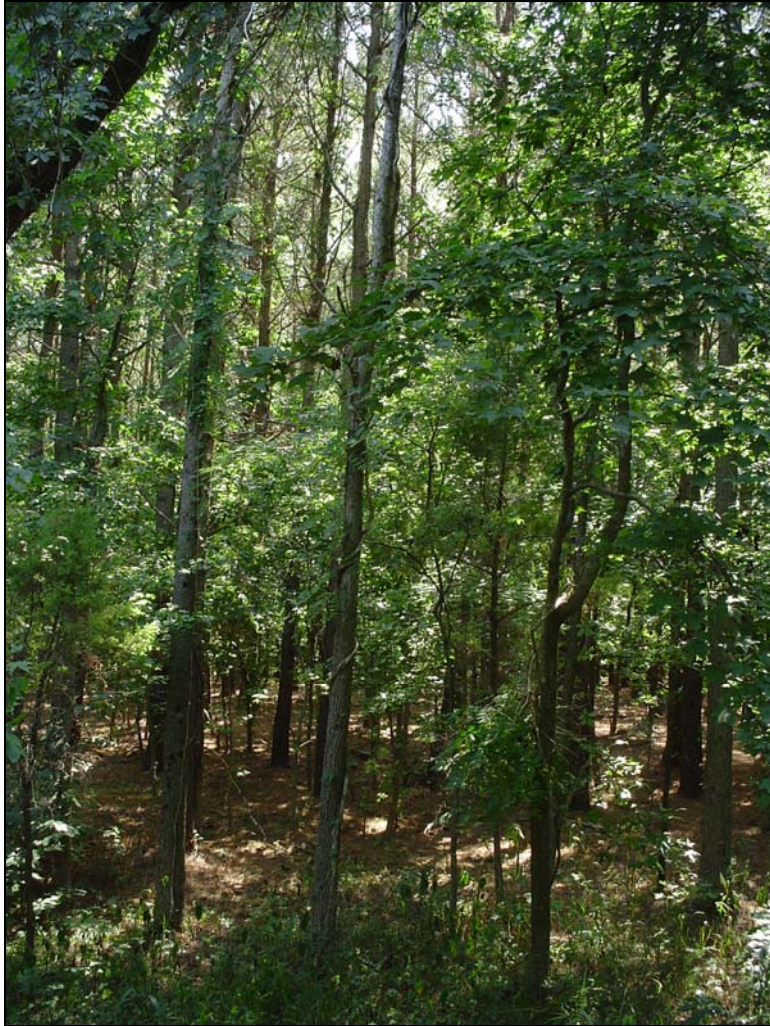


Figure H6. Successional Sweetgum Forest at George Washington Birthplace National Monument. August 2007. NAD 1983 / UTM easting 332398, northing 4229124. Photo by Rijk Morawe.

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

SYNONYMS

USNVC English Name: Chinquapin Oak / Eastern Redbud / Bosc's Witchgrass - Common Eastern Brome - Robin's-plantain - Eastern Columbine Forest

USNVC Scientific Name: *Quercus muehlenbergii* / *Cercis canadensis* / *Dichanthelium boscii* - *Bromus pubescens* - *Erigeron pulchellus* var. *pulchellus* - *Aquilegia canadensis* Forest

USNVC Identifier: CEGLO07748

LOCAL INFORMATION

Environmental Description: Coastal Plain Dry Calcareous Forest occurs on gentle to moderately steep, north-facing slopes, over well-drained, loamy soils containing shell fragments. These soils have high pH values (averaging 6.0) and calcium levels averaging over 4000 ppm.

Vegetation Description: This deciduous forest occurs as a linear feature, fringing the marshes near Bridges Creek Landing. The largest trees in the canopy are *Carya cordiformis* (bitternut hickory), *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Quercus muehlenbergii* (chinkapin oak), and *Quercus pagoda* (cherrybark oak). Other canopy trees can include *Celtis occidentalis* (common hackberry), *Prunus serotina* var. *serotina* (black cherry), and *Tilia americana* (American basswood). The moderately dense shrub layer can have high cover of *Asimina triloba* (pawpaw), *Cercis canadensis* var. *canadensis* (eastern redbud), *Ilex opaca* var. *opaca* (American holly), and *Viburnum prunifolium* (blackhaw). Other common shrubs and small trees are *Cornus florida* (flowering dogwood), *Diospyros virginiana* (common persimmon), and *Liquidambar styraciflua* (sweetgum). Vines are abundant in this forest, with *Parthenocissus quinquefolia* (Virginia creeper) and *Toxicodendron radicans* (eastern poison ivy) climbing into the canopy strata with high cover. Other vines include *Campsis radicans* (trumpet creeper), *Hedera helix* (English ivy), *Lonicera japonica* (Japanese honeysuckle), *Smilax bona-nox* (saw greenbrier), *Smilax rotundifolia* (roundleaf greenbrier), and *Vitis vulpina* (frost grape). Herb cover is sparse but diverse. Common or characteristic species include *Aquilegia canadensis* (red columbine), *Arabis laevigata* var. *laevigata* (smooth rockcress), *Elymus villosus* (hairy wildrye), *Galium triflorum* (fragrant bedstraw), *Geum virginianum* (cream avens), *Melothria pendula* var. *pendula* (Guadeloupe cucumber), *Phryma leptostachya* (American lopseed), *Sanicula canadensis* (Canadian blacksnakeroot), and *Verbesina occidentalis* (yellow crownbeard).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Carya cordiformis</i> (bitternut hickory), <i>Quercus muehlenbergii</i> (chinkapin oak)

Characteristic Species: *Aquilegia canadensis* (red columbine), *Arabis laevigata* var. *laevigata* (smooth rockcress), *Carya cordiformis* (bitternut hickory), *Cercis canadensis* var. *canadensis* (eastern redbud), *Elymus villosus* (hairy wildrye), *Quercus muehlenbergii* (chinkapin oak).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Aquilegia canadensis</i> (red columbine)	-	plant	indicates high base status soils

<i>Arabis laevigata</i> var. <i>laevigata</i> (smooth rockcress)	plant	indicates high base status soils
<i>Hedera helix</i> (English ivy)	- plant	invasive nonnative
<i>Lonicera japonica</i> (Japanese honeysuckle)	- plant	invasive nonnative

Subnational Distribution with Crosswalk Data:

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

Local Range: This association occurs in the vicinity of Bridges Creek Landing and covers 1.7 hectares (4.2 acres) in 2 polygons.

Classification Comments: Information not available.

Other Comments: The example of this globally rare community at George Washington Birthplace National Monument has exotic species in the shrub and herb strata and lacks some of the typical indicators of the association. It exists as an isolated forest fragment, almost entirely surrounded by agricultural land and is vulnerable to further degradation.

Local Description Authors: K. D. Patterson.

Plots: GEWA.3, GEWA.6.

George Washington Birthplace National Monument Inventory Notes: Both polygons of Coastal Plain Dry Calcareous Forest were observed in the field and two quantitative plot samples were collected.

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 muehlenbergii</i> - (<i>Acer saccharum</i>) Forest Alliance (A.1912)
Alliance (English name)	Chinquapin Oak - (Sugar Maple) Forest Alliance
Association	<i>Quercus muehlenbergii</i> / <i>Cercis canadensis</i> / <i>Dichanthelium boscii</i> - <i>Bromus pubescens</i> - <i>Erigeron pulchellus</i> var. <i>pulchellus</i> - <i>Aquilegia canadensis</i> Forest
Association (English name)	Chinquapin Oak / Eastern Redbud / Bosc's Witchgrass - Common Eastern Brome - Robin's-plantain - Eastern Columbine Forest
Ecological System(s):	Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242) Northern Atlantic Coastal Plain Calcareous Ravine (CES203.069)

GLOBAL DESCRIPTION

Concept Summary: This dry, open, calcareous forest of the Coastal Plain of Virginia and Maryland is restricted to subxeric to xeric, fertile habitats over unconsolidated, calcareous deposits. These localized habitats are found on southeast- to southwest-facing, usually convex slopes of deep ravines or stream-fronting bluffs that have downcut into Tertiary shell deposits or limesands. Occurrences are small (typically <1 acre) and highly localized in dissected portions of the Virginia inner Coastal Plain and Maryland outer Coastal Plain. *Quercus muehlenbergii*

(chinkapin oak) is a constant, codominant or dominant canopy tree and is the most characteristic tree of this type. Some stands tend toward a woodland physiognomy, with low-statured, gnarled trees and a very open canopy. The understory includes *Juniperus virginiana* var. *virginiana* (eastern redcedar) and *Cercis canadensis* var. *canadensis* (eastern redbud). The herb layer is usually patchy but contains a diversity of species, including several long-range mountain disjuncts. Particularly abundant or noteworthy herbaceous species include *Erigeron pulchellus* var. *pulchellus* (robin's plantain), *Dichanthelium boscii* (Bosc's panicgrass), *Bromus pubescens* (hairy woodland brome), and *Aquilegia canadensis* (red columbine). Other locally important species are *Carex albicans* (whitetinge sedge), *Matelea carolinensis* (maroon Carolina milkvine), *Elymus hystrix* var. *hystrix* (eastern bottlebrush grass), *Elymus villosus* (hairy wildrye), *Solidago ulmifolia* var. *ulmifolia* (elmleaf goldenrod), *Symphotrichum patens* (late purple aster), *Arabis laevigata* (smooth rockcress), *Verbesina virginica* var. *virginica* (white crownbeard), *Campanulastrum americanum* (American bellflower), *Smallanthus uvedalius* (hairy leafcup), *Silphium trifoliatum* var. *trifoliatum* (whorled rosinweed), *Desmodium pauciflorum* (fewflower ticktrefoil), *Hexalectris spicata* (spiked crested coralroot), and *Piptochaetium avenaceum* (blackseed speargrass).

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

Vegetation Description: *Quercus muehlenbergii* (chinkapin oak) is a constant, codominant or dominant canopy tree and is the most characteristic tree of this type, occurring with a variety of mostly inconstant associates, including *Acer barbatum* (southern sugar maple), *Carya cordiformis* (bitternut hickory), *Celtis occidentalis* (common hackberry), *Fagus grandifolia* (American beech), *Fraxinus americana* (white ash), *Quercus alba* (white oak), *Quercus rubra* (northern red oak), *Quercus prinus* (chestnut oak), *Tilia americana* (American basswood), and *Ulmus rubra* (slippery elm). Small tree and shrub associates include *Cercis canadensis* var. *canadensis* (eastern redbud), *Cornus florida* (flowering dogwood), *Dirca palustris* (eastern leatherwood), *Ilex opaca* var. *opaca* (American holly), *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Ostrya virginiana* (hophornbeam), *Sideroxylon lycioides* (buckthorn bully), and *Viburnum rufidulum* (rusty blackhaw). The most characteristic or locally abundant herbs include *Agrimonia rostellata* (beaked agrimony), *Aquilegia canadensis* (red columbine), *Arabis laevigata* var. *laevigata* (smooth rockcress), *Aristolochia serpentaria* (Virginia snakeroot), *Bromus pubescens* (hairy woodland brome), *Carex albicans* var. *australis* (stellate sedge), *Carex laxiflora* var. *laxiflora* (broad looseflower sedge), *Dichanthelium boscii* (Bosc's panicgrass), *Elymus hystrix* var. *hystrix* (eastern bottlebrush grass), *Elymus villosus* (hairy wildrye), *Erigeron pulchellus* var. *pulchellus* (robin's plantain), *Phryma leptostachya* (American lopseed), *Solidago caesia* (wreath goldenrod), and *Solidago ulmifolia* var. *ulmifolia* (elmleaf goldenrod). Herbs that are important in specific geographic parts of the range include *Arnoglossum atriplicifolium* (pale Indian plaintain), *Asclepias verticillata* (whorled milkweed), *Chasmanthium sessiliflorum*

(longleaf woodoats), *Desmodium pauciflorum* (fewflower ticktrefoil), *Fleischmannia incarnata* (pink thoroughwort), *Eupatorium sessilifolium* (upland boneset), *Heuchera americana* (American alumroot), *Matelea carolinensis* (maroon Carolina milkvine), *Piptochaetium avenaceum* (blackseed speargrass), *Scleria oligantha* (littlehead nutrush), *Silphium trifoliatum* (whorled rosinweed), *Smallanthus uvedalius* (hairy leafcup), *Sorghastrum elliottii* (slender Indiangrass), and *Symphotrichum patens* var. *patens* (late purple aster). Stands of this community type also contain a number of species that are more-or-less strongly disjunct from primary ranges in the mountains and Piedmont, including *Hexalectris spicata* (spiked crested coralroot), *Corallorhiza wisteriana* (spring coralroot), *Campanulastrum americanum* (American bellflower), *Celastrus scandens* (American bittersweet), *Muhlenbergia sobolifera* (rock muhly), *Muhlenbergia tenuiflora* (slender muhly), *Sanicula marilandica* (Maryland sanicle), *Arabis lyrata* (lyrate rockcress), *Packera obovata* (roundleaf ragwort), *Symphotrichum laeve* var. *laeve*, and *Thalictrum revolutum* (waxyleaf meadow-rue). Mean species richness of 24 plot samples analyzed by VDNH was 67 taxa per 400 square meters.

Most Abundant Species:

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

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

Other Noteworthy Species:

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

USFWS Wetland System: Not applicable.

DISTRIBUTION

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

States/Provinces: MD, VA:S1.

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

CONSERVATION STATUS

Rank: G1 (15-Feb-2007).

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

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

Comments: Classification of this type is supported by analysis of a 1,250-plot regional dataset for the NCR and mid-Atlantic national parks vegetation mapping projects. In that analysis, this association was represented by 22 plots from James City, Stafford, Surry, Westmoreland, and York counties, Virginia, and two plots from Kent County, Maryland. According to Rod Simmons, vegetation similar to the stands of this type at Crow's Nest, Stafford County, Virginia, occurs across the Potomac River at Chapman's Landing, Maryland. It is likely that this community type is endemic to a narrow region of the Coastal Plain stretching from Charles County, Maryland, south to Surry County, Virginia. Further inventory is required to determine whether it is present in Isle of Wight County and City of Suffolk, Virginia. This is a small-patch community type, usually occurring in patches of <1 acre or 0.4 ha. The total acreage of all known occurrences is <20 hectares.

Similar Associations:

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

Related Concepts:

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

SOURCES

Description Authors: G. P. Fleming.

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



Figure H7. Coastal Plain Dry Calcareous Forest (plot GEWA.6) at George Washington Birthplace National Monument. October 2002. NAD 1983 / UTM easting 330740, northing 4229697.

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

SYNONYMS

USNVC English Name: Black Locust Forest

USNVC Scientific Name: *Robinia pseudoacacia* Forest

USNVC Identifier: CEG007279

LOCAL INFORMATION

Environmental Description: Successional Black Locust Forest covers a small area that was a former livestock pen in the northern section of the park. It is surrounded by Loblolly Pine Plantation and Successional Red-cedar Forest.

Vegetation Description: This forest is dominated by *Robinia pseudoacacia* (black locust) with some *Celtis occidentalis* (common hackberry) and *Diospyros virginiana* (common persimmon). The herb stratum is sparse and a mixture of weedy and exotic species. Herb species noted include *Apocynum cannabinum* (Indianhemp), *Elymus hystrix* (eastern bottlebrush grass), *Lolium pratense* (meadow ryegrass), *Juncus effusus* (common rush), *Lonicera japonica* (Japanese honeysuckle), *Perilla frutescens* (beefsteakplant), *Verbesina alternifolia* (wingstem), and *Yucca filamentosa* (Adam's needle).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Robinia pseudoacacia</i> (black locust)

Characteristic Species: *Robinia pseudoacacia* (black locust).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Lolium pratense</i> (meadow ryegrass)	-	plant	invasive nonnative
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	plant	invasive nonnative
<i>Perilla frutescens</i> (beefsteakplant)	-	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: This association occurs as one polygon covering 0.33 hectare (0.82 acre), just east of the Muse property, in the vicinity of Longwood Swamp.

Classification Comments: Information not available.

Other Comments: Information not available.

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace National Monument Inventory Notes: The single polygon of Successional Black Locust Forest were observed in the field.

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

GLOBAL DESCRIPTION

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

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

Vegetation Description: The vegetation is dominated by *Robinia pseudoacacia* (black locust) forming a partial to nearly complete canopy. Associated woody species vary from site to site and include *Prunus serotina* var. *serotina* (black cherry), *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Ulmus americana* (American elm), *Ulmus rubra* (slippery elm), *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), and in some areas *Acer platanoides* (Norway maple) or *Ailanthus altissima* (tree of heaven). *Cornus florida* (flowering dogwood) may be present in the subcanopy. Understory vegetation is highly variable depending on site history and often includes *Toxicodendron radicans* (eastern poison ivy). The invasive species *Rosa multiflora* (multiflora rose) and *Elaeagnus umbellata* (autumn olive) are typically the most common shrubs. Nonnative species such as *Alliaria petiolata* (garlic mustard), *Chelidonium majus* (celandine), *Glechoma hederacea* (ground ivy), *Dactylis glomerata* (orchardgrass), *Daucus carota* (Queen Anne's lace), and *Convallaria majalis* (European lily of the valley) can characterize the herb layer, which may have a native component as well, for example with *Ageratina altissima* (white snakeroot), *Dichanthelium clandestinum* (deertongue), *Parthenocissus quinquefolia* (Virginia creeper), *Pilea pumila* (Canadian clearweed), *Solidago canadensis* (Canada goldenrod), and *Solidago rugosa* (wrinkleleaf goldenrod).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Robinia pseudoacacia</i> (black locust)

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

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

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

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

Federal Lands: DOD (Camp Dawson); NPS (Blue Ridge Parkway, Buffalo River?, Cape Cod, George Washington Birthplace, Marsh-Billings-Rockefeller, Minute Man, Morristown, New River Gorge, Saratoga, Shenandoah, Vicksburg); USFS (George Washington, Jefferson, Nantahala, Ouachita, Ouachita (Mountains), Ozark, Pisgah).

CONSERVATION STATUS

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

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

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

Comments: Information not available.

Similar Associations:

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

Related Concepts:

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

SOURCES

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

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



Figure H8. Successional Black Locust Forest at George Washington Birthplace National Monument. August 2002. NAD 1983 / UTM easting 332400, northing 4229224. Photo by NSCU-CEO.

COMMON NAME (PARK-SPECIFIC): NON-RIVERINE SATURATED FOREST

SYNONYMS

USNVC English Name: (Willow Oak, Cherrybark Oak, Swamp Chestnut Oak) / American Holly / Coastal Sweet-pepperbush / Netted Chainfern Forest

USNVC Scientific Name: *Quercus (phellos, pagoda, michauxii)* / *Ilex opaca* var. *opaca* / *Clethra alnifolia* / *Woodwardia areolata* Forest

USNVC Identifier: CEG004644

LOCAL INFORMATION

Environmental Description: Non-Riverine Saturated Forest developed on an ancient river terrace over deep, poorly drained soils. The natural hydrology of this forest has been impacted by historic anthropogenic activities, and historic berms and ditches are evident on the site. This forest is surrounded by and grades into Loblolly Pine - Hardwood Forest.

Vegetation Description: Non-Riverine Saturated Forest at George Washington Birthplace National Monument is a deciduous to mixed wetland forest with a tall canopy of large hydric oaks with scattered large *Pinus taeda* (loblolly pine). Characteristic trees are *Quercus pagoda* (cherrybark oak), *Quercus palustris* (pin oak), *Quercus falcata* (southern red oak), *Quercus phellos* (willow oak), and *Quercus michauxii* (swamp chestnut oak). *Liquidambar styraciflua* (sweetgum) is abundant in some areas. There is a well-developed subcanopy of *Ilex opaca* var. *opaca* (American holly). The shrub and herb layers are typically not well-developed, although wet depressions can have local dominance of ferns (*Thelypteris noveboracensis* (New York fern), *Thelypteris palustris* var. *pubescens* (eastern marsh fern), *Woodwardia virginica* (Virginia chainfern), and *Osmunda regalis* (royal fern)).

Non-Riverine Saturated Forest occurs as patches of deciduous to mixed forest in a matrix of Loblolly Pine - Hardwood Forest. It is distinguished by the presence of large hydric oaks such as *Quercus pagoda* (cherrybark oak), *Quercus palustris* (pin oak), *Quercus phellos* (willow oak), and *Quercus michauxii* (swamp chestnut oak) and its occurrence on a non-alluvial, wetland terrace.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Liquidambar styraciflua</i> (sweetgum)
Tree subcanopy	Broad-leaved evergreen shrub	<i>Ilex opaca</i> var. <i>opaca</i> (American holly)

Characteristic Species: *Ilex opaca* var. *opaca* (American holly), *Liquidambar styraciflua* (sweetgum), *Quercus michauxii* (swamp chestnut oak), *Quercus pagoda* (cherrybark oak), *Quercus palustris* (pin oak), *Quercus phellos* (willow oak).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>Sname</u>	<u>Reference</u>
VA	SNR*	B	1	Non-Riverine Saturated Forest	Fleming et al. 2006

Local Range: Non-Riverine Saturated Forest is found north and west of Dancing Marsh. It is mapped as two polygons, 1.4 and 4.5 hectares (3.4 and 11.0 acres) in size.

Classification Comments: Many of the typical species found in this association are missing from the example at George Washington Birthplace National Monument.

Other Comments: The example of this globally rare association at George Washington Birthplace National Monument is much smaller than other known occurrences of this large-patch association. Many typical indicator species are missing and successional species (*Pinus taeda* (loblolly pine) and *Liquidambar styraciflua* (sweetgum)) predominate. Nonnative species are extensive in some areas but not dominant over the native species component. These compositional differences are likely due to hydrologic alteration and the fact that the stand is surrounded by cultural and semi-natural vegetation and isolated from a functioning natural landscape.

Local Description Authors: K. D. Patterson.

Plots: GEWA.1.

George Washington Birthplace National Monument Inventory Notes: Both polygons mapped as Non-Riverine Saturated Forest were observed in the field and one quantitative plot sample was collected.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Seasonally flooded cold-deciduous forest (I.B.2.N.e.)
Alliance	<i>Quercus phellos</i> Seasonally Flooded Forest Alliance (A.330)
Alliance (English name)	Willow Oak Seasonally Flooded Forest Alliance
Association	<i>Quercus (phellos, pagoda, michauxii)</i> / <i>Ilex opaca</i> var. <i>opaca</i> / <i>Clethra alnifolia</i> / <i>Woodwardia areolata</i> Forest
Association (English name)	(Willow Oak, Cherrybark Oak, Swamp Chestnut Oak) / American Holly / Coastal Sweet-pepperbush / Netted Chainfern Forest
Ecological System(s):	Northern Atlantic Coastal Plain Basin Swamp and Wet Hardwood Forest (CES203.520)

GLOBAL DESCRIPTION

Concept Summary: This association occurs in the central and northern Virginia Coastal Plain on extensive, flat terraces and very wide, ancient floodplains that are no longer subject to alluvial processes. Its hydrology is seasonally to nearly permanently saturated, with occasional ponding or groundwater sheetflows, and is maintained by a high water table rather than riverine or estuarine flooding. The overstory of relatively undisturbed examples contain variable mixtures of hydrophytic oaks, most commonly *Quercus phellos* (willow oak), *Quercus pagoda* (cherrybark oak), and *Quercus michauxii* (swamp chestnut oak). Associated canopy species varying from site to site can include *Quercus alba* (white oak), *Quercus palustris* (pin oak), *Quercus lyrata* (overcup oak), *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), *Pinus taeda* (loblolly pine), *Nyssa sylvatica* (blackgum), and *Fraxinus pennsylvanica* (green ash). The subcanopy layers are usually dominated by *Ilex opaca* var. *opaca* (American holly) and also contain *Magnolia virginiana* (sweetbay) and recruitment of the overstory trees. The shrub layer varies from open to dense. and most characteristically contains *Clethra alnifolia* (coastal

sweetpepperbush), *Leucothoe racemosa* (swamp doghobble), *Ilex verticillata* (common winterberry), *Vaccinium corymbosum* (highbush blueberry), *Vaccinium fuscum* (black highbush blueberry), *Vaccinium formosum* (southern blueberry), *Viburnum dentatum* (southern arrowwood), *Rhododendron viscosum* (swamp azalea), and *Viburnum nudum* var. *nudum* (possumhaw). The herb layer is also highly variable. Some stands have a rather sparse herbaceous flora, with scattered colonies and individuals of *Woodwardia areolata* (netted chainfern), *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* var. *spectabilis* (royal fern), *Woodwardia virginica* (Virginia chainfern), *Saururus cernuus* (lizard's tail), and various sedges. Others have a relatively dense graminoid-dominated herb layer with variable patch-dominance by *Chasmanthium laxum* (slender woodoats), *Carex debilis* var. *debilis* (white edge sedge), *Carex intumescens* (greater bladder sedge), *Carex seorsa* (weak stellate sedge), *Carex lonchocarpa* (southern long sedge), and more rarely, *Carex bullata* (button sedge) or *Carex striata* var. *brevis* (Walter's sedge). Many stands of this association have been degraded by cutting or ditching, and extensive areas of suitable habitat have been lost to agriculture, hydrologic alterations, and conversion of hardwood forests to silvicultural pine plantations.

Environmental Description: This association occurs on extensive, flat Coastal Plain terraces and very wide, ancient floodplains that are no longer subject to alluvial processes. Its hydrology is seasonally to nearly permanently saturated, with occasional ponding or groundwater sheetflows, and is maintained by a high water table rather than riverine or estuarine flooding. Shallow channels and streams are sometimes evident, and hummock and hollow microtopography may be present. On the Eastern Shore of Virginia (Accomack County), it is found in isolated and extensive but shallow upland depressions. The stands here cover many hectares and occur in slight depressions with drainage impeded by an impermeable clay layer about half a meter below the soil surface. The habitat apparently has a seasonally high water table but ponds water only intermittently or for short periods (G. Fleming pers. comm.). Surficial soils occupied by this forest are extremely acidic and infertile silt or silty-clay loams.

Vegetation Description: The overstory of relatively undisturbed examples contain variable mixtures of hydrophytic oaks, most commonly *Quercus phellos* (willow oak), *Quercus pagoda* (cherrybark oak), and *Quercus michauxii* (swamp chestnut oak). Associated canopy species varying from site to site can include *Quercus alba* (white oak), *Quercus palustris* (pin oak), *Quercus lyrata* (overcup oak), *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), *Pinus taeda* (loblolly pine), *Nyssa sylvatica* (blackgum), and *Fraxinus pennsylvanica* (green ash). *Liquidambar styraciflua* (sweetgum), *Acer rubrum* (red maple), and *Pinus taeda* (loblolly pine) are often abundant in stands disturbed by cutting. The subcanopy layers are usually dominated by *Ilex opaca* var. *opaca* (American holly) and also contain *Magnolia virginiana* (sweetbay) and recruitment of the overstory trees. The shrub layer varies from open to dense, and most characteristically contains *Clethra alnifolia* (coastal sweetpepperbush), *Leucothoe racemosa* (swamp doghobble), *Ilex verticillata* (common winterberry), *Vaccinium corymbosum* (highbush blueberry), *Vaccinium fuscum* (black highbush blueberry), *Vaccinium formosum* (southern blueberry), *Viburnum dentatum* (southern arrowwood), *Rhododendron viscosum* (swamp azalea), and *Viburnum nudum* var. *nudum* (possumhaw). The herb layer is also highly variable. Some stands have a rather sparse herbaceous flora, with scattered colonies and individuals of *Woodwardia areolata* (netted chainfern), *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* var. *spectabilis* (royal fern), *Woodwardia virginica* (Virginia chainfern), *Saururus cernuus* (lizard's tail), and various sedges. Others have a relatively dense graminoid-dominated herb layer with variable patch-dominance by *Chasmanthium laxum* (slender

woodoats), *Carex debilis* var. *debilis* (white edge sedge), *Carex intumescens* (greater bladder sedge), *Carex seorsa* (weak stellate sedge), *Carex lonchocarpa* (southern long sedge), and more rarely, *Carex bullata* (button sedge) or *Carex striata* var. *brevis* (Walter's sedge). Many other hydrophytic herbs occur at low constancy and cover. The composition of this community is something of a "hybrid," with an overstory similar to that of oak-dominated floodplain forests and lower strata resembling those of an acidic seepage swamp.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree subcanopy	Broad-leaved evergreen tree	<i>Ilex opaca</i> var. <i>opaca</i> (American holly), <i>Magnolia virginiana</i> (sweetbay)
Herb (field)	Graminoid	<i>Carex debilis</i> var. <i>debilis</i> (white edge sedge), <i>Carex intumescens</i> (greater bladder sedge), <i>Carex lonchocarpa</i> (southern long sedge), <i>Carex seorsa</i> (weak stellate sedge), <i>Chasmanthium laxum</i> (slender woodoats)

Characteristic Species: *Clethra alnifolia* (coastal sweetpepperbush), *Ilex verticillata* (common winterberry), *Leucothoe racemosa* (swamp doghobble), *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* var. *spectabilis* (royal fern), *Quercus michauxii* (swamp chestnut oak), *Quercus pagoda* (cherrybark oak), *Quercus phellos* (willow oak), *Rhododendron viscosum* (swamp azalea), *Saururus cernuus* (lizard's tail), *Vaccinium corymbosum* (highbush blueberry), *Viburnum dentatum* (southern arrowwood), *Viburnum nudum* var. *nudum* (possumhaw), *Woodwardia areolata* (netted chainfern), *Woodwardia virginica* (Virginia chainfern).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine

DISTRIBUTION

Range: This association is known from about 25 sites in 13 counties of the Virginia central and northern Coastal Plain. It is not currently documented in Maryland, but requisite habitat conditions are present (J. Harrison pers. comm.).

States/Provinces: VA:S2?

Federal Lands: DOD (Fort Lee); NPS (Colonial, Fredericksburg-Spotsylvania, George Washington Birthplace, Richmond).

CONSERVATION STATUS

Rank: G2? (15-Aug-1997).

Reasons: This association is restricted to special wetland habitats and was probably never common on the landscape. However, extensive areas of suitable habitat have been lost to agriculture, hydrologic alterations, and conversion of hardwood forests to silvicultural pine plantations. The largest known remaining stands are all on private lands and are not protected. Mature, undisturbed examples of this type are rare.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

Comments: Classification of this type is based on intensive field investigation by the Virginia Natural Heritage Program (VDNH) and analysis of a 1,250-plot regional dataset assembled for the NCR and mid-Atlantic national parks vegetation mapping projects. In that analysis, this

association was represented by 21 plots from the northern Coastal Plain of Virginia. The original concept of this vegetation was based on field work by Bill Moorhead (VDNH), who investigated several of the large, elliptical depressions that dot the flat landscape in Accomack County. There are three plots that document this vegetation at two sites: "Dahl Swamp" and "The Lake" (G. Fleming pers. comm.). The stands apparently cover many hectares and are associated with slight depressions with drainage impeded by an impermeable clay layer about half a meter below the soil surface. The habitat apparently has a seasonally high water table but ponds water only intermittently or for short periods. Most of the areas seen by Bill Moorhead had been logged some decades ago and had a very open (woodland-like) physiognomy due to poor restocking of canopy trees. However, he also obtained information from local people that one of the areas was known historically as "savanna land," suggesting that fire and hydrology maintained a woodland physiognomy in the depressions (G. Fleming pers. comm.).

Similar Associations:

- *Carex striata* var. *brevis* Herbaceous Vegetation (CEGL004120).
- *Liquidambar styraciflua* - *Acer rubrum* - *Quercus phellos* / *Leucothoe racemosa* Forest (CEGL006110)--is also found in Ecoregion 58.
- *Quercus michauxii* - *Quercus pagoda* / *Clethra alnifolia* - *Leucothoe axillaris* Forest (CEGL007449)--southern analogue found on mineral soils near the edge of extensive peat flats on the outer Coastal Plain terraces of southeastern Virginia and North Carolina; compositionally very similar to CEGL004644 but contains southern species such as *Quercus laurifolia*, *Leucothoe axillaris*, *Arundinaria gigantea* ssp. *tecta*, and *Sabal minor* that are absent from CEGL004644.

Related Concepts:

- *Quercus* (*michauxii*, *pagoda*, *phellos*, *alba*) / *Clethra alnifolia* / *Woodwardia virginica* Forest (VDNH 2003) =

SOURCES

Description Authors: G. P. Fleming, mod. M. Pyne and G. P. Fleming.

References: Fleming et al. 2001, Fleming pers. comm., J. Harrison pers. comm., Southeastern Ecology Working Group n.d., VDNH 2003.



Figure H9. Non-Riverine Saturated Forest (plot GEWA.1) at George Washington Birthplace National Monument. June 2002. NAD 1983 / UTM easting 331930 northing 4228759.

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

SYNONYMS

USNVC English Name: Red Maple - Blackgum - Sweetbay / Southern Wild Raisin / Cinnamon Fern - Netted Chainfern Forest

USNVC Scientific Name: *Acer rubrum* - *Nyssa sylvatica* - *Magnolia virginiana* / *Viburnum nudum* var. *nudum* / *Osmunda cinnamomea* - *Woodwardia areolata* Forest

USNVC Identifier: CEG006238

LOCAL INFORMATION

Environmental Description: Coastal Plain / Piedmont Acidic Seepage Swamp is a wetland forest that occurs as a narrow feature at the heads of ravines above marshes. These wetlands occur at the base of seeping toe slopes where seepage discharged at the ground surface is drained away as streamflow. One example, at the head of Dancing Marsh, is bisected by a road and culvert, which may alter its natural hydrology. Examples may have standing water for at least part of the year.

Vegetation Description: Coastal Plain / Piedmont Acidic Seepage Swamp has a tall canopy dominated by *Acer rubrum* (red maple). Other trees present in the canopy and subcanopy can include *Liquidambar styraciflua* (sweetgum), *Nyssa sylvatica* (blackgum), *Pinus taeda* (loblolly pine), and *Quercus palustris* (pin oak). The open shrub stratum typically includes *Ilex opaca* var. *opaca* (American holly), *Ilex verticillata* (common winterberry), *Lindera benzoin* (northern spicebush), and *Viburnum nudum* (possumhaw). Herbs are sparse and there is much exposed soil / muck in the driest part of the year. Typical herb species include *Boehmeria cylindrica* (smallspike false nettle), *Carex crinita* (fringed sedge), *Carex lurida* (shallow sedge), *Cinna arundinacea* (sweet woodreed), *Galium obtusum* (bluntleaf bedstraw), *Glyceria striata*, *Gratiola virginiana* (roundfruit hedgehyssop), *Lycopus virginicus* (Virginia water horehound), *Onoclea sensibilis* (sensitive fern), *Pilea pumila* (Canadian clearweed), *Polygonum virginianum* (jumpseed), and *Woodwardia virginica* (Virginia chainfern).

Most Abundant Species:

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

Characteristic Species: *Acer rubrum* (red maple), *Glyceria striata* (fowl mannagrass), *Ilex verticillata* (common winterberry), *Onoclea sensibilis* (sensitive fern), *Viburnum nudum* (possumhaw).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Ligustrum obtusifolium</i> (border privet)	-	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	S3?	=	1	Coastal Plain / Piedmont Acidic Seepage Swamp	Fleming et al. 2006

Local Range: Coastal Plain / Piedmont Acidic Seepage Swamp occurs at the heads of Dancing Marsh and Digwood Swamp. It covers a total of 1.57 hectares (3.9 acres) and is mapped in three polygons ranging from 0.39 to 0.87 hectare (0.8 to 2.1 acres) in size.

Classification Comments: Examples of Coastal Plain / Piedmont Acidic Seepage Swamp at George Washington Birthplace National Monument may have altered hydrology and nutrient inputs from the surrounding pasture lands. While they share many species in common with undisturbed examples of the Coastal Plain / Piedmont Acidic Seepage Swamp, they also have species indicative of nutrient-enriched soils such as *Carex lurida* (shallow sedge), *Gratiola virginiana* (roundfruit hedgehyssop), *Polygonum virginianum* (jumpseed), and *Smilax rotundifolia* (roundleaf greenbrier).

Other Comments: Information not available.

Local Description Authors: K. D. Patterson.

Plots: GEWA.2.

George Washington Birthplace National Monument Inventory Notes: All polygons mapped as Coastal Plain / Piedmont Acidic Seepage Swamp were observed in the field and one quantitative plot sample was collected.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Saturated cold-deciduous forest (I.B.2.N.g.)
Alliance	<i>Acer rubrum</i> - <i>Nyssa sylvatica</i> Saturated Forest Alliance (A.348)
Alliance (English name)	Red Maple - Blackgum Saturated Forest Alliance
Association	<i>Acer rubrum</i> - <i>Nyssa sylvatica</i> - <i>Magnolia virginiana</i> / <i>Viburnum nudum</i> var. <i>nudum</i> / <i>Osmunda cinnamomea</i> - <i>Woodwardia areolata</i> Forest
Association (English name)	Red Maple - Blackgum - Sweetbay / Southern Wild Raisin / Cinnamon Fern - Netted Chainfern Forest
Ecological System(s):	Northern Atlantic Coastal Plain Basin Peat Swamp (CES203.522) Northern Atlantic Coastal Plain Pitch Pine Lowland (CES203.374) Northern Atlantic Coastal Plain Stream and River (CES203.070)

GLOBAL DESCRIPTION

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

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

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

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

(kidneyleaf grass of Parnassus), *Carex collinsii* (Collins' sedge), and *Bartonia paniculata* (twining screwstem).

Most Abundant Species:

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

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

Other Noteworthy Species:

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

USFWS Wetland System: Palustrine.

DISTRIBUTION

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

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

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

CONSERVATION STATUS

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

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

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

Comments: Information not available.

Similar Associations:

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

Related Concepts:

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

SOURCES

Description Authors: G. Fleming.

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



Figure H10. Coastal Plain / Piedmont Acidic Seepage Swamp at George Washington Birthplace National Monument. August 2002. NAD 1983 / UTM easting 331625, northing 4228431. Photo by NCSU-CEO.



Figure H11. Coastal Plain / Piedmont Acidic Seepage Swamp at George Washington Birthplace National Monument. July 2004. NAD 1983 / UTM easting 331532, northing 4229363.

COMMON NAME (PARK-SPECIFIC): TIDAL SHRUB SWAMP (IVA TYPE)**SYNONYMS**

USNVC English Name: Maritime Marsh-elder / Saltmeadow Cordgrass Shrubland
USNVC Scientific Name: *Iva frutescens* / *Spartina patens* Shrubland
USNVC Identifier: CEG006848

LOCAL INFORMATION

Environmental Description: Tidal Shrub Swamp (Iva Type) occurs on tidal islands in Pope's Creek at the mouth of Longwood Swamp. These features may be spoil mounds from past dredging (Mercer 1978) or delta features that form where Pope's Creek joins the Potomac River. This shrubland is flooded by high tides and storm tides. Substrate is organic peat, sand, or sandy loam, and forms a hummock-and-hollow topography.

Vegetation Description: These shrublands form dense, impenetrable thickets (60–90% cover) about 2 m tall dominated by *Iva frutescens* (Jesuit's bark), which is often the only shrub present. Other shrub species that are inconstant and occur only in low cover include *Atriplex patula* (spear saltbush), *Amorpha fruticosa* (desert false indigo), and *Baccharis halimifolia* (eastern baccharis). Herbaceous salt marsh species dominate in openings between the shrubs. Typical species include *Distichlis spicata* (inland saltgrass), *Spartina alterniflora* (smooth cordgrass), *Spartina patens* (saltmeadow cordgrass), and *Symphyotrichum tenuifolium* (perennial saltmarsh aster).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Iva frutescens</i> (Jesuit's bark)

Characteristic Species: *Iva frutescens* (Jesuit's bark), *Spartina alterniflora* (smooth cordgrass), *Symphyotrichum tenuifolium* (perennial saltmarsh aster).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Phragmites australis</i> (common reed)	-	plant	invasive nonnative

Subnational Distribution with Crosswalk Data:

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

Local Range: This association occurs on tidal islands at the confluence of Longwood Swamp, Pope's Creek, and the Potomac River. It is mapped as eleven polygons ranging in size from 0.02 to 1.8 hectares (0.06 to 4.9 acres) and covering a total of 4.7 hectares (11.7 acres).

Classification Comments: Areas mapped as this association may have inclusions (less than 0.5 ha) of Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh).

Other Comments: Information not available.

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace National Monument Inventory Notes: All polygons mapped as Tidal Shrub Swamp (Iva Type) were observed in the field.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Tidal cold-deciduous shrubland (III.B.2.N.h.)
Alliance	<i>Baccharis halimifolia</i> - <i>Iva frutescens</i> Tidal Shrubland Alliance (A.1023)
Alliance (English name)	Groundsel-tree - Maritime Marsh-elder Tidal Shrubland Alliance
Association	<i>Iva frutescens</i> / <i>Spartina patens</i> Shrubland
Association (English name)	Maritime Marsh-elder / Saltmeadow Cordgrass Shrubland
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This maritime shrubland of the eastern Atlantic states occurs in association with salt marshes. In its natural condition, this community forms the ecotone between high salt marsh and adjacent upland vegetation. It also occurs in patches on areas of slightly higher elevation within the salt marsh or on spoil mounds adjacent to ditches. *Iva frutescens* (Jesuit's bark) is the most characteristic and dominant shrub species. *Spartina patens* (saltmeadow cordgrass) is a characteristic and usually abundant grass, often occurring as a monoculture beneath the shrub canopy. Other common herbaceous associates include *Distichlis spicata* (inland saltgrass) and *Spartina alterniflora* (smooth cordgrass); *Juncus gerardii* (saltmeadow rush) may also occur at the northern end of the range. Other less common associates may include *Cuscuta gronovii* (scaldweed), *Limonium carolinianum* (Carolina sealavender), *Lythrum lineare* (wand lythrum), and *Solidago sempervirens* (seaside goldenrod). The vegetation is characterized by an open and relatively evenly spaced shrub stratum of short stature, rarely exceeding one meter in height, with a well-developed herbaceous layer, reflecting an intergrading of this community with the adjacent high salt marsh. Storm-induced disturbance causes periodic die-back of the shrubs restricting the extent of their spread.

Environmental Description: This maritime and estuarine shrubland of the eastern Atlantic states occurs in association with salt marshes. It forms an ecotone between the high salt marsh and adjacent upland vegetation. It also occurs in patches on areas of slightly higher elevation within the salt marsh or on spoil mounds adjacent to ditches. This shrubland occurs above mean high tide but can be flooded by storm tides. Substrate is organic peat over glacial till, sand, or sandy loam.

Vegetation Description: *Iva frutescens* (Jesuit's bark) is the most characteristic and dominant shrub species. *Spartina patens* (saltmeadow cordgrass) is a characteristic and usually abundant grass, often occurring as a monoculture beneath the shrub canopy. Other common herbaceous associates include *Distichlis spicata* (inland saltgrass) and *Spartina alterniflora* (smooth cordgrass); *Juncus gerardii* (saltmeadow rush) may also occur at the northern end of the range. Other less common associates may include *Cuscuta gronovii* (scaldweed), *Limonium carolinianum* (Carolina sealavender), *Lythrum lineare* (wand lythrum), and *Solidago sempervirens* (seaside goldenrod). The vegetation is characterized by an open and relatively evenly spaced shrub stratum of short stature, rarely exceeding one meter in height, with a well-

developed herbaceous layer, reflecting an intergrading of this community with the adjacent high salt marsh.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Short shrub/sapling	Semi-shrub	<i>Iva frutescens</i> (Jesuit's bark)
Herb (field)	Graminoid	<i>Spartina patens</i> (saltmeadow cordgrass)

Characteristic Species: *Iva frutescens* (Jesuit's bark).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association ranges from Massachusetts to South Carolina.

States/Provinces: CT, DE:S5, MA, MD:S5, NC, NJ:S2S3, NY:S4, RI, SC, VA:S5.

Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Fire Island, Gateway, George Washington Birthplace); USFWS (Back Bay?, Chesapeake Marshlands, Chincoteague, Monomoy?, Parker River, Prime Hook).

CONSERVATION STATUS

Rank: G5 (1-Dec-1997).

Reasons: This vegetation occurs commonly in salt marshes of the eastern seaboard.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

Comments: As shrub cover decreases, the community often grades into high salt marsh associations such as *Panicum virgatum* - *Spartina patens* Herbaceous Vegetation (CEGL006150) or *Spartina patens* (saltmeadow cordgrass)-dominated high marsh associations. Southern analogs of this salt marsh-upland border shrubland include *Baccharis halimifolia* - *Iva frutescens* - *Morella cerifera* - (*Ilex vomitoria*) Shrubland (CEGL003920) along the southern Atlantic Coast from the Carolinas to Florida west to Louisiana and *Iva frutescens* ssp. *frutescens* - *Baccharis halimifolia* / *Spartina spartinae* Shrubland (CEGL004616) along the Texas Gulf Coast. This community is differentiated from *Morella cerifera* - *Baccharis halimifolia* / *Spartina patens* Shrubland (CEGL003809) by the presence of *Iva frutescens* (Jesuit's bark) and by the influence of tidal flooding. It is differentiated from *Baccharis halimifolia* - *Iva frutescens* / *Panicum virgatum* Shrubland (CEGL006063) by a relatively lower species composition, lower elevation and more gradual transition to the adjacent high salt marsh, and by the unimportance of *Baccharis halimifolia* (eastern baccharis) and *Panicum virgatum* (switchgrass).

Similar Associations:

- *Baccharis halimifolia* - *Iva frutescens* - *Morella cerifera* - (*Ilex vomitoria*) Shrubland (CEGL003920).
- *Baccharis halimifolia* - *Iva frutescens* / *Panicum virgatum* Shrubland (CEGL003921).
- *Eleocharis rostellata* - *Spartina patens* Herbaceous Vegetation (CEGL006611).
- *Iva frutescens* / *Spartina cynosuroides* Tidal Shrubland (CEGL006847).
- *Iva frutescens* ssp. *frutescens* - *Baccharis halimifolia* / *Spartina spartinae* Shrubland (CEGL004616).
- *Panicum virgatum* - *Spartina patens* Herbaceous Vegetation (CEGL006150).

Related Concepts:

- *Baccharis halimifolia* - *Iva frutescens* ssp. *oraria* / *Spartina patens* Shrubland (Bartgis 1986) B
- *Iva frutescens* - *Baccharis halimifolia* / *Spartina patens* - *Distichlis spicata* Tidal Shrubland (VDNH 2003) =
- *Iva frutescens* - *Baccharis halimifolia* (Good 1965) ?
- *Iva frutescens* / *Spartina patens* Tidal Shrubland (Harrison and Stango 2003) =
- *Iva frutescens* and *Baccharis halimifolia* (Klemas et al. 1973) B
- Estuarine scrub-shrub wetland (Tiner 1985a) ?
- Estuarine scrub-shrub wetland (Tiner 1985b) ?
- Salt Marsh (Rawinski 1984) ?
- Salt Marsh Complex, marsh-upland border (Breden 1989) B
- Salt Shrub (High Subtype) (Schafale 2000) ?
- Salt bush - salt meadow marsh (Daiber et al. 1976) =
- Salt grass - marsh elder savanna (Martin 1959b) =
- Salt marsh and upper border (Barry 1980) ?
- Salt marsh community (Hill 1986) B
- Salt shrub (Reschke 1990) B
- Saltbush zone (Boule 1979) B
- Shrub succession community (Higgins et al. 1971) B
- Swamp thicket (Klotz 1986) B

SOURCES

Description Authors: S. L. Sneid, E. F. Largay, mod. L. A. Sneddon.

References: Barry 1980, Bartgis 1986, Bell et al. 2002, Berdine 1998, Boule 1979, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1996, Coulling 2002, Coulling pers. comm., Daiber et al. 1976, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming 2001, Fleming et al. 2001, Fleming pers. comm., Good 1965, Harrison 2004, Harrison and Stango 2003, Higgins et al. 1971, Hill 1986, J. Harrison pers. comm., Klemas et al. 1973, Klotz 1986, Martin 1959b, Mercer 1978, Metzler and Barrett 2001, NRCS 2001b, Rawinski 1984, Reschke 1990, Schafale 2000, Schafale and Weakley 1990, Sneddon et al. 1995, Swain and Kearsley 2001, TNC 1995c, Tiner 1984, Tiner 1985a, Tiner 1985b, VDNH 2003.



Figure H12. Tidal Shrub Swamp (Iva Type) at George Washington Birthplace National Monument. August 2007. NAD 1983 / UTM easting 333025, northing 4228937. Photo by Rijk Morawe.

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: CEGLO06107

LOCAL INFORMATION

Environmental Description: Cultural Meadow includes all the mowed fields without buildings or trees in the park. The fields are maintained to give the feel of a working farm and are allowed to grow to a height of 0.6 to 0.9 m (2–3 feet) before being mowed.

Vegetation Description: This vegetation is comprised of a mix of native and European grasses and forbs. Typical grasses in these fields include *Lolium pratense* (meadow ryegrass), *Andropogon virginicus* (broomsedge bluestem), *Tridens flavus* (purpletop tridens), and *Tripsacum dactyloides* (eastern gamagrass), while common forbs include *Achillea millefolium* (common yarrow), *Ambrosia artemisiifolia* (annual ragweed), *Apocynum cannabinum* (Indianhemp), *Artemisia vulgaris* (common wormwood), *Cirsium* spp. (thistles), *Solidago juncea* (early goldenrod), and *Lespedeza cuneata* (Chinese lespedeza). In areas that are mowed more closely, *Allium vineale* (wild garlic), *Cynodon dactylon* (Bermudagrass), *Dactylis glomerata* (orchardgrass), *Digitaria sanguinalis* (hairy crabgrass), *Duchesnea indica* (Indian strawberry), *Echinochloa crus-galli* (barnyardgrass), and *Melilotus officinalis* (yellow sweetclover).

Most Abundant Species: Information not available.

Characteristic Species: *Cynodon dactylon* (Bermudagrass), *Lolium pratense* (meadow ryegrass).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

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

Local Range: Cultural Meadow is found throughout the park and covers a total of 71.8 hectares (177.6 acres). Polygons range in size from 0.4 to 48.3 hectares (1 to 119 acres).

Classification Comments: Information not available.

Other Comments: Information not available.

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace 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 (1–3 feet tall) grasses and forbs, with occasional scattered shrubs. Species composition varies from site to site, depending on land-use history and perhaps soil type, but in general this vegetation is quite wide-ranging in northeastern and midwestern states and at higher elevations (610–1220 m [2000–4000 feet]) in the southeastern states. Dominant grasses vary from site to site but generally feature the nominal species. Other graminoid associates may include *Agrostis stolonifera* (creeping bentgrass), *Agrostis hyemalis* (winter bentgrass), *Elymus repens* (quackgrass), *Bromus inermis* (smooth brome), *Bromus tectorum* (cheatgrass), *Lolium perenne* (perennial ryegrass), *Poa pratensis* (Kentucky bluegrass), *Poa compressa* (Canada bluegrass), *Schizachyrium scoparium* (little bluestem) (not in abundance), and *Anthoxanthum odoratum* (sweet vernalgrass). Forbs scattered among the grasses are varied but include *Hieracium* spp. (hawkweeds), *Oxalis stricta* (common yellow oxalis), *Achillea millefolium* (common yarrow), *Asclepias syriaca* (common milkweed), *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago nemoralis* (gray goldenrod), *Solidago juncea* (early goldenrod), *Solidago canadensis* (Canada goldenrod), *Solidago altissima* (tall goldenrod), *Euthamia graminifolia* (flat-top goldentop), *Cerastium arvense* (field chickweed), *Oenothera biennis* (common evening-primrose), *Potentilla simplex* (common cinquefoil), *Symphyotrichum lateriflorum* (calico aster), *Symphyotrichum novae-angliae* (New England aster), *Symphyotrichum lanceolatum* (white panicle aster), *Daucus carota* (Queen Anne's lace), *Ambrosia artemisiifolia* (annual ragweed), *Vicia cracca* (bird vetch), *Trifolium* spp. (clovers), and many others.

Environmental Description: This association occurs on pastures and land that has been tilled. Generally the fields are mowed at least annually.

Vegetation Description: In addition to *Dactylis glomerata* (orchardgrass) and *Phleum pratense* (timothy), these grassy fields are characterized by graminoids including *Agrostis stolonifera* (creeping bentgrass), *Agrostis hyemalis* (winter bentgrass), *Elymus repens* (quackgrass), *Bromus inermis* (smooth brome), *Bromus tectorum* (cheatgrass), *Lolium perenne* (perennial ryegrass), *Poa pratensis* (Kentucky bluegrass), *Poa compressa* (Canada bluegrass), *Schizachyrium scoparium* (little bluestem) (not in abundance), and *Anthoxanthum odoratum* (sweet vernalgrass). Forbs scattered among the grasses are varied but include *Hieracium* spp. (hawkweeds), *Oxalis stricta* (common yellow oxalis), *Achillea millefolium* (common yarrow), *Asclepias syriaca* (common milkweed), *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago nemoralis* (gray goldenrod), *Solidago juncea* (early goldenrod), *Solidago canadensis* (Canada goldenrod), *Solidago altissima* (tall goldenrod), *Euthamia graminifolia* (flat-top goldentop), *Cerastium*

arvense (field chickweed), *Oenothera biennis* (common evening-primrose), *Potentilla simplex* (common cinquefoil), *Symphyotrichum lateriflorum* (calico aster), *Symphyotrichum novae-angliae* (New England aster), *Symphyotrichum lanceolatum* (white panicle aster), *Daucus carota* (Queen Anne's lace), *Ambrosia artemisiifolia* (annual ragweed), *Vicia cracca* (bird vetch), *Trifolium* spp. (clovers), and many others.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Forb	<i>Rumex acetosella</i> (common sheep sorrel)
Herb (field)	Graminoid	<i>Dactylis glomerata</i> (orchardgrass), <i>Festuca rubra</i> (red fescue), <i>Phleum pratense</i> (timothy)

Characteristic Species: *Achillea millefolium* (common yarrow), *Anthoxanthum odoratum* (sweet vernalgrass), *Dactylis glomerata* (orchardgrass), *Euthamia graminifolia* (flat-top goldentop), *Phleum pratense* (timothy), *Rumex acetosella* (common sheep sorrel), *Solidago altissima* (tall goldenrod), *Solidago canadensis* (Canada goldenrod), *Solidago rugosa* (wrinkleleaf goldenrod).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This vegetation is quite wide-ranging in northeastern and midwestern states and possibly occurs at higher elevations in the southeastern states.

States/Provinces: CT, DE, KY, MA, MD, ME, NB?, NH, NJ, NS?, NY, PA, QC?, RI, TN, VA, VT, WV.

Federal Lands: NPS (Allegheny Portage Railroad, Appomattox Court House, Booker T. Washington, Boston Harbor Islands, Cape Cod, Colonial, Delaware Water Gap, Fire Island, Fort Necessity, Fredericksburg-Spotsylvania, Friendship Hill, Gateway, George Washington Birthplace, Gettysburg, Johnstown Flood, Marsh-Billings-Rockefeller, Minute Man, Morristown, Petersburg, Richmond, Saint-Gaudens, Saratoga, Upper Delaware, Valley Forge, Weir Farm); USFWS (Aroostook, Assabet River, Carlton Pond, Erie, Great Meadows, Moosehorn, Nulhegan Basin, Oxbow, Parker River).

CONSERVATION STATUS

Rank: GNA (modified/managed) (8-Dec-2005).

Reasons: This vegetation type includes pasture and post-agricultural fields and is largely composed of nonnative grasses and herbs (generally of European origin).

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 - Weak.

Comments: *Schizachyrium scoparium* - (*Andropogon virginicus*) - *Solidago* spp. Herbaceous Vegetation (CEGL006333) is similar to this type but is dominated by warm-season grasses.

Similar Associations:

- *Lolium* (*arundinaceum*, *pratense*) Herbaceous Vegetation (CEGL004048).
- *Phleum pratense* - *Bromus pubescens* - *Helenium autumnale* Herbaceous Vegetation (CEGL004018).
- *Schizachyrium scoparium* - (*Andropogon virginicus*) - *Solidago* spp. Herbaceous Vegetation (CEGL006333)--has a greater component of native species and occurs on drier soils.

Related Concepts: Information not available.

SOURCES

Description Authors: S. C. Gawler.

References: Clark 1986, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Ehrenfeld 1977, Elliman 2003, Keever 1979, Newbold et al. 1988, Perles et al. 2005a, Perles et al. 2005b, Perles et al. 2005c, Perles et al. 2007, Sneddon et al. 1995, TDNH unpubl. data.



Figure H13. Cultural Meadow at George Washington Birthplace National Monument. July 2002. NAD 1983 / UTM easting 330943, northing 4229330. Photo by NCSU-CEO.

COMMON NAME (PARK-SPECIFIC): TIDAL OLIGOHALINE MARSH (COMMON REED TIDAL MARSH)

SYNONYMS

USNVC English Name: Common Reed Tidal Herbaceous Vegetation
USNVC Scientific Name: *Phragmites australis* Tidal Herbaceous Vegetation
USNVC Identifier: CEG004187

LOCAL INFORMATION

Environmental Description: Tidal Oligohaline Marsh (Common Reed Tidal Marsh) is a dense, tall grassland indicative of disturbance. It occurs at the mouths of tidal creeks, on tidal islands, and on sandy beaches, generally in areas that are regularly flooded with tidal water. Species within and adjacent to this community are typical of oligohaline conditions where salt concentrations are between 0.5 and 5 ppt. It can be adjacent to Tidal Shrub Swamp (Iva Type), Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh), or other tidal oligohaline associations. Substrates range from muck or peat to sand.

Vegetation Description: This vegetation is characterized by dense stands of the invasive, nonnative grass *Phragmites australis* (common reed), typically to the exclusion of all other vascular plant species. Other species noted in this community with low frequency and cover include *Cyperus odoratus* (fragrant flatsedge), *Iva frutescens* (Jesuit's bark), and *Rumex verticillatus* (swamp dock).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Graminoid	<i>Phragmites australis</i> (common reed)

Characteristic Species: *Phragmites australis* (common reed)

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Phragmites australis</i> (common reed)	-	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	1	Tidal Oligohaline Marsh	Fleming et al. 2001

Local Range: In 2002, this association was noted along Bridge's Creek, in Digwood Swamp, and in Longwood Swamp. This type has been targeted for eradication by the park and may no longer occur in these areas. Conversely, since the dominant species is invasive, acreage of this association may have increased since 2002.

Classification Comments: Information not available.

Other Comments: All observed stands of this association were below minimum mapping unit (<0.5 ha), and were not mapped separately from the surrounding vegetation. This association is one of three associations included in the map class Tidal Oligohaline Marsh.

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace 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	Tidal temperate or subpolar grassland (V.A.5.N.n.)
Alliance	<i>Phragmites australis</i> Tidal Herbaceous Alliance (A.1477)
Alliance (English name)	Common Reed Tidal Herbaceous Alliance
Association	<i>Phragmites australis</i> Tidal Herbaceous Vegetation
Association (English name)	Common Reed Tidal Herbaceous Vegetation
Ecological System(s):	Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260) Central Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270) Atlantic Coastal Plain Embayed Region Tidal Freshwater Marsh (CES203.259) Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519)

GLOBAL DESCRIPTION

Concept Summary: This community is a dense tall grassland indicative of disturbance. It occurs in a range of tidal wetland habitats from fresh to brackish in salinity. It is characterized by dense stands of *Phragmites australis* (common reed), a species which tends to grow in colonies of tall, stout, leafy plants often to the exclusion of all other vascular plant species. Associated species are highly variable, depending on the community that has been invaded. Spreading in large colonies, *Phragmites* (reed) eventually dominates disturbed areas at coverage up to 100%. More typically, though, scattered individuals of other species may occur, such as sparse *Morella cerifera* (wax myrtle) shrubs, *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Calystegia sepium* (hedge false bindweed), *Boehmeria cylindrica* (smallspike false nettle), *Typha angustifolia* (narrowleaf cattail), *Apocynum cannabinum* (Indianhemp), *Rosa palustris* (swamp rose), *Polygonum* sp. (a knotweed), and *Mikania scandens* (climbing hempvine). Vines of *Toxicodendron radicans* (eastern poison ivy) are also frequent, but typically occur at low cover. This community has a broad geographic range, including coastal areas of the eastern and southeastern United States and Canada.

Environmental Description: This community is a dense tall grassland indicative of disturbance. It occurs in a range of tidal wetland habitats from fresh to brackish in salinity.

Vegetation Description: This community is a broadly defined reed-grass marsh. It is characterized by dense stands of *Phragmites australis* (common reed), a species which tends to grow in colonies of tall, stout, leafy plants often to the exclusion of all other vascular plant species. Associated species are highly variable, depending on the community that has been invaded. Spreading in large colonies, *Phragmites* (reed) eventually dominates disturbed areas at coverage up to 100%. More typically, though, scattered individuals of other species may occur, such as sparse *Morella cerifera* (wax myrtle) shrubs, *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Calystegia sepium* (hedge false bindweed), *Boehmeria cylindrica* (smallspike false nettle), *Typha angustifolia* (narrowleaf cattail), *Apocynum cannabinum* (Indianhemp), *Rosa palustris* (swamp rose), *Polygonum* sp. (a knotweed), and *Mikania scandens* (climbing

hempsvine). Vines of *Toxicodendron radicans* (eastern poison ivy) are also frequent but typically occur at low cover.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Graminoid	<i>Phragmites australis</i> (common reed)

Characteristic Species: *Phragmites australis* (common reed).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Estuarine.

DISTRIBUTION

Range: This community has a broad geographic range, including coastal areas of the eastern and southeastern United States and Canada.

States/Provinces: AL, CT, DE, FL, GA, LA, LB?, MA, MD, ME, MS, NC, NF?, NH, NJ, NS?, NY, PA, PE?, QC?, RI, SC, TX, VA.

Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Colonial, Fire Island, Gateway, George Washington Birthplace, Saugus Iron Works); USFWS (Back Bay, Bon Secour, Chesapeake Marshlands).

CONSERVATION STATUS

Rank: GNA (invasive) (22-Nov-1997).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 1 - Strong.

Comments: Although *Phragmites australis* (common reed) rhizomes have been noted in salt marsh sediments exceeding three thousand years in age (Niering and Warren 1977) and is thus a native component of salt marshes in some areas in North America, the growth of the species in its native condition was likely to have been significantly different than the dense monotypic stands that characterize this community in parts of its range today. The invasive, nonnative strain has been labeled haplotype M (Saltonstall 2002). The presence of the *Phragmites australis* (common reed) community in wetlands today generally indicates human-induced disturbance, either through direct habitat manipulation or through passive introduction of reproductive material to naturally disturbed substrates. Historically, without alteration, these sites would generally be more saline. In New England, *Phragmites* (reed) tends to invade behind artificial/man-made levees where regular salt input is blocked, making the sites more brackish and less saline than prior to levee construction and anthropogenic modification. In cases where *Phragmites australis* (common reed) is a significant component of the vegetation but the vegetation retains sufficient species composition to retain its identity, the site is considered an unhealthy or degraded example of that original community. Where *Phragmites australis* (common reed) cover is so high that native species have been excluded and the original community is no longer recognizable, the occurrence is then treated as an example of *Phragmites australis* (common reed) Tidal Herbaceous Vegetation (CEGL004187).

Similar Associations:

- *Phragmites australis* - (*Sagittaria platyphylla*, *Vigna luteola*) Tidal Herbaceous Vegetation (CEGL007891).
- *Phragmites australis* Eastern North America Temperate Semi-natural Herbaceous Vegetation (CEGL004141).

Related Concepts:

- *Phragmites australis* Association (Fleming 1998) ?
- *Phragmites australis* community (Metzler and Barrett 1992) ?
- *Phragmites australis* tidal marsh association (Clancy 1993b) ?
- Brackish Tidal Marsh (Rawinski 1984) ?
- Salt Marsh Complex (Breden 1989) B

SOURCES

Description Authors: R. E. Zaremba.

References: Bell et al. 2002, Bowman 2000, Breden 1989, Clancy 1993b, Edinger et al. 2002, Fleming 1998, Harrison 2001, Metzler and Barrett 1992, Metzler and Barrett 1996, Metzler and Barrett 2001, NRCS 2001b, Nelson 1986, Niering and Warren 1977, Odum et al. 1984, Rawinski 1984, Saltonstall 2002, Schafale and Weakley 1990, Schotz pers. comm., Southeastern Ecology Working Group n.d., Swain and Kearsley 2001.



Figure H14. Tidal Oligohaline Marsh (Common Reed Tidal Marsh) at George Washington Birthplace National Monument. August 2007. NAD 1983 / UTM easting 331729, northing 4229789. Photo by Rijk Morawe.

COMMON NAME (PARK-SPECIFIC): TIDAL MESOHALINE AND POLYHALINE MARSH (LOW SALT MARSH)

SYNONYMS

USNVC English Name: Saltmarsh Cordgrass - Saltgrass Tidal Herbaceous Vegetation
USNVC Scientific Name: *Spartina alterniflora* - *Distichlis spicata* Tidal Herbaceous Vegetation
USNVC Identifier: CEG006586

LOCAL INFORMATION

Environmental Description: In George Washington Birthplace National Monument, Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) occurs as small pocket marshes along tidal creeks that flow into the Potomac River. Mesohaline conditions comprise salt concentrations between 5 and 18 ppt, whereas polyhaline conditions range from 18 to 30 ppt.

Vegetation Description: Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) is a graminoid-dominated salt marsh that tends to be shorter in stature than Tidal Oligohaline Marsh. These marshes are strongly dominated by *Spartina alterniflora* (smooth cordgrass), often in association with *Spartina patens* (saltmeadow cordgrass), which may be locally dominant. Other common associates include *Distichlis spicata* (inland saltgrass), *Pluchea odorata* (sweetscent), *Kosteletzkya virginica* (Virginia saltmarsh mallow), and *Typha angustifolia* (narrowleaf cattail). Other less consistent, low-cover marsh species noted in this community include *Amaranthus cannabinus* (tidalmarsh amaranth), *Cyperus odoratus* (fragrant flatsedge), *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow), *Schoenoplectus americanus* (chairmaker's bulrush), *Schoenoplectus robustus* (sturdy bulrush), and *Spartina cynosuroides* (big cordgrass). Scattered shrubs of *Iva frutescens* (Jesuit's bark) and *Baccharis halimifolia* (eastern baccharis) may be found in this community along the nearshore margins and on high areas. Tidal Mesohaline and Polyhaline Marshes (Low Salt Marsh) can occur as small patches within a larger Tidal Oligohaline Marsh.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Graminoid	<i>Spartina alterniflora</i> (smooth cordgrass)

Characteristic Species: *Distichlis spicata* (inland saltgrass), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Pluchea odorata* (sweetscent), *Spartina alterniflora* (smooth cordgrass), *Spartina patens* (saltmeadow cordgrass).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

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

Local Range: This association is found as small pocket marshes opening into Pope's Creek at Longwood Swamp, Duck Hall Point, and Dancing Marsh. A small area of Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) is also found along Bridges Creek near its confluence with the Potomac River. It covers 7.2 hectares in four polygons, ranging in size from 0.2 to 3.6 hectares.

Classification Comments: Information not available.

Other Comments: Information not available.

Local Description Authors: K. D. Patterson.

Plots: GEWA.4, GEWA.5.

George Washington Birthplace National Monument Inventory Notes: All polygons mapped as Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) were observed in the field and two quantitative vegetation plots were collected.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Tidal temperate or subpolar grassland (V.A.5.N.n.)
Alliance	<i>Spartina alterniflora</i> Tidal Herbaceous Alliance (A.1471)
Alliance (English name)	Saltmarsh Cordgrass Tidal Herbaceous Alliance
Association	<i>Spartina alterniflora</i> - <i>Distichlis spicata</i> Tidal Herbaceous Vegetation [Provisional]
Association (English name)	Saltmarsh Cordgrass - Saltgrass Tidal Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519)

GLOBAL DESCRIPTION

Concept Summary: This community represents low salt marsh vegetation dominated by the "short form" of *Spartina alterniflora* (smooth cordgrass) and *Distichlis spicata* (inland saltgrass), although the latter species may be somewhat less abundant. Diversity is exceedingly low, but some stands may be codominated by *Spartina patens* (saltmeadow cordgrass). Most occurrences of this community type are located in nonriverine, mesohaline marshes subject to regular, diurnal tides.

Environmental Description: Stands of this vegetation are located in mesohaline (5–18 ppt salinity), chiefly nonriverine marshes subject to regular, diurnal tides. The substrate typically consists of extremely dense, often firm, fibric peat rich in fine roots and rhizomes. This vegetation is documented from large estuaries that are somewhat more sheltered from storm overwash than similar vegetation of barrier island marshes.

Vegetation Description: This community is dominated by short-statured *Spartina alterniflora* (smooth cordgrass), generally much less than 1 m in height; *Distichlis spicata* (inland saltgrass) is a constant and typically codominant associate. *Spartina patens* (saltmeadow cordgrass) may attain moderate to high cover in some stands. Infrequent components of this vegetation include *Limonium carolinianum* (Carolina sealavender), *Schoenoplectus pungens* (common threesquare), *Iva frutescens* (Jesuit's bark), *Juncus roemerianus* (needlegrass rush), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Pluchea odorata* (sweetscent) and *Salicornia virginica* (Virginia glasswort). Species richness is very low, with an average of five species per 100 square meters.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Graminoid	<i>Distichlis spicata</i> (inland saltgrass), <i>Spartina alterniflora</i> (smooth cordgrass)

Characteristic Species: *Distichlis spicata* (inland saltgrass), *Spartina alterniflora* (smooth cordgrass).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Estuarine.

DISTRIBUTION

Range: This association has been documented from several, chiefly nonriverine sites on the eastern and western shores of the Chesapeake Bay in Maryland and Virginia.

States/Provinces: MD, VA.

Federal Lands: NPS (Colonial, George Washington Birthplace); USFWS (Chincoteague).

CONSERVATION STATUS

Rank: GNR (2-Jun-2007).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Provisional.

Confidence: 3 - Weak.

Comments: Stands of this vegetation generally occupy lower landscape positions than the typically adjacent high marsh represented by *Spartina patens* - *Distichlis spicata* - (*Juncus roemerianus*) Herbaceous Vegetation (CEGL004197) and are usually flooded daily. Salt pannes dominated by *Salicornia (virginica, bigelovii, maritima)* - *Spartina alterniflora* Herbaceous Vegetation (CEGL004308) may form at intermediate landscape positions, where salt concentrations are higher due to evaporation between less regular episodes of inundation, and hence halophytic forbs attain greater importance. This type is documented by 11 vegetation plots from Virginia and Maryland.

Similar Associations:

- *Salicornia (virginica, bigelovii, maritima)* - *Spartina alterniflora* Herbaceous Vegetation (CEGL004308)
- *Spartina patens* - *Distichlis spicata* - (*Juncus roemerianus*) Herbaceous Vegetation (CEGL004197)

Related Concepts: Information not available.

SOURCES

Description Authors: P. P. Coulling.

References: Coulling 2002, Eastern Ecology Working Group n.d.



Figure H15. Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) (plot GEWA.4) at George Washington Birthplace National Monument. September 2002. NAD 1983 / UTM easting 330784, northing 4229770.

COMMON NAME (PARK-SPECIFIC): TIDAL OLIGOHALINE MARSH (BIG CORDGRASS TYPE)

SYNONYMS

USNVC English Name: Giant Cordgrass Herbaceous Vegetation
USNVC Scientific Name: *Spartina cynosuroides* Herbaceous Vegetation
USNVC Identifier: C EGL004195

LOCAL INFORMATION

Environmental Description: Tidal Oligohaline Marsh (Big Cordgrass Type) occurs along a tidal creek, over a mucky substrate that receives regular tidal flooding. It occurs with species characteristic of oligohaline conditions where salt concentrations are between 0.5 and 5 ppt. It occurs adjacent to Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh).

Vegetation Description: This association is a dense, tidal, grassland dominated by *Spartina cynosuroides* (big cordgrass) in a virtually monospecific stand. Other low-cover species noted within this association include *Schoenoplectus robustus* (sturdy bulrush), *Kosteletzkya virginica* (Virginia saltmarsh mallow), and *Spartina alterniflora* (smooth cordgrass).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Graminoid	<i>Spartina cynosuroides</i> (big cordgrass)

Characteristic Species: *Spartina cynosuroides* (big cordgrass).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>Sname</u>	<u>Reference</u>
VA	SNR*	B	1	Tidal Oligohaline Marsh	Fleming et al. 2001

Local Range: This association was noted along Bridges Creek near its confluence with the Potomac River, but is not mapped separately. It is included in the map class Tidal Oligohaline Marsh, which is a composite of three associations.

Classification Comments: Information not available.

Other Comments: This is one of three associations included in the map class Tidal Oligohaline Marsh.

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace 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	Tidal temperate or subpolar grassland (V.A.5.N.n.)
Alliance	<i>Spartina cynosuroides</i> Tidal Herbaceous Alliance (A.1480)
Alliance (English name)	Giant Cordgrass Tidal Herbaceous Alliance

Association	<i>Spartina cynosuroides</i> Herbaceous Vegetation
Association (English name)	Giant Cordgrass Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Brackish Tidal Marsh (CES203.894) Central Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.376) Atlantic Coastal Plain Embayed Region Tidal Freshwater Marsh (CES203.259)

GLOBAL DESCRIPTION

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

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

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

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Graminoid	<i>Spartina cynosuroides</i> (big cordgrass)

Characteristic Species: *Spartina cynosuroides* (big cordgrass).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Estuarine.

DISTRIBUTION

Range: This association occurs along the Atlantic coast from New Jersey to Georgia.

States/Provinces: DE:S3?, GA, MA, MD:S4?, NC, NJ:S3, SC, VA.

Federal Lands: NPS (Cape Cod, Colonial, Fort Pulaski, George Washington Birthplace); USFWS (Back Bay, Chesapeake Marshlands).

CONSERVATION STATUS

Rank: G4 (13-Aug-1997).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

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

Similar Associations:

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

Related Concepts:

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

SOURCES

Description Authors: S. L. Neid.

References: Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1996, Coulling 2002, Fleming 2001, Fleming and Moorhead 1998, Fleming et al. 2001, Harrison 2001, Harrison 2004, Nelson 1986, Odum 1988, Odum and Smith 1981, Odum et al. 1984, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Southeastern Ecology Working Group n.d., Wharton 1978.

COMMON NAME (PARK-SPECIFIC): TIDAL OLIGOHALINE MARSH (MIXED FORBS TYPE)

SYNONYMS

USNVC English Name: Eastern Rosemallow - Dotted Smartweed - Green Arrow-arum
Tidal Herbaceous Vegetation

USNVC Scientific Name: *Hibiscus moscheutos* - *Polygonum punctatum* - *Peltandra virginica* Tidal Herbaceous Vegetation

USNVC Identifier: CEGLO06181

LOCAL INFORMATION

Environmental Description: Tidal Oligohaline Marsh (Mixed Forbs Type) includes vegetation along the upper reaches of tidal creeks in areas that have regular or irregular tidal flooding, as well as areas farther from tidal influence that are transitioning to a seasonally flooded or saturated hydrology, such as in the upper portions of ravines. In general, these areas are slightly brackish zones with species typical of oligohaline conditions where salt concentrations are between 0.5 and 5 ppt. Some areas mapped as this association have been cut off from regular tidal flooding by berms (natural or artificial) and have altered species composition with species more typical of saturated or seasonally flooded environments. Substrate is muck or peat, and there is often an accumulation of *Typha* (cattail) litter. This community can occur adjacent to Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) or Tidal Oligohaline Marsh (Common Reed Tidal Marsh).

Vegetation Description: This community includes dense herbaceous vegetation dominated by varying mixtures of *Typha angustifolia* (narrowleaf cattail), *Hibiscus moscheutos* (crimson-eyed rosemallow), and *Decodon verticillatus* (swamp loosestrife). Other species commonly found in this association include *Bidens coronata* (crowned beggarticks), *Boehmeria cylindrica* (smallspike false nettle), *Cyperus odoratus* (fragrant flatsedge), *Echinochloa walteri* (coast cockspur grass), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Pluchea odorata* (sweetscent), and *Polygonum punctatum* (dotted smartweed). Other species typical of tidal marshes that can occur at low frequency and abundance include *Carex hyalinolepis* (shoreline sedge), *Eleocharis fallax* (creeping spikerush), *Hydrocotyle* sp. (a hydrocotyle), *Leersia oryzoides* (rice cutgrass), *Panicum virgatum* (switchgrass), *Peltandra virginica* (green arrow arum), *Rumex verticillatus* (swamp dock), *Schoenoplectus robustus* (sturdy bulrush), *Spartina alterniflora* (smooth cordgrass), *Symphyotrichum subulatum* (eastern annual saltmarsh aster), *Symphyotrichum tenuifolium* (perennial saltmarsh aster), and *Zizania aquatica* (annual wildrice). Towards the heads of ravines, near the limits of tidal influence, there may be scattered emergent trees and shrubs such as *Acer rubrum* (red maple) and *Morella cerifera* (wax myrtle).

This community may be variously dominated by *Typha angustifolia* (narrowleaf cattail), *Hibiscus moscheutos* (crimson-eyed rosemallow), or *Decodon verticillatus* (swamp loosestrife). When these species occur as patch dominants, they may reflect different environmental or disturbance regimes. Areas cut off from regular tidal flooding or areas farther from the reach of tidal influence (upper stream reaches) will have a more seasonally flooded or saturated hydrology and are strongly dominated by *Decodon verticillatus* (swamp loosestrife). Areas with regular tidal flooding are more strongly dominated by *Hibiscus moscheutos* (crimson-eyed

rosemallow). Areas with more freshwater inputs or eutrophication will have dominance by *Typha angustifolia* (narrowleaf cattail).

Several of the dominant herbaceous species in this association are considered suffrutescent or suffruticose, thus, even though it is classed as "herbaceous," this association can have a shrubby appearance.

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Forb	<i>Decodon verticillatus</i> (swamp loosestrife), <i>Hibiscus moscheutos</i> (crimson-eyed rosemallow)
Herb (field)	Graminoid	<i>Typha angustifolia</i> (narrowleaf cattail)

Characteristic Species: *Hibiscus moscheutos* (crimson-eyed rosemallow), *Typha angustifolia* (narrowleaf cattail).

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Phragmites australis</i> (common reed)	-	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	1	Tidal Oligohaline Marsh	Fleming et al. 2001

Local Range: This association occurs along Bridge Creek, Digwood Swamp and in the upper reaches of Dancing Marsh. It is part of the composite map class Tidal Oligohaline Marsh, which includes three associations.

Classification Comments: Information not available.

Other Comments: This is one of three associations included in the map class Tidal Oligohaline Marsh.

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace National Monument Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial forb vegetation (V.B.)
Physiognomic Group	Temperate or subpolar perennial forb vegetation (V.B.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar perennial forb vegetation (V.B.2.N.)
Formation	Tidal temperate perennial forb vegetation (V.B.2.N.g.)
Alliance	<i>Peltandra virginica</i> - <i>Pontederia cordata</i> Tidal Herbaceous Alliance (A.1703)
Alliance (English name)	Green Arrow-arum - Pickerelweed Tidal Herbaceous Alliance
Association	<i>Hibiscus moscheutos</i> - <i>Polygonum punctatum</i> - <i>Peltandra virginica</i> Tidal Herbaceous Vegetation
Association (English name)	Eastern Rosemallow - Dotted Smartweed - Green Arrow-arum Tidal Herbaceous Vegetation

Ecological System(s): Northern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.516)

GLOBAL DESCRIPTION

Concept Summary: This association is a diverse oligohaline marsh characterized by variable dominance of species found in the Chesapeake and Delaware bays. Species that form locally dominant patches can include *Polygonum arifolium* (halberdleaf tearthumb), *Hibiscus moscheutos* ssp. *moscheutos* (crimson-eyed rosemallow), *Polygonum punctatum* (dotted smartweed), *Peltandra virginica* (green arrow arum), *Leersia oryzoides* (rice cutgrass), *Polygonum sagittatum* (arrowleaf tearthumb), *Mikania scandens* (climbing hempvine), *Spartina cynosuroides* (big cordgrass), and *Toxicodendron radicans* (eastern poison ivy), among others. All of these species are able to tolerate a broad range of halinity, and the high mean species richness of this type suggests that it is generally restricted to only slightly oligohaline habitats. *Typha angustifolia* (narrowleaf cattail) and *Spartina cynosuroides* (big cordgrass) often form large dominance patches. Infrequently present are several species that are more specific to oligohaline conditions, including *Echinochloa walteri* (coast cockspur grass), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Pluchea odorata* (sweetscent), *Rumex verticillatus* (swamp dock), *Sagittaria lancifolia* (bulltongue arrowhead), and *Teucrium canadense* (Canada germander). The colonial sedge *Carex stricta* sometimes forms local dominance patches, characteristically on hummocks raised 20–25 cm above the primary marsh surface.

Environmental Description: Most stands are located near the edge of an extensive marsh but set by the main river channel and often bordered by scattered clumps of shrubs. There is often hummock-and-hollow microtopography.

Vegetation Description: These are diverse oligohaline marshes characterized by variable dominance patterns but generally containing *Polygonum arifolium* (halberdleaf tearthumb), *Hibiscus moscheutos* ssp. *moscheutos* (crimson-eyed rosemallow), *Polygonum punctatum* (dotted smartweed), *Peltandra virginica* (green arrow arum), *Leersia oryzoides* (rice cutgrass), *Polygonum sagittatum* (arrowleaf tearthumb), *Mikania scandens* (climbing hempvine), and *Toxicodendron radicans* (eastern poison ivy). *Bidens laevis* (smooth beggartick), *Cicuta maculata* (spotted water hemlock), *Cuscuta* sp. (a dodder), *Impatiens capensis* (jewelweed), *Lycopus americanus* (American water horehound), and *Sagittaria latifolia* (broadleaf arrowhead), and graminoids such as *Typha latifolia* (broadleaf cattail) and *Schoenoplectus fluviatilis* (river bulrush) may also be present at variable cover. *Typha angustifolia* (narrowleaf cattail) and *Spartina cynosuroides* (big cordgrass) may form extensive dominance patches. All of these species are able to tolerate a broad range of halinity, and the high mean species richness of this type suggests that it is generally restricted to only slightly oligohaline habitats. Infrequently present are several species that are more specific to oligohaline conditions, including *Echinochloa walteri* (coast cockspur grass), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Pluchea odorata* (sweetscent), *Rumex verticillatus* (swamp dock), *Sagittaria lancifolia* (bulltongue arrowhead), and *Teucrium canadense* (Canada germander). *Spartina cynosuroides* (big cordgrass) occurs in approximately two-thirds of the representative vegetation sample plots and at times codominates. The colonial sedge *Carex stricta* (upright sedge) often forms local dominance patches, characteristically on hummocks raised 20–25 cm above the primary marsh surface. Such stands also characteristically contain scattered individuals of *Rosa palustris* (swamp rose) or *Cephalanthus occidentalis* (common buttonbush).

Most Abundant Species: Information not available.

Characteristic Species: *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow), *Leersia oryzoides* (rice cutgrass), *Mikania scandens* (climbing hempvine), *Peltandra virginica* (green arrow arum), *Polygonum arifolium* (halberdleaf tearthumb), *Polygonum punctatum* (dotted smartweed), *Polygonum sagittatum* (arrowleaf tearthumb), *Spartina cynosuroides* (big cordgrass), *Toxicodendron radicans* (eastern poison ivy).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Estuarine.

DISTRIBUTION

Range: This association is currently described from Virginia, Maryland, and New Jersey.

States/Provinces: MD, NJ, VA.

Federal Lands: NPS (Colonial, George Washington Birthplace); USFWS (Chesapeake Marshlands).

CONSERVATION STATUS

Rank: GNR (12-May-2002).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

Comments: In Virginia, occurrences are known from the Mattaponi (New and Gleason marshes), Pamunkey (Sweet Hall, Cousiac, and Cohoke marshes), and Rappahannock (Otterburn Marsh) rivers. In Maryland, an occurrence documented from the Pocomoke River (Cypress Swamp) is currently attributed to this type. In New Jersey, an occurrence is known from Rancocas Creek.

Similar Associations:

- *Impatiens capensis* - *Peltandra virginica* - *Polygonum arifolium* - *Schoenoplectus fluviatilis* - *Typha angustifolia* Tidal Herbaceous Vegetation (CEGL006325).

Related Concepts:

- *Hibiscus moscheutos* - *Polygonum arifolium* - *Leersia oryzoides* - (*Carex stricta*) Tidal Herbaceous Vegetation (Coulling 2002) ?
- *Hibiscus moscheutos* - *Polygonum punctatum* - *Peltandra virginica* - (*Typha angustifolia*) - (*Spartina cynosuroides*) Herbaceous Vegetation (Coulling 2002) =
- *Osmunda regalis* - *Rosa palustris* Herbaceous Vegetation (Bartgis 1986) ?

SOURCES

Description Authors: S. L. Neid, mod. L. A. Sneddon.

References: Bartgis 1986, Coulling 2002, Eastern Ecology Working Group n.d., Fleming et al. 2004, Harrison 2004, J. Harrison pers. comm., New Jersey Department of Environmental Protection 2001, Strakosch Walz et al. 2006.



Figure H16. Tidal Oligohaline Marsh (Mixed Forbs Type) at George Washington Birthplace National Monument. July 2004. NAD 1983 / UTM easting 331895, northing 4228441.

COMMON NAME (PARK-SPECIFIC): DISTURBED CALCAREOUS FOREST

SYNONYMS

USNVC English Name: Not applicable

USNVC Scientific Name: Not applicable

USNVC Identifier: Nonstandard

LOCAL INFORMATION

Environmental Description: Highly disturbed forests fringing rivers, ponds and marshes, over various soil types. These forests are narrow, linear features, occurring on short, steep slopes of all aspects. They are strips of forest that remained or regenerated on the slopes after development or clearing, occurring between a natural wetland and agricultural fields or developed areas. Some examples may be as narrow as 8 m. Soils often have shell fragments on the surface.

Vegetation Description: Disturbed Calcareous Forest is a broad-leaved deciduous forest, although some examples may have high cover of evergreen species in the subcanopy. Structure can vary from a well-developed forest to a short-statured, shrubby forest. Species composition varies from stand to stand, but the most common trees are *Celtis occidentalis* (common hackberry), *Juniperus virginiana* var. *virginiana* (eastern redcedar), and *Liquidambar styraciflua* (sweetgum). Other trees can include *Carya cordiformis* (bitternut hickory), *Gleditsia triacanthos* (honeylocust), *Juglans nigra* (black walnut), *Prunus serotina* var. *serotina* (black cherry), *Quercus falcata* (southern red oak), *Quercus phellos* (willow oak), and *Robinia pseudoacacia* (black locust). The subcanopy and shrub layers can be locally dominated by *Asimina triloba* (pawpaw) or *Ilex opaca* var. *opaca* (American holly) but are usually dominated by vines of *Parthenocissus quinquefolia* (Virginia creeper) and *Lonicera japonica* (Japanese honeysuckle). Herbs are variable in dominance and cover. Some species noted include *Circaea lutetiana* (broadleaf enchanter's nightshade), *Elymus virginicus* (Virginia wildrye), *Hypericum punctatum* (spotted St. Johnswort), *Leersia virginica* (whitegrass), *Lysimachia nummularia* (creeping jenny), *Phryma leptostachya* (American lopseed), *Sanicula canadensis* (Canadian blacksnakeroot), *Teucrium canadense* (Canada germander), and *Verbesina alternifolia* (wingstem). Near tidal creeks this forest may have *Baccharis halimifolia* (eastern baccharis), *Phragmites australis* (common reed), *Toxicodendron radicans* (eastern poison ivy), and *Campsis radicans* (trumpet creeper).

Most Abundant Species: Information not available.

Characteristic Species: Information not available.

Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Asimina triloba</i> (pawpaw)	-	plant	presence may indicate calcareous soils
<i>Carya cordiformis</i> (bitternut hickory)	-	plant	presence may indicate calcareous soils
<i>Celtis occidentalis</i> (common hackberry)	-	plant	presence may indicate calcareous soils
<i>Gleditsia triacanthos</i> (honeylocust)	-	plant	presence may indicate calcareous soils
<i>Juglans nigra</i> (black walnut)	-	plant	presence may indicate calcareous soils

<i>Juniperus virginiana</i> var. <i>virginiana</i> (eastern redcedar)	-	plant	presence may indicate calcareous soils
<i>Lonicera japonica</i> (Japanese honeysuckle)	-	plant	invasive nonnative
<i>Lysimachia nummularia</i> (creeping jenny)	-	plant	nonnative
<i>Phragmites australis</i> (common reed)	-	plant	invasive nonnative
<i>Teucrium canadense</i> (Canada germander)	-	plant	nonnative
<i>Verbesina alternifolia</i> (wingstem)	-	plant	nonnative

Subnational Distribution with Crosswalk Data:

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

Local Range: Disturbed Calcareous Forest is mapped as seven polygons ranging in size from 0.06 to 2.4 hectares (0.14 to 5.9 acres) and covering a total of 6.3 hectares (15.6 acres). It is found on slopes over Bridges Creek and around the pond at Bridges Landing. Small areas are mapped on the slopes over Longwood Swamp and Pope's Creek.

Classification Comments: Polygons tagged to this map class are too disturbed to classify to a natural community. They may represent very disturbed stands of the rare community Coastal Plain Dry Calcareous Forest but are too disturbed to have the representative species composition.

Other Comments: Information not available.

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace National Monument Inventory Notes: All polygons mapped as Disturbed Calcareous Forest were observed in the field.

GLOBAL INFORMATION

Disturbed Calcareous Forest is a park-specific, nonstandard type and has no global information.

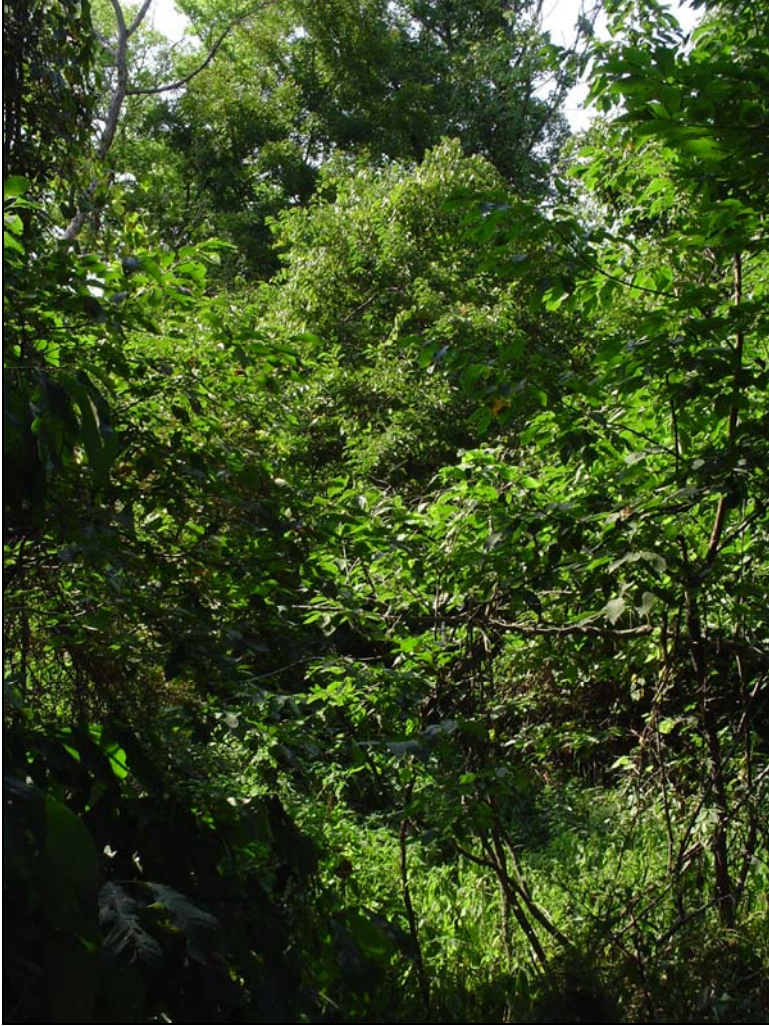


Figure H17. Disturbed Calcareous Forest at George Washington Birthplace National Monument. August 2007. NAD 1983 / UTM easting 331108, northing 4229830. Photo by Rijk Morawe.

COMMON NAME (PARK-SPECIFIC): SEMIPERMANENT IMPOUNDMENT

SYNONYMS

USNVC English Name: Not applicable

USNVC Scientific Name: Not applicable

USNVC Identifier: Nonstandard

LOCAL INFORMATION

Environmental Description: Semipermanent Impoundments are wetlands associated with persistent man-made impoundments and ditching. Semipermanent Impoundments at George Washington Birthplace National Monument include an anthropogenic pond at the upper reaches of Dancing Marsh and the associated disturbed wetland south of the pond that extends outside the park boundary. The pond is in a natural drainageway that was artificially deepened and dammed in the past. The hydrology is permanently flooded. The associated vegetation across the road is semipermanently to permanently flooded and may have been disturbed by ditching.

Vegetation Description: Vegetation in the pond is dominated by the floating aquatic *Nuphar lutea* ssp. *advena* (yellow pond-lily), with less cover by *Lemna valdiviana* (valdivia duckweed). Plants are interspersed with areas of open water. Other aquatic species, such as *Sagittaria latifolia* (broadleaf arrowhead), are rooted around the pond margins. Vegetation in the disturbed wetland across the road from the pond is dominated by the grass *Zizania aquatica* (annual wildrice), occurring with other wetland and weedy herbs. Other species noted include *Carex crinita* (fringed sedge), *Commelina communis* (Asiatic dayflower), *Cyperus strigosus* (strawcolored flatsedge), *Eclipta prostrata* (false daisy), *Impatiens capensis* (jewelweed), *Juncus effusus* (common rush), and *Onoclea sensibilis* (sensitive fern).

Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Graminoid	<i>Zizania aquatica</i> (annual wildrice)
Floating aquatic	Aquatic herb (floating & submergent)	<i>Nuphar lutea</i> ssp. <i>advena</i> (yellow pond-lily)

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: Semipermanent Impoundment is mapped as two polygons separated by a road. The polygons are both below minimum mapping unit (0.5 ha). The pond covers 0.3 hectare (0.7 acre), and the disturbed wetland extends beyond the park boundary covering a total of 0.25 hectare (0.6 acre). It occurs in the very upper reaches of the drainage that flows into Dancing Marsh.

Classification Comments: This vegetation may have once been part of a natural freshwater marsh but has been highly disturbed within an agricultural landscape. It is not tidal. *Nuphar lutea* ssp. *advena* (yellow pond-lily) and *Zizania aquatica* (annual wildrice) can occur as a part of natural freshwater tidal wetlands.

Other Comments: These areas may have once been natural freshwater tidal wetlands and still have some native species components of these natural communities.

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace National Monument Inventory Notes: All polygons mapped as Semipermanent Impoundment were observed in the field.

GLOBAL INFORMATION

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



Figure H18. Semipermanent Impoundment at George Washington Birthplace National Monument. August 2007. NAD 1983 / UTM easting 331749, northing 4228094. Photo by Rijk Morawe.

COMMON NAME (PARK-SPECIFIC): BEACHES

SYNONYMS

USNVC English Name: Not applicable

USNVC Scientific Name: Not applicable

USNVC Identifier: Not applicable

LOCAL INFORMATION

Local Range: This map class includes accumulations of sand along shorelines. It is equal to the Anderson (1976) Level II unit 72 - Beaches.

Classification Comments: This map class includes accumulations of sand along shorelines. Beaches may grade into the map classes Tidal Shrub Swamp (Iva Type) and Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh) and have small areas of shrubby or sparse vegetation. Species noted in this map class include *Amorpha fruticosa* (desert false indigo), *Atriplex patula* (spear saltbush), *Chamaesyce polygonifolia* (seaside sandmat), *Solidago sempervirens* (seaside goldenrod), and *Spartina patens* (saltmeadow cordgrass). The Beach map class is equal to the Anderson (1976) Level II unit 72 - Beaches.

Other Comments: Information not available.

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace National Monument Inventory Notes: Information not available.

Citation: Anderson et al. 1976.

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

SYNONYMS

USNVC English Name: Not applicable

USNVC Scientific Name: Not applicable

USNVC Identifier: Not applicable

LOCAL INFORMATION

Local Range: Other Urban or Built-up Land is mapped throughout the park and includes maintenance facilities, the water tower, a cemetery, picnic grounds, park offices and housing, the visitor's center, historic buildings, and farm buildings and grounds.

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

Other Comments: The comment field in the vegetation map attribute table indicates if a polygon represents a forested developed area, a cemetery, or water tower.

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace 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: The Transportation, Communications, and Utilities class is mapped on the western portion of the Park.

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

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

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace National Monument Inventory Notes: Information not available.

Citation: Anderson et al. 1976.

COMMON NAME (PARK-SPECIFIC): WATER

SYNONYMS

USNVC English Name: Not applicable

USNVC Scientific Name: Not applicable

USNVC Identifier: Not applicable

LOCAL INFORMATION

Local Range: Water is mapped as a pond near Bridges Landing and a pond and open water on Pope's Creek near Longwood Swamp.

Classification Comments: This map class includes large areas of open water, including ponds and open water areas of Pope's Creek. This map class is equal to the Anderson (1976) Level II units 54 - Bays and Estuaries, and 53 - Reservoirs.

Other Comments: The comment field in the vegetation map attribute table indicates if a polygon represents a pond.

Local Description Authors: K. D. Patterson.

Plots: None.

George Washington Birthplace National Monument Inventory Notes: Information not available.

Citation: Anderson et al. 1976.

Literature cited in the global vegetation descriptions.

- ALNHP [Alabama Natural Heritage Program]. 2002. Eufaula National Wildlife Refuge: Natural community and rare plant survey. Alabama Natural Heritage Program, The Nature Conservancy. Montgomery.
- Allard, D. J. 1990. Southeastern United States ecological community classification. Interim report, Version 1.2. The Nature Conservancy, Southeast Regional Office. Chapel Hill, NC. 96 pp.
- Ambrose, J. 1990a. Georgia's natural communities--A preliminary list. Unpublished document. Georgia Natural Heritage Inventory. 5 pp.
- Andreu, M. G., and M. L. Tukman. 1995. Forest communities of the Tellico Lake Area, East Tennessee. M.F. project report, Duke University, School of the Environment. Durham, NC. 66 pp. plus appendices.
- Au, S. 1974. Vegetation and ecological processes on Shackleford Bank, North Carolina. USDI National Park Service. Scientific Monograph No. 6.
- Baalman, R. J. 1965. Vegetation of the Salt Plains National Wildlife Refuge, Jet, Oklahoma. Unpublished Ph.D. dissertation. University of Oklahoma, Norman.
- Barry, J. F. 1980. Natural vegetation of South Carolina. University of South Carolina Press. Columbia. 214 pp.
- Bartgis, R. 1986. Natural community descriptions. Unpublished draft. Maryland Natural Heritage Program, Maryland Department of Natural Resources. Annapolis.
- Bell, R., M. Chandler, R. Buchsbaum, and C. Roman. 2002. Inventory of intertidal habitats: Boston Harbor Islands, a National Park area. Technical Report NPS/NERBOST/NRTR-2004/1. USDI National Park Service, Northeast Region. Boston, MA. 13 pp.
- Berdine, M. A. 1998. Maryland vegetation classification. Maryland Department of Natural Resources. Annapolis.
- Boule, M. E. 1979. The vegetation of Fisherman Island, Virginia. *Castanea* 44:98–108.
- Bowen, B., M. Pyne, and D. Withers. 1995. An ecological survey of selected tracts in the Tennessee River Gorge: A report to the Tennessee River Gorge Trust. Tennessee Natural Heritage Program, Department of Environment and Conservation. Nashville. 100 pp.
- Bowman, P. 2000. Draft classification for Delaware. Unpublished draft. Delaware Natural Heritage Program.

- Breden, T. F. 1989. A preliminary natural community classification for New Jersey. Pages 157–191 in E. F. Karlin, editor. *New Jersey's rare and endangered plants and animals*. Institute for Environmental Studies, Ramapo College. Mahwah, NJ. 280 pp.
- Breden, T. F., Y. R. Alger, K. S. Walz, and A. G. Windisch. 2001. Classification of vegetation communities of New Jersey: Second iteration. Association for Biodiversity Information and New Jersey Natural Heritage Program, Office of Natural Lands Management, Division of Parks and Forestry, New Jersey Department of Environmental Protection. Trenton.
- Burns, R. M., and B. H. Honkala, technical coordinators. 1990b. *Silvics of North America*. Volume 2: Hardwoods. Agriculture Handbook 654. USDA Forest Service. Washington, DC. 877 pp.
- CAP [Central Appalachian Forest Working Group]. 1998. Central Appalachian Working group discussions. The Nature Conservancy. Boston, MA.
- Cain, M. D., and M. G. Shelton. 1994. Indigenous vegetation in a southern Arkansas pine-hardwood forest after a half century without catastrophic disturbances. *Natural Areas Journal* 14:165–174.
- Campbell, J. J. N. 1980. Present and presettlement forest conditions in the Inner Bluegrass region of Kentucky. Ph.D. dissertation. University of Kentucky, Lexington. 109 pp. [Excerpts only].
- Campbell, J. J. N. 1989b. Historical evidence of forest composition in the Bluegrass Region of Kentucky. Pages 231–246 in *Proceedings of the Seventh Central Hardwood Forest Conference*. Southern Illinois University. Carbondale.
- Clancy, K. 1993b. A preliminary classification of the natural communities of Delaware. Unpublished draft. Delaware Natural Heritage Inventory, Division of Parks and Recreation. Dover. 30 pp.
- Clancy, K. 1996. Natural communities of Delaware. Unpublished review draft. Delaware Natural Heritage Program, Division of Fish and Wildlife, Delaware Division of Natural Resources and Environmental Control. Smyrna, DE. 52 pp.
- Clark, J. S. 1986. Vegetation and land-use history of the William Floyd Estate, Fire Island National Seashore, Long Island, New York. USDI, National Park Service, North Atlantic Region, Office of Scientific Studies. 126 pp.
- Collins, B. R., and K. H. Anderson. 1994. *Plant communities of New Jersey*. Rutgers University Press. New Brunswick, NJ. 287 pp.

- Coulling, P. P. 2002. A preliminary classification of tidal marsh, shrub swamp, and hardwood swamp vegetation and assorted non-tidal, chiefly non-maritime, herbaceous wetland communities of the Virginia Coastal Plain. October 2002. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Natural Heritage Technical Report 02-18. 30 pp.
- Coulling, Phil. Personal communication. Vegetation Ecologist. Department of Conservation & Recreation, 217 Governor St., Richmond, VA 23219.
- Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, Biological Service Program. FWS/OBS-79/31. Washington, DC. 103 pp.
- Crites, G. D., and E. E. C. Clebsch. 1986. Woody vegetation in the inner Nashville Basin: An example from the Cheek Bend area of the central Duck River valley. *ASB Bulletin* 33:167–177.
- Daiber, F. C., L. L. Thornton, K. A. Bolster, T. G. Campbell, O. W. Crichton, G. L. Esposito, D. R. Jones, and J. M. Tyrawski. 1976. An atlas of Delaware's wetlands and estuarine resources. College of Marine Studies, University of Delaware. Newark. 528 pp.
- Diamond, D. D. 1993. Classification of the plant communities of Texas (series level). Unpublished document. Texas Natural Heritage Program. Austin. 25 pp.
- Diggs, G. M., Jr., B. L. Lipscomb, and R. J. O'Kennon. 1999. *Shinners & Mahler's Illustrated Flora of North Central Texas*. Botanical Research Institute of Texas. Fort Worth. 1626 pp.
- Dowhan, J. J., and R. Rozsa. 1989. Flora of Fire Island, Suffolk County, New York. *Bulletin of the Torrey Botanical Club* 116:265–282.
- Doyle, K. M., and D. J. Allard. 1990. Applying an ecosystem classification on national forest land in the southeastern United States: A pilot study. 108 pp. plus appendices.
- Eastern Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe. Boston, MA.
- Edinger, G. J., D. J. Evans, S. Gebauer, T. G. Howard, D. M. Hunt, and A. M. Olivero, editors. 2002. Ecological communities of New York state. Second edition. A revised and expanded edition of Carol Reschke's ecological communities of New York state. (Draft for review). New York Natural Heritage Program, New York State Department of Environmental Conservation. Albany, NY.
- Ehrenfeld, J. G. 1977. Vegetation of Morristown National Historical Park: Ecological analysis and management alternatives. Final Report. USDI National Park Service Contract No. 1600-7-0004. 166 pp.

- Ehrenfeld, J. G., and M. Gulick. 1981. Structure and dynamics of hardwood swamps in the New Jersey Pine Barrens: Contrasting patterns in trees and shrubs. *American Journal of Botany* 68:471–481.
- Eleuterius, L. N. 1972. The marshes of Mississippi. *Castanea* 37:153–168.
- Elias, T. B. 1980. The complete trees of North America, field guide and natural history. Book Division, Times Mirror Magazines, Inc. 948 pp.
- Elliman, T. 2003. Boston Harbor Islands plant communities. Report submitted to Massachusetts Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife. Westborough.
- Enser, R. 1999. Natural communities of Rhode Island. Unpublished draft, December 1999. 22 pp.
- Evans, M. 1991. Kentucky ecological communities. Draft report to the Kentucky Nature Preserves Commission. 19 pp.
- Eyre, F. H., editor. 1980. Forest cover types of the United States and Canada. Society of American Foresters. Washington, DC. 148 pp.
- FNAI [Florida Natural Areas Inventory]. 1992a. Natural communities. Unpublished document. The Nature Conservancy, Florida Natural Areas Inventory. Tallahassee. 6 pp.
- FNAI [Florida Natural Areas Inventory]. 1992b. Natural community classification. Unpublished document. The Nature Conservancy, Florida Natural Areas Inventory. Tallahassee. 16 pp.
- Faber-Langendoen, D., and Midwest State Natural Heritage Program Ecologists. 1996. Terrestrial vegetation of the midwest United States. International classification of ecological communities: Terrestrial vegetation of the United States. The Nature Conservancy. Arlington, VA.
- Farnum, P., R. Timmis, and J. L. Kulp. 1983. Biotechnology of forest yield. *Science* 219:694–702.
- Felix, A. C., III, T. L. Sharik, B. S. McGinnes, and W. C. Johnson. 1983. Succession in loblolly pine plantations converted from second growth forest in the central Piedmont of Virginia. *The American Midland Naturalist* 110:365–380.
- Fike, J. 1999. Terrestrial and palustrine plant communities of Pennsylvania. Pennsylvania Natural Diversity Inventory. Pennsylvania Department of Conservation and Recreation. Bureau of Forestry. Harrisburg, PA. 86 pp.
- Fleming, G. P. 1998. Virginia natural community framework, version January 30, 1998. Unpublished document. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond. 6 pp.

- Fleming, G. P. 2001. Community types of Coastal Plain calcareous ravines in Virginia. Preliminary analysis and classification. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, VA. 4 pp.
- Fleming, G. P. No date. Unpublished data. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, VA.
- Fleming, G. P., P. P. Coulling, D. P. Walton, K. M. McCoy, and M. R. Parrish. 2001. The natural communities of Virginia: Classification of ecological community groups. First approximation. Natural Heritage Technical Report 01-1. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, VA. Unpublished report. January 2001. 76 pp.
- Fleming, G. P., P. P. Coulling, K. D. Patterson, and K. M. McCoy. 2004. The natural communities of Virginia: Classification of ecological community groups. Second approximation. Natural Heritage Technical Report 04-01. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, VA. <http://www.dcr.virginia.gov/dnh/ncintro.htm>.
- Fleming, G. P., and P. P. Coulling. 2001. Ecological communities of the George Washington and Jefferson national forests, Virginia. Preliminary classification and description of vegetation types. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, VA. 317 pp.
- Fleming, G. P., and W. H. Moorhead, III. 1998. Comparative wetlands ecology study of the Great Dismal Swamp, Northwest River, and North Landing River in Virginia. Natural Heritage Technical Report 98-9. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond. Unpublished report submitted to the U.S. Environmental Protection Agency. 181 pp. plus appendices.
- Fleming, Gary P. Personal communication. Ecologist. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, VA.
- Foti, T., M. Blaney, X. Li, and K. G. Smith. 1994. A classification system for the natural vegetation of Arkansas. Proceedings of the Arkansas Academy of Science 48:50–53.
- Foti, T., compiler. 1994b. Natural vegetation classification system of Arkansas, draft five. Unpublished document. Arkansas Natural Heritage Commission. Little Rock. 8 pp.
- Foti, Tom . Personal communication. Ecologist. Arkansas Natural Heritage Commission. Little Rock.
- Fowells, H. A, compiler. 1965. Silvics of the forest trees of the United States. Agriculture Handbook No. 271. USDA Forest Service. Washington, DC. 762 pp.
- Funk, V. A. 1975. A floristic and geologic survey of selected seeps in Calloway County, Kentucky. M.S. thesis. Murray State University. Murray, KY. 84 pp.

- Funk, V. A., and M. J. Fuller. 1978. A floristic survey of the seeps of Calloway County, Kentucky. *Castanea* 43:162–172.
- Gaertner, F. 1955. Honeylocust (*Gleditsia triacanthos* L.) in field shelterbelts of western Oklahoma. Unpublished M.S. thesis. Oklahoma State University. Stillwater.
- Gallyoun, M., G. Meyer, A. Andreu, and W. Slocumb. 1996. Mapping vegetation communities with The Nature Conservancy's vegetation classification system on five small national parks in the southeastern USA. Unpublished report. The Nature Conservancy, Southeast Regional Office, Conservation Science Department. Chapel Hill, NC.
- Golet, F. C., A. J. K. Calhoun, W. R. DeRagon, D. J. Lowry, and A. J. Gold. 1993. Ecology of red maple swamps in the glaciated Northeast: A community profile. USDI Fish & Wildlife Service. Washington, DC. 151 pp.
- Good, R. E. 1965. Salt marsh vegetation, Cape May, New Jersey. *Bulletin of the New Jersey Academy of Science* 10:1–11.
- Harcombe, P. A., and J. E. Neaville. 1977. Vegetation types of Chambers County, Texas. *The Texas Journal of Science* 29:209–234.
- Harrison, J. W. 2001. Herbaceous tidal wetland communities of Maryland's eastern shore: Identification, assessment and monitoring. Report submitted to the U.S. EPA (Clean Water Act 1998 State Wetlands Protection Development Grant Program). Biodiversity Program, Maryland Department of Natural Resources, Wildlife and Heritage Division. 30 June 2001. [U.S. EPA Reference Wetland Natural communities of Maryland's Herbaceous Tidal Wetlands Grant #CD993724].
- Harrison, J. W., and P. Stango, III. 2003. Shrubland tidal wetland communities of Maryland's Eastern Shore: Identification, assessment and monitoring. Maryland Natural Heritage Program, Maryland Department of Natural Resources. Annapolis. 118 pp.
- Harrison, J. W., compiler. 2004. Classification of vegetation communities of Maryland: First iteration. A subset of the International Classification of Ecological Communities: Terrestrial Vegetation of the United States, NatureServe. Maryland Natural Heritage Program, Maryland Department of Natural Resources. Annapolis. 243 pp.
- Harrison, Jason W. Personal communication. State Community Ecologist. Maryland Wildlife and Heritage Division, Department of Natural Resources, Tawes State Office Building, E-1, Annapolis, MD 21401.
- Harvill, A. M., Jr. 1967. The vegetation of Assateague Island, Virginia. *Castanea* 32:105–108.
- Heckscher, S. 1994. The vegetation of the Glades Region, Cumberland County, New Jersey. *Bartonia* 58:101–113.
- Higgins, E. A. T., R. D. Rappleye, and R. G. Brown. 1971. The flora and ecology of Assateague Island. University of Maryland Experiment Station Bulletin A-172. 70 pp.

- Hill, S. R. 1986. An annotated checklist of the vascular flora of Assateague Island (Maryland and Virginia). *Castanea* 5:265–305.
- Hillestad, H. O., J. R. Bozeman, A. S. Johnson, C. W. Berisford, and J. I. Richardson. 1975. The ecology of the Cumberland Island National Seashore, Camden County, Georgia. Technical Report Series No. 75-5. Georgia Marine Sciences Center. Skidway Island.
- Hoagland, B. 2000. The vegetation of Oklahoma: A classification for landscape mapping and conservation planning. *The Southwestern Naturalist* 45(4):385–420.
- Hoagland, B. W. 1997. Preliminary plant community classification for Oklahoma. Unpublished draft document, version 35629. University of Oklahoma, Oklahoma Natural Heritage Inventory. Norman. 47 pp.
- Hoagland, B. W. 1998a. Classification of Oklahoma vegetation types. Working draft. University of Oklahoma, Oklahoma Natural Heritage Inventory. Norman. 43 pp.
- Hosier, P. E. 1975. Dunes and marsh vegetation. Pages D3–D45 in W. M. Campbell and J. M. Dean, directors. Environmental inventory of Kiawah Island. Environmental Research Center, Inc. Columbia, SC.
- Hunter, M. L., Jr. 1990. Wildlife, forests, and forestry: Principles of managing forests for biological diversity. Prentice Hall Career & Technology. Englewood Cliffs, NJ. 370 pp.
- INAI [Iowa Natural Areas Inventory]. No date. Vegetation classification of Iowa. Iowa Natural Areas Inventory, Iowa Department of Natural Resources. Des Moines.
- Jones, S. M., D. H. Van Lear, and S. K. Cox. 1981b. Major forest community types of the Savannah River Plant: A field guide. USDE Savannah River Plant, National Environmental Research Park Program. Report No. SRO-NERP-9. 79 pp. plus 24 illustrations.
- Keever, C. 1979. Mechanisms of plant succession on old fields of Lancaster County, Pennsylvania. *Bulletin of the Torrey Botanical Club* 106(4):299–308.
- Klemas, V., F. C. Daiber, D. S. Bartlett, O. W. Crichton, and A. O. Fornes. 1973. Coastal vegetation of Delaware. University of Delaware, College of Marine Studies. 27 pp.
- Klimas, C. V. 1988b. Forest vegetation of the leveed floodplain of the lower Mississippi River. U.S. Army Corps of Engineers, Waterways Experimental Station, Lower Mississippi River Environmental Program. Report No. 11. Vicksburg, MS. 281 pp.
- Klotz, L. H. 1986. The vascular flora of Wallops Island and Wallops Mainland, Virginia. *Castanea* 51:306–326.
- Kurz, H., and K. Wagner. 1957. Tidal marshes of the Gulf and Atlantic coasts of northern Florida and Charleston, South Carolina. Florida State University Studies, No. 24. Tallahassee, FL. 168 pp.

- Marks, M., B. Lapin, and J. Randall. 1994. *Phragmites australis* (*P. communis*): Threats, management, and monitoring. *Natural Areas Journal* 14(4):285–294.
- Martin, D. L., and L. M. Smith. 1991. A survey and description of the natural plant communities of the Kisatchie National Forest, Winn and Kisatchie districts. Louisiana Department of Wildlife and Fisheries. Baton Rouge, LA. 372 pp.
- Martin, D. L., and L. M. Smith. 1993. A survey and description of the natural plant communities of the Kisatchie National Forest, Evangeline and Catahoula districts. Louisiana Department of Wildlife and Fisheries. Baton Rouge. 274 pp.
- Martin, W. E. 1959b. The vegetation of Island Beach State Park, New Jersey. *Ecological Monographs* 29:1–46.
- McCormick, J. 1979. The vegetation of the New Jersey Pine Barrens. *In* R. T. T. Formann, editor. *Pine Barrens: Ecosystem and landscape*. Academic Press. NY.
- McCormick, J., and H. A. Somes, Jr. 1982. The coastal wetlands of Maryland. Unpublished report to Maryland Department of Natural Resources, Coastal Zone Management Program. Jack McCormick and Associates. Chevy Chase, MD.
- McDonald, A. 1938. Erosion and its control in Oklahoma Territory. Miscellaneous Publication 301, U.S. Department of Agriculture. Washington, DC.
- Mercer, J. L. 1978. Westmoreland County Tidal Marsh Inventory. Special Report No. 59 in *Applied Marine Science and Ocean Engineering*. Virginia Institute of Marine Science. Gloucester Point, VA. 108 pp.
- Metzler, K. J., and J. Barrett. 1992. Connecticut community classification. Unpublished draft. Connecticut Department of Environmental Protection, Natural Resources Center, Natural Diversity Database. Hartford.
- Metzler, K. J., and J. P. Barrett. 2001. Vegetation classification for Connecticut. Draft 5/21/2001. Connecticut Department of Environmental Protection, Natural Resources Center, Natural Diversity Database. Hartford.
- Metzler, K., and J. Barrett. 1996. Vegetation classification for Connecticut organized into the modified UNESCO hierarchy. Unpublished review draft. Connecticut Natural Diversity Database. Hartford, CT. 48 pp.
- Metzler, K., and R. Rosza. 1982. Vegetation of fresh and brackish tidal marshes in Connecticut. *Newsletter of the Connecticut Botanical Society* 10(1):1–3.
- Midwestern Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe. Minneapolis, MN.

- Monk, C. D., D. W. Imm, R. L. Potter, and G. G. Parker. 1989. A classification of the deciduous forest of eastern North America. *Vegetatio* 80:167–181.
- Montague, C. L., and R. G. Wiegert. 1990. Salt marshes. Pages 481–516 *in* R. L. Myers and J. J. Ewel, editors. *Ecosystems of Florida*. University of Central Florida Press. Orlando.
- Moorhead, D. J., C. W. Dangerfield, Jr., and J. R. Beckwith, III. 1998. Opportunities for intensive pine plantation management. The Entomology and Forest Resources Digital Information Work Group, College of Agricultural and Environmental Sciences and Warnell School of Forest Resources, The University of Georgia, Tifton.
<http://www.bugwood.caes.uga.edu/>
- NRCS [Natural Resources Conservation Service]. 2001b. Soil survey of Gateway National Recreation Area, New York and New Jersey. USDA Natural Resources Conservation Service and USDI National Park Service, Gateway National Recreation Area in partnership with Cornell University Agricultural Experiment Station and New York City Soil and Water Conservation District.
- NatureServe Ecology - Southeastern United States. No date. Unpublished data. NatureServe. Durham, NC.
- Nelson, J. B. 1986. The natural communities of South Carolina: Initial classification and description. South Carolina Wildlife and Marine Resources Department, Division of Wildlife and Freshwater Fisheries. Columbia, SC. 55 pp.
- Nelson, P. W. 1985. The terrestrial natural communities of Missouri. Missouri Natural Areas Committee. Jefferson City. 197 pp. Revised edition, 1987.
- New Jersey Department of Environmental Protection. 2001. New Jersey 1995/97 Land Use / Land Cover - Level 3 Modified. Land Use Land Cover (Anderson) Classification System (derived from: A Land Use and Land Cover Classification System for Use with Remote Sensor Data, U.S. Geological Survey Professional Paper 964, 1976: edited by NJDEP, OIRM, BGIA, 1998, 2000, 2001). New Jersey Department of Environmental Protection. Trenton.
- Newbold, A., J. Evert, and J. Holt. 1988. Rare plant and general flora survey of the White Clay Creek Park, Newcastle County, Delaware. 40 pp.
- Niering, W. A., and R. S. Warren. 1977. Our dynamic tidal marshes: Vegetation changes as revealed by peat analysis. *The Connecticut Arboretum Bulletin* 22.
- Odum, W. E. 1988. Comparative ecology of tidal freshwater and salt marshes. *Annual Review of Ecological Systems* 19:147–176.
- Odum, W. E., T. J. Smith, III, J. K. Hoover, and C. C. McIvor. 1984. The ecology of tidal freshwater marshes of the United States east coast: A community profile. USDI Fish & Wildlife Service. FWS/OBS-83/17. 176 pp.

- Odum, W. E., and T. J. Smith. 1981. Ecology of tidal, low salinity ecosystems. Pages 36–44 in R. C. Carey, P. S. Markovits, and J. B. Kirkwood, editors. Proceedings of the workshop on coastal ecosystems of the southeastern United States. USDI Fish & Wildlife Service, Office of Biological Services. Report No. FWS/OBS-80/59. Washington, DC.
- Patterson, Karen D. Personal communication. Ecologist. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, VA.
- Peet, R. K., T. R. Wentworth, M. P. Schafale, and A.S. Weakley. 2002. Unpublished data of the North Carolina Vegetation Survey. University of North Carolina, Chapel Hill.
- Perles, S. J., G. S. Podniesinski, E. A. Zimmerman, W. A. Millinor, and L. A. Sneddon. 2005a. Vegetation classification and mapping at Fort Necessity National Battlefield. Technical Report NPS/NER/NRTR—2006/038. National Park Service. Philadelphia, PA.
- Perles, S. J., G. S. Podniesinski, E. A. Zimmerman, W. A. Millinor, and L. A. Sneddon. 2005b. Vegetation classification and mapping at Friendship Hill National Historic Site. Technical Report NPS/NER/NRTR—2006/041. National Park Service. Philadelphia, PA.
- Perles, S. J., G. S. Podniesinski, W. A. Millinor, and L. A. Sneddon. 2005c. Vegetation classification and mapping at Gettysburg National Military Park and Eisenhower National Historic Site. Draft Technical Report NPS/NER/NRTR—2006/058. National Park Service. Philadelphia, PA.
- Perles, S. J., G. S. Podniesinski, E. Eastman, L. A. Sneddon, and S. C. Gawler. 2007. Classification and Mapping of Vegetation and Fire Fuel Models at Delaware Water Gap National Recreation Area: Volume 2 of 2 –Appendix G. Technical Report NPS/NER/NRTR—2007/076. National Park Service. Philadelphia, PA.
- Pyne, M. 1994. Tennessee natural communities. Unpublished document. Tennessee Department of Conservation, Ecology Service Division. Nashville. 7 pp.
- Rabie, P.A. 2000. Invasive nitrogen fixers. Restoration and Reclamation Review 6:6.3. <http://horticulture.coafes.umn.edu/vd/h5015/rrr.htm>
- Rawinski, T. 1984. Natural community description abstract - southern New England calcareous seepage swamp. Unpublished report. The Nature Conservancy. Boston, MA. 6 pp.
- Rawinski, T. J., K. N. Hickman, J. Waller-Eling, G. P. Fleming, C. S. Austin, S. D. Helmick, C. Huber, G. Kappesser, F. C. Huber, Jr., T. Bailey, and T. K. Collins. 1996. Plant communities and ecological land units of the Glenwood Ranger District, George Washington and Jefferson national forests, Virginia. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Natural Heritage Technical Report 96-20. Richmond. 65 pp. plus appendices.

- Reschke, C. 1990. Ecological communities of New York State. New York Natural Heritage Program. New York State Department of Environmental Conservation. Latham, NY. 96 pp.
- Robichaud, B., and M. F. Buell. 1973. Vegetation of New Jersey. Rutgers University Press. New Brunswick, NJ. 340 pp.
- Saltonstall, K. 2002. Cryptic invasion by a nonnative genotype of the common reed, *Phragmites australis*, into North America. *Proceedings of the National Academy of Science* 99:2445–2449.
- Schafale, M. 2000. Fourth approximation guide. Coastal Plain. January 2000 draft. North Carolina Natural Heritage Program. Raleigh.
- Schafale, M. 2003b. Fourth approximation guide. Coastal Plain communities. March 2003 draft. North Carolina Natural Heritage Program. Raleigh.
- Schafale, M. P., and A. S. Weakley. 1990. Classification of the natural communities of North Carolina. Third approximation. North Carolina Department of Environment, Health, and Natural Resources, Division of Parks and Recreation, Natural Heritage Program. Raleigh. 325 pp.
- Schafale, Mike P. Personal communication. Ecologist. North Carolina Department of Environment, Health, and Natural Resources, Division of Parks and Recreation, Natural Heritage Program. Raleigh.
- Schotz, Al. Personal communication. Community Ecologist. Alabama Natural Heritage Program. Huntingdon College, Massey Hall, 1500 East Fairview Avenue, Montgomery, AL 36106-2148.
- Sipple, W. S., and W. A. Klockner. 1984. Uncommon wetlands in Coastal Plain of Maryland. Pages 111–137 in: A. W. Norden, et al., editors. *Threatened and endangered plants and animals of Maryland*. Special Publication 84-I. Maryland Natural Heritage Program.
- Smith, L. M. 1996b. The rare and sensitive natural wetland plant communities of interior Louisiana. Unpublished document. Louisiana Department of Wildlife and Fisheries, Louisiana Natural Heritage Program. Baton Rouge. 38 pp.
- Smith, L. M., compiler. 1996a. Natural plant communities in Louisiana currently recognized by the Louisiana Natural Heritage Program. Unpublished document. Louisiana Department of Wildlife and Fisheries, Natural Heritage Program. Baton Rouge. 2 pp.
- Smith, T. L. 1991. Natural ecological communities of Pennsylvania. First revision. Unpublished report. Pennsylvania Science Office of The Nature Conservancy. Middletown, PA. 111 pp.

- Sneddon, L. A., K. J. Metzler, and M. Anderson. 1995. A classification and description of natural community alliances and selected community elements of the Delaware Estuary. *In* L. E. Dove and R. M. Nyman, editors. Living resources of the Delaware Estuary. The Delaware Estuary Program. 530 pp. plus appendices.
- Sneddon, L., and J. Lundgren. 2001. Vegetation classification of Fire Island National Seashore and William Floyd Estate. Final Draft. TNC/ABI Vegetation Mapping Program. 87 pp.
- Southeastern Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe. Durham, NC.
- Strakosch Walz, K., K. Anderson, L. Kelly, and D. Snyder. 2006. New Jersey ecological community crosswalk. Unpublished report. New Jersey Department of Environmental Protection, Office of Natural Lands Management. Trenton.
- Swain, P. C., and J. B. Kearsley. 2001. Classification of natural communities of Massachusetts. September 2001 draft. Natural Heritage and Endangered Species Program, Massachusetts Division of Fisheries and Wildlife. Westborough, MA.
- TDNH [Tennessee Division of Natural Heritage]. Unpublished data. Tennessee Division of Natural Heritage, 14th Floor, L&C Tower, 401 Church Street, Nashville, TN 37243-0447. 615-532-0431.
- TNC [The Nature Conservancy]. 1995c. NBS/NPS Vegetation Mapping Program: Vegetation classification of Assateague Island National Seashore. Unpublished report. The Nature Conservancy, Eastern Regional Office. Boston, MA.
- TNC [The Nature Conservancy]. 1998a. An investigation and assessment of the vegetation of Arnold Air Force Base. Coffee and Franklin counties, Tennessee. The Nature Conservancy, Tennessee Field Office. Nashville. 37 pp. plus appendices.
- TNC [The Nature Conservancy]. 1998b. Classification of the vegetation of Congaree Swamp National Monument. Report to BRD-NPS Vegetation Mapping Program. The Nature Conservancy, Southern Conservation Science. Chapel Hill, NC. 67 pp.
- Tiner, R. W., Jr. 1977. An inventory of South Carolina's coastal marshes. South Carolina Marine Resources Center. Technical Report 23. Columbia, SC. 33 pp.
- Tiner, R. W., Jr. 1984. Wetlands of the United States: Current status and recent trends. USDI Fish and Wildlife Service, National Wetlands Inventory. 59 pp.
- Tiner, R. W., Jr. 1985a. Wetlands of Delaware. Cooperative publication of USDI Fish & Wildlife Service, National Wetlands Inventory. Newton Corner, MA. [and] Delaware Department of Natural Resources and Environmental Control. Dover, DE. 77 pp.
- Tiner, R. W., Jr. 1985b. Wetlands of New Jersey. USDI Fish & Wildlife Service, National Wetlands Inventory. Newton Corner, MA. 117 pp.

- Turner, R. L., J. E. Van Kley, L. S. Smith, and R. E. Evans. 1999. Ecological classification system for the national forests and adjacent areas of the West Gulf Coastal Plain. The Nature Conservancy. Nacogdoches, TX. 95 pp. plus appendices.
- USFS [U.S. Forest Service]. 1988. Silvicultural examination and prescription field book. USDA Forest Service, Southern Region. Atlanta, GA. 35 pp.
- Ursic, S. J. 1963. Planting loblolly pine for erosion control in north Mississippi. USDA Forest Service Research Paper SO-3. Southern Forest Experiment Station. New Orleans, LA. 21 pp.
- VDNH [Virginia Division of Natural Heritage]. 2003. The natural communities of Virginia: Hierarchical classification of community types. Unpublished document, working list of November 2003. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Ecology Group. Richmond.
- Vanderhorst, J. P., J. Jeuck, and S. C. Gawler. 2007. Vegetation classification and mapping of New River Gorge National River, West Virginia. Technical Report NPS/NER/NRTR—2007/092. USDI National Park Service. Philadelphia, PA.
- Voigt, J. W., and R. H. Mohlenbrock. 1964. Plant communities of southern Illinois. Southern Illinois University Press. Carbondale. 202 pp.
- Ware, D. M. E., and S. Ware. 1992. An *Acer barbatum*-rich ravine forest community in the Virginia coastal plain. *Castanea* 57:110–122.
- Wharton, C. H. 1978. The natural environments of Georgia. Georgia Department of Natural Resources. Atlanta. 227 pp.
- Wharton, C. H., W. M. Kitchens, E. C. Pendleton, and T. W. Sipe. 1982. The ecology of bottomland hardwood swamps of the Southeast: A community profile. U.S. Fish and Wildlife Service, Office of Biological Services. FWS/OBS-81/37. Washington, DC.
- White, J., and M. Madany. 1978. Classification of natural communities in Illinois. Pages 311–405 in *Natural Areas Inventory technical report: Volume I, survey methods and results*. Illinois Natural Areas Inventory. Urbana, IL.
- Wieland, R. G. 1994a. Marine and estuarine habitat types and associated ecological communities of the Mississippi Coast. Mississippi Department of Wildlife, Fisheries, and Parks. Museum of Natural Science. Museum Technical Report 25. Jackson, MS. 270 pp.
- Wieland, R. G. 1994b. Mississippi Natural Heritage Program: Ecological communities. Unpublished document. Mississippi Department of Wildlife, Fisheries, and Parks, Museum of Natural Science, Natural Heritage Program. Jackson, MS. 7 pp.

- Windisch, A. G. 1995b. Natural community inventory of Fort Dix, New Jersey. The Nature Conservancy report. New Jersey Natural Heritage Program, Office of Natural Lands Management. Trenton, NJ. 81 pp.
- Wolfe, S. H., editor. 1990. An ecological characterization of the Florida Springs Coast: Pithlachascotee to Waccasassa rivers. USDI Fish & Wildlife Service, Biological Report 90(21). Slidell, LA. 323 pp.
- Zanoni, T. A., P. G. Risser, and I. H. Butler. 1979. Natural areas for Oklahoma. Oklahoma Natural Heritage Program. Norman. 72 pp.

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 within 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 classes at George Washington Birthplace National Monument.

- 1a Vegetation primarily woody; dominated by trees and shrubs. 5
- 1b Vegetation dominated by herbaceous plants (including coarse suffrutescent species); woody species absent or very sparse. 2

HERBACEOUS VEGETATION

- 2a Upland herbaceous vegetation; meadows and mowed areas dominated by sod-forming exotic grasses such as meadow ryegrass (*Lolium pratense*), purple tridens (*Tridens flavus* var. *flavus*), eastern gamagrass (*Tripsacum dactyloides*), hairy crabgrass (*Digitaria sanguinalis*), Bermudagrass (*Cynodon dactylon*); and forbs such as common yarrow (*Achillea millefolium*) common dandelion (*Taraxacum officinale*), early goldenrod (*Solidago juncea*), yellow sweetclover (*Melilotus officinalis*) and others; may include scattered trees and shrubs, windrows, ditches, and small isolated wetland areas. **Cultural Meadow**
- 2b Herbaceous wetlands. 3
- 3a Nontidal wetlands; wetlands associated anthropogenic impoundments or ditching; may have floating vegetation. **Semipermanent Impoundment**
- 3b Tidal wetlands: herbaceous wetlands of rivers or tidal creeks; influenced by tidal flooding. 4
- 4a Tidal marshes comprised of grasses generally less than 1m tall; dominated by smooth cordgrass (*Spartina alterniflora*) or saltmeadow cordgrass (*Spartina patens*). **Tidal Mesohaline and Polyhaline Marsh (Low Salt Marsh)**
- 4a Tidal marshes dominated by tall (> 1m) species, particularly big cordgrass (*Spartina cynosuroides*), narrowleaf cattail (*Typha angustifolia*), crimsoneyed rosemallow (*Hibiscus moscheutos* ssp. *moscheutos*), swamp loosestrife (*Decodon verticillatus*), or common reed (*Phragmites australis*), occurring in mixtures or as patch dominants. **Tidal Oligohaline Marsh**

FORESTS AND SHRUBLANDS

- 5a Vegetation dominated by evergreen trees or shrubs; loblolly pine (*Pinus taeda*), eastern redcedar (*Juniperus virginiana* var. *virginiana*), American Holly (*Ilex opaca* var. *opaca*). 6
- 5b Vegetation mainly of deciduous trees or shrubs, although loblolly pine (*Pinus taeda*) or eastern redcedar may be present. 9
- 6a Forest of scrubby vegetation dominated by eastern redcedar (*Juniperus virginiana* var. *virginiana*), sometimes with common persimmon (*Diospyros virginiana*) and sweetgum (*Liquidambar styraciflua*). **Successional Red-cedar Forest**
- 6b Forest vegetation with canopy dominated by loblolly pine (*Pinus taeda*). 7

- 7a Forests on steep, short slopes over wetlands, canopy and subcanopy has loblolly pine (*Pinus taeda*) with sweetgum (*Liquidambar styraciflua*), American holly (*Ilex opaca* var. *opaca*), eastern redcedar (*Juniperus virginiana* var. *virginiana*), red maple (*Acer rubrum*), or willow oak (*Quercus phellos*); very sparse or no shrubs or herbs. **Disturbed Acidic Slope Forest**
- 7b Forests on upland flats. 8
- 8a Mature forest with large loblolly pine (*Pinus taeda*) in canopy with mixtures including sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), tuliptree (*Liriodendron tulipifera*), black cherry (*Prunus serotina* var. *serotina*), and/or American Holly (*Ilex opaca* var. *opaca*) in the canopy and subcanopy. **Loblolly Pine - Hardwood Forest**
- 8b Young forest with canopy dominated by small diameter (less than 30 cm) loblolly pine. **Loblolly Pine Plantation / Early-Successional Loblolly Pine Forest**
- 9a Vegetation dominated by shrubs; may have scattered, emergent trees. 10
- 9b Vegetation dominated by trees. 11
- 10a Shrublands of tidal islands and beaches, dominated by Jesuit's bark (*Iva frutescens*), sometimes with eastern baccharis (*Baccharis halimifolia*). **Tidal Shrub Swamp (Iva Type)**
- 10b Shrubby vegetation with no clear dominant; mixtures of common hackberry (*Celtis occidentalis*), eastern redcedar (*Juniperus virginiana* var. *virginiana*), sweetgum (*Liquidambar styraciflua*), black walnut (*Juglans nigra*), black locust (*Robinia pseudoacacia*), black cherry (*Prunus serotina* var. *serotina*) with vines and weedy species; shell fragments may be on ground surface. **Disturbed Calcareous Forest**
- 11a Forests with saturated soils, standing water, or seasonally wet depressions; may appear dry during parts of the year. 12
- 11b Forests with well-drained soils on upland flats or on steep slopes over wetlands. 13
- 12a Forest with scattered hydric oaks; pin oak (*Quercus palustris*), cherrybark oak (*Quercus pagoda*), willow oak (*Quercus phellos*), or swamp chestnut oak (*Quercus michauxii*), some Loblolly Pine (*Pinus taeda*), and sweetgum (*Liquidambar styraciflua*); little to no herbaceous cover; may have seasonally wet depressions with wetland herbs. **Non-Riverine Saturated Forest**
- 12b Forested wetlands dominated by red maple (*Acer rubrum*). **Coastal Plain / Piedmont Acidic Seepage Swamp**
- 13a Mature forests with large trees dominated by oaks (*Quercus* spp.), hickories (*Carya* spp.), and/or sweetgum (*Liquidambar styraciflua*). 14
- 13b Disturbed or successional forests; characteristic trees include sweetgum (*Liquidambar styraciflua*), black locust (*Robinia pseudoacacia*), southern red oak (*Quercus falcata*), eastern redcedar (*Juniperus virginiana* var. *virginiana*), loblolly pine (*Pinus taeda*). 15

- 14a Forests with canopies of chinkapin oak (*Quercus muhlenbergii*), bitternut hickory (*Carya cordiformis*), eastern redcedar (*Juniperus virginiana* var. *virginiana*), and shrubs of common hackberry (*Celtis occidentalis*), pawpaw (*Asimina triloba*); sparse herb cover, but with calciphile indicators like American basswood (*Tilia americana*), red columbine (*Aquilegia canadensis*), smooth rockcress (*Arabis laevigata* var. *laevigata*), hairy wildrye (*Elymus villosus*), and yellow crownbeard (*Verbesina occidentalis*); shell fragments prominent on soil ground surface. **Coastal Plain Dry Calcareous Forest**
- 14b Forest dominated by white oak (*Quercus alba*) or sweetgum (*Liquidambar styraciflua*), sometimes with willow oak (*Quercus phellos*); with American holly (*Ilex opaca* var. *opaca*) prominent in subcanopy or shrub layer; sparse herbs, Swan's Sedge (*Carex swanii*), poverty oatgrass (*Danthonia spicata*), striped prince's pine (*Chimaphila maculata*), eastern bottlebrush grass (*Elymus hystrix* var. *hystrix*); no shell fragments on soil surface. **Disturbed Acidic Slope Forest**
- 15a Forest with no clear dominant species in canopy; common hackberry (*Celtis occidentalis*), eastern redcedar (*Juniperus virginiana* var. *virginiana*), sweetgum (*Liquidambar styraciflua*), black walnut (*Juglans nigra*), black locust (*Robinia pseudoacacia*), black cherry (*Prunus serotina* var. *serotina*) with vines and weedy species; shell fragments may be on ground surface. **Disturbed Calcareous Forest**
- 15b Forest dominated by black locust (*Robinia pseudoacacia*) or sweetgum (*Liquidambar styraciflua*). 16
- 16a Forest with black locust (*Robinia pseudoacacia*) and or common hackberry (*Celtis occidentalis*) abundant. **Successional Black Locust Forest**
- 16b Forest with sweetgum (*Liquidambar styraciflua*) dominant. 17
- 17a Young forest strongly dominated by sweetgum; weedy herbs and vines such as Japanese honeysuckle (*Lonicera japonica*), eastern poison ivy (*Toxicodendron radicans*), and trumpet creeper (*Campsis radicans*) common. **Successional Sweetgum Forest**
- 17b Middle to late successional forest with mixtures of sweetgum (*Liquidambar styraciflua*) and loblolly pine (*Pinus taeda*), sometimes with mixtures of red maple (*Acer rubrum*), sweetgum (*Liriodendron tulipifera*), black cherry (*Prunus serotina* var. *serotina*), and American holly (*Ilex opaca* var. *opaca*). **Loblolly Pine - Hardwood Forest**

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.

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/>