National Park Service
U.S. Department of the Interior

Northeast Region
Philadelphia, Pennsylvania

Vegetation Classification and Mapping of Morristown National Historical Park, New Jersey

Technical Report NPS/NER/NRTR—2008/116

ON THE COVER
Southern New England Red Maple Seepage Swamp in Morristown National Historical Park.
Photograph by: Stephanie Perles.

Vegetation Classification and Mapping of Morristown National Historical Park, New Jersey

Technical Report NPS/NER/NRTR—2008/116

Lesley Sneddon[1], Robert E. Zaremba[2], Ery Largay[1], Greg Podniesinski[3], Stephanie Perles[3], and John Thompson[4]

[1]NatureServe
11 Avenue de Lafayette
Boston, MA 02111

[2]Box 607
1409 Main Street
Chatham, MA 02633

[3]Western Pennsylvania Conservancy
209 Fourth Avenue
Pittsburgh, PA 15222

[4]Aerial Photograph Interpretation
558 Main Street
St. Remy, NY 12401

April 2008

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

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, 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 4560–B-0009 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-116.

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:

Sneddon, L., R.E. Zaremba, E. Largay, G. Podniesinski, S. Perles and J. Thompson. 2008. Vegetation Classification and Mapping of Morristown National Historical Park, New Jersey. Technical Report NPS/NER/NRTR—2008/116. National Park Service. Philadelphia, PA.

NPS D-116, April 2008

Table of Contents

Page

Figures v

Tables vii

Appendixes ix

Acknowledgments xi

Executive Summary xiii

Introduction 1

General Background 1

Park-specific Information 2

Project Area 5

Location and Regional Setting 5

Park Environmental Attributes and Site History 5

Materials and Methods 7

Planning and Scoping 7

Preliminary Data Collection and Review of Existing Information 7

Aerial Photography Acquisition and Processing 8

Photointerpretation and Preliminary Vegetation Map Preparation 8

Field Data Collection and Classification 8

Vegetation Map Preparation 13

Results 23

Vegetation Classification and Characterization 23

Association Descriptions 25

Association-level Vegetation Map Production 97

Accuracy Assessment 98

Project Deliverables 104
Discussion 105
Vegetation Classification and Characterization 105
Vegetation Map Production 108
Accuracy Assessment 108
Recommendations for Future Projects 109
Literature Cited 111

Figures

Page

Figure 1. Location of Morristown National Historical Park in the Lower New England/Northern Piedmont Ecoregion. 6

Figure 2. Locations of 22 plots sampled in the Jockey Hollow and New Jersey Brigade units of Morristown National Historical Park. 11

Figure 3. Mapping observation points in the New Jersey Brigade Unit of Morristown National Historical Park. 15

Figure 4. Mapping observation points in the Jockey Hollow Unit of Morristown National Historical Park. 16

Figure 5. Location of accuracy assessment points in Morristown National Historical Park, Jockey Hollow Unit. 20

Figure 6. Location of accuracy assessment points in Morristown National Historical Park, Jockey Hollow (Detail). 21

Figure 7. Location of accuracy assessment points in Morristown National Historical Park, New Jersey Brigade Unit. 22

Figure 8. Tuliptree - Beech - Maple Forest in Morristown National Historical Park (plot MORR.19, photo 19-1). 30

Figure 9. Northern Piedmont Mesic Oak - Beech Forest in Morristown National Historical Park (plot MORR.06, photo 6-2). 35

Figure 10. Successional Tuliptree Forest in Morristown National Historical Park (plot MORR.17, photo 17-1). 41

Figure 11. Northeastern Dry-Oak Hickory Forest in Morristown National Historical Park (plot MORR.13, photo 13-2). 51

Figure 12. Dry-Mesic Chestnut Oak - Red Oak Forest in Morristown National Historical Park (plot MORR.01, photo 1-1). 57

Figure 13. Black Locust Successional Forest in Morristown National Historical Park (plot MORR.08, photo 8-2). 66

Figure 14. Southern New England Red Maple Seepage Swamp in Morristown National Historical Park (plot MORR.20, photo 20-1). 71

Figure 15. Montane Basic Seepage Swamp in Morristown National Historical Park (plot MORR.22, photo 22-1). 79

Figure 16. Hemlock - Red Oak - Mixed Hardwood Forest in Morristown National Historical Park (plot MORR.03, photo 3-1). 84

Figure 17. Northeastern Old Field in Morristown National Historical Park (plot MORR.04, photo 4-2). 88

Figure 18. Smartweed - Cutgrass Wetland in Morristown National Historical Park (plot MORR.09, photo 9-1). 96

Figure 19. USNVC associations and Anderson Level II (modified) land use categories of the final association-level vegetation map for Morristown National Historical Park, 2006. 99

Figure 20. Wetland polygons (associations belonging to Saturated USNVC formations) in Morristown National Historical Park, Jockey Hollow Unit. 101

Figure 21. Wetland polygons (associations belonging to Saturated USNVC formations) in Morristown National Historical Park, New Jersey Brigade Unit. 102

Figure 22. Mature forest types of Ehrenfeld (1977) superimposed on the final association-level vegetation map (top); the final association-level map is included as a reference (bottom). 106

Tables

Page

Table 1. Summary of key information for Morristown National Historical Park aerial photography digital files. 9

Table 2. U.S. National Vegetation Classification associations and Anderson Level II (modified) land use categories of the preliminary vegetation map for Morristown National Historical Park. 9

Table 3. Mapping observation points from the New Jersey Brigade and Jockey Hollow units of Morristown National Historical Park. 14

Table 4. Summary information for mapped vegetation associations and accuracy assessment sampling points[1] in Morristown National Historical Park based on the final association-level vegetation map. 18

Table 5. Map classes and corresponding USNVC associations of the final association-level vegetation map for Morristown National Historical Park. 24

Table 6. Anderson Level II (modified) land use categories of the final association-level vegetation map for Morristown National Historical Park. 97

Table 7. Number of polygons and total mapped hectares within the park boundary for the map classes of the final association-level vegetation map of Morristown National Historical Park, 2006. 100

Table 8. Contingency table and calculated errors for thematic accuracy assessment of the final association-level vegetation map of Morristown National Historical Park. 103

Table 9. Summary of products resulting from the Morristown National Historical Park vegetation classification and mapping project. 104

Appendixes

Page

Appendix A. Aerial photograph interpretation descriptions for USNVC vegetation associations at Morristown National Historical Park..... 115

Appendix B. Vegetation Plot Sampling Form. 117

Appendix C. Data dictionary for fields in PLOTS 2.0 Database..... 119

Appendix D. Results of Morristown National Historical Park TWINSPAN plot data analysis. 125

Appendix E. Dichotomous field key to the USNVC associations of Morristown National Historical Park..... 129

Appendix F. Mapping Observation Point Form. 133

Appendix G. Accuracy Assessment Form for USGS/NPS Vegetation Mapping Program..... 135

Appendix H. Field definitions for local and global USNVC association descriptions. 137

Appendix I. Plants observed in Morristown National Historical Park during vegetation plot and thematic accuracy assessment sampling. 149

Appendix J. Index of representative photographs of vegetation classification sampling plots in Morristown National Historical Park, by figure number. 155

Appendix K. Index of representative photographs of vegetation classification sampling plots in Morristown National Historical Park, by plot number..... 157

Appendix L. Bibliography for global descriptions from the U.S. National Vegetation Classification. 159

Acknowledgments

This project required the cooperation and assistance of many people in various capacities. It has been a long process and it is the sincere hope of the authors that we have not inadvertently omitted anyone who assisted in this work.

The National Park Service Vegetation Mapping Program and Morristown National Historical Park's 80% Fee Demonstration Program are gratefully acknowledged for funding this project. Bob Masson of Morristown National Historical Park was instrumental in providing unfettered access and information about the park, as well as good-humored guidance throughout. Elizabeth Johnson of the NPS Northeast Region coordinated funding and provided support, without which this project would not have been possible. Nigel Shaw of the NPS Northeast Region provided guidance in procuring the photography. Thanks are also due to Mary Russo and Kristin Snow of NatureServe for providing essential data management services for the vegetation type descriptions.

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

Executive Summary

Vegetation classification and mapping of Morristown National Historical Park was conducted following U.S. Geological Survey/National Park Service (USGS/NPS) Vegetation Mapping Program protocols. After a scoping session with park staff and field reconnaissance, NatureServe developed an initial vegetation classification for the park based on NatureServe's U.S. National Vegetation Classification (USNVC) and other existing information. Twenty-two vegetation plots were sampled in the summer of 2003 and 2004, stratified across the vegetation types identified in the preliminary vegetation classification. Plot sampling included information on vegetation structure, composition, and individual species cover by vegetation stratum and on environmental setting. Quantitative analysis of the plot data, along with supplemental information, yielded fourteen vegetation associations within the park, thirteen of which were mapped. The unmapped association was small and limitations of the photography did not allow for its depiction on the map.

Eleven of the fourteen associations are forested and three are herbaceous. The upland forests that characterize the area include two American beech (*Fagus grandifolia*) associations, a tuliptree (*Liriodendron tulipifera*) association, two different oak (*Quercus spp.*) associations, one modified successional forest association, one black locust (*Robinia pseudoacacia*) forest association, one Upland / Wetland Transitional Forest, and a forest formerly characterized by eastern hemlock (*Tsuga canadensis)* that is now dominated by oaks and hardwoods . Wetland forests include two red maple (*Acer rubrum)* swamp associations. Upland herb-dominated areas consist primarily of field vegetation. Wetland herbaceous associations include a skunk cabbage (*Symplocarpus foetidus*)-dominated community and smartweed (*Polygonum spp.*)-dominated impoundment. The most common forest types within the park are the Northern Piedmont Mesic Oak-Beech Forest and Successional Tuliptree Forest. Because these two forest types do not exhibit distinct signatures on aerial photography, and because they intergrade on the landscape, they are largely represented by one map class that covers 81.6% of the park. Areas of heavy land use that were not classified using the USNVC were mapped as Anderson Level II (modified) land cover classes (Anderson et al. 1976). These categories are orchard / plantation; pond / reservoir; commercial and services; and transportation, communications, and utilities.

A thematic accuracy assessment was completed in August 2005. Seventy-three accuracy assessment sampling points were placed in a stratified random scheme throughout the park, resulting in an overall accuracy of 74.0%. Overall accuracy is calculated by dividing the number of correctly identified points by the total number of points. The USGS/NPS VMP standard is 80% accuracy, so total percent accuracy is somewhat lower. Accuracy of the map increases to 82% if classes are changed such that Black Locust Successional Forest and Northeastern Modified Successional Forest are combined with Northern Piedmont Mesic Oak-Beech Forest and Successional Tuliptree Forest. However, the combined map class results in a greater loss of information to the user than the does the smaller benefit gained in accuracy.

One wetland forest type of note is the Montane Basic Seepage Swamp that is located in a drainage between Soldiers Hut and Aqueduct Trails and ranked G3 by NatureServe. A G3 rank is defined as “globally rare or uncommon, with generally 21–100 occurrences and 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).” The occurrence at Morristown National Historical Park is small (0.58 ha [1.43 ac]) but has low cover of invasive species and is a good representation of the type, with a very diverse herbaceous layer in comparison to other associations at Morristown National Historical Park.

Detailed descriptions of the local and global expressions of each vegetation type, a field key to vegetation types, a photo interpretation key to map units, a plant species list derived from the plot samples, metadata for the vegetation map, accuracy assessment points, observation point and plot data, the accuracy assessment report, an index to ground photos, and bibliography for vegetation descriptions are included as appendixes.

Keywords: vegetation, association, vegetation classification, vegetation mapping, National Vegetation Classification, Morristown National Historical Park.

Introduction

General Background

One of the goals of the National Park Service's Inventory and Monitoring Program is to provide the information and expertise needed by park managers for effective, long-term management of the natural resources held in trust (NPS 2003). The program recommends that 12 basic natural resource inventories be developed for each park that contains significant natural resources. These inventories provide crucial baseline information needed for park natural and cultural resource stewardship. A map of each park's vegetation based on aerial photography less than five years old is one of the 12 inventories recommended by the program (NPS 2003). To ensure that vegetation mapping is standardized across the National Park Service (NPS), The Nature Conservancy (TNC), in conjunction with NatureServe, the Federal Geographic Data Committee (FGDC), and the Ecological Society of America (ESA) Vegetation Subcommittee, developed a protocol for creating vegetation maps in national parks. This protocol was adopted by the U. S. Geological Survey (USGS)/National Park Service (NPS) Vegetation Mapping Program as the standard (TNC and ESRI 1994a, b, c) and has been implemented at Morristown National Historical Park by NatureServe.

The goal of the mapping effort at Morristown National Historical Park was to produce an up-to-date digital geospatial vegetation database for the park and to provide a plant species list, a dichotomous key for vegetation associations, and descriptions of the vegetation associations in the park. Baseline information on plant community composition and rarity is critical to establishing desired conditions and park management goals relating to native plant communities, nonnative plant and insect species, and effects of deer browse and other disturbances. The identification and description of plant communities also provide habitat information important to understanding associated organisms, including animals, protozoa, bacteria, and fungi. A map of vegetation associations may 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. TNC, in conjunction with NatureServe, the FGDC, and the ESA Vegetation Subcommittee, developed the U.S. National Vegetation Classification (USNVC) in order to standardize vegetation classification and facilitate the comparison of vegetation types throughout the United States and internationally. The USNVC is a systematic approach to classifying existing natural vegetation using physiognomy and floristics. This classification system has a hierarchical structure (Grossman et al. 1998).

The basic unit of vegetation classification in the USNVC is the association. 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, Northeastern Dry Oak - Hickory Forest is a common forest type on well-drained, acidic midslopes in the northeastern United States. 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 often equivalent to communities in state-specific vegetation classifications such as the Classification of Vegetation Communities of New Jersey: Second Iteration (Breden et al. 2001). Therefore, USNVC associations can be crosswalked with communities in these state classifications.

Several associations that share one or more dominant or characteristic species can be grouped to form an alliance. Alliances are generally more wide-ranging geographically than are associations, covering multiple habitats and broader species composition. For example, the Northeastern Dry Oak - Hickory Forest association mentioned previously is grouped with other similar oak-dominated forest associations into the White Oak - (Northern Red Oak, Hickory species) Forest Alliance. One level above alliance is the formation, representing vegetation types that share a common physiognomy within broadly defined environmental factors (Grossman et al. 1998). For example, Lowland or Submontane Cold-Deciduous Forest is a common formation that encompasses numerous forest types in the northeastern and Midwestern United States.

The USNVC was developed by ecologists of the Natural Heritage Program network and TNC after many years of literature review, data collection, and data analysis. This collaborative effort culminated in the publication of the International Classification of Ecological Communities: Terrestrial Vegetation of the United States (Grossman et al. 1998). The International Classification of Ecological Communities, now known as the International Vegetation Classification, of which the USNVC is a subset, has been revised and refined since 1998, and is now managed by NatureServe in continued collaboration with the network of Natural Heritage Programs. The classification is housed in the Biotics database and is updated regularly (NatureServe 2006). The upper levels of the USNVC were adopted as a standard by the FGDC to support the production of uniform statistics on vegetation at the national level (FGDC 1996). The USGS/NPS Vegetation Mapping Program adopted the alliance level, and where possible, the association level, as the mapping unit for national parks.

Park-specific Information

Morristown National Historical Park (MORR) and environs, in northwestern New Jersey, is the site of the main encampments of the American Continental Army over the winters of 1777 and 1779 during the Revolutionary War. At the time of the American Revolution, as it is today, the town was located at the junction of important east-west and north-south routes. As such, Morristown was the site of nearly constant passage of American troops. After successfully raiding Trenton and Princeton, General George Washington and his Continental Army of fewer than 2,500 troops first arrived in Morristown in January of 1777. The Morristown citizenry requested that General Washington and The Continental Army quarter in Morristown where their presence would help to protect the town. The Arnold Tavern on the western edge of the town green became Washington's Headquarters. The Army remained in Morristown until May 1777. Prior to breaking camp, Washington decided to secure Morristown as a supply base and ordered the construction of a fort on a hill, known as "Kinney's Hill," to serve as a place of retreat for troops staying in the town. The troops reinforced the crest of the hill with a redoubt, dug trenches, and built a guardhouse. But because the British never attacked Morristown, the fort was never used and came to be known as Fort Nonsense.

MORR is comprised of four non-contiguous units: Washington's Headquarters (including the Ford Mansion and the Headquarters Museum), Fort Nonsense, Jockey Hollow, and the New Jersey Brigade. The majority of the Jockey Hollow Unit is in Harding, with a small section in Morris Township. Fort Nonsense Unit is in Morristown and Morris Township, and the Washington's Headquarters Unit is in Morristown. The New Jersey Brigade Unit is in Mendham and Harding in Morris County and in Bernardsville in Somerset County. The park was established in 1933 with the acquisition of part of the Jockey Hollow Unit. Acquisitions have continued with the last major addition to the New Jersey Brigade Unit from the Jarvis Estate in 1973. Currently, the park consists of blocks of forest broken by roads, trails, and open fields that are mowed annually. The park also includes the Wick Farm at the Jockey Hollow Unit, where restoration efforts have attempted to re-create the farm as closely as possible to its appearance during the war.

Project Area

Location and Regional Setting

Morristown National Historical Park consists of approximately 690 ha (1,706 ac) and is located within Morris County, with a small portion in Somerset County. This area occurs in the southeast portion of the Reading Prong subsection (221Am) of the Lower New England Northern Piedmont Ecoregion, as defined by TNC (based on Keys et al. 1995) (Figure 1). This region is characterized by broad uplands separated by narrow valleys at elevations generally ranging from 107–457 m (350–1500 ft) supporting forests of oaks (*Quercus* spp.), American beech (*Fagus grandifolia*), black birch (*Betula lenta*), and other hardwoods.

Park Environmental Attributes and Site History

The vegetation of the park is highly influenced by past land use. Low elevation areas were cleared and, in a few areas, used for tillage. Lower slopes were cleared and used for pastures. Many of the upper slopes were too rocky for agricultural uses and were primarily maintained as wood lots. The forests have been cut repeatedly, most notably when Washington's Army used the wood of these forests to produce a log-house "city" of over 1,000 soldier huts. Other areas are successional forests regenerating on former agricultural fields. Between the early 1880s and 1900, there were several charcoal producing operations in the area. Trees were maintained in a coppice form and harvested regularly. Much of the forest had partially recovered from nearly 100 years of coppicing when it was logged immediately before the land was acquired for the park. All of the forested areas reflect evidence of some clearing and logging.

Historical records related to the vegetation of the park were assembled by Ehrenfeld (1977) and Ehrenfeld and Dibeler (1992). Early forests were dominated by American chestnut (*Castanea dentata*), several oak species, and hickory (*Carya* spp.). American chestnut was eliminated as a major component in the canopy by 1920, reduced only to scattered re-sprouts in the understory. Today, there are numerous old chestnut logs decomposing throughout the park. American beech and tuliptree (*Liriodendron tulipifera*) are typical forest canopy dominants in several forest types; these species are not mentioned as canopy components in any early forest descriptions and are not among the data for witness trees in the park. This shift in forest species composition over time likely reflects forest adaptations to past land uses and years of severe deer browse.

The substrate throughout the park consists of glacial deposits over weathered pre-Cambrian gneiss. The area was altered by glacial scouring and retreat deposits during the Jerseyan and Illinoian glaciations, but not during the Wisconsin glaciation. The terrain is made up of low hills with moderately steep slopes (20–40 degrees) and rounded summits with elevations ranging from 116–183 m (380–600 ft) above sea level. Soils are thin, mostly small lenses of well-drained sandy loam among rocky gneiss. Lower elevation sites have deeper soils that are saturated in the spring. The park lies within the upper Great Swamp watershed; the Passaic River flows through the New Jersey Brigade Unit, and Primrose Brook, with several small tributaries, flows through the Jockey Hollow Unit. The only wetland sites within the park are small impoundments on the Primrose Brook system along the Aqueduct Trail and at Cat Swamp. There are small patches of palustrine forest along the Passaic River, Tempe Wick Road, and Primrose Brook.

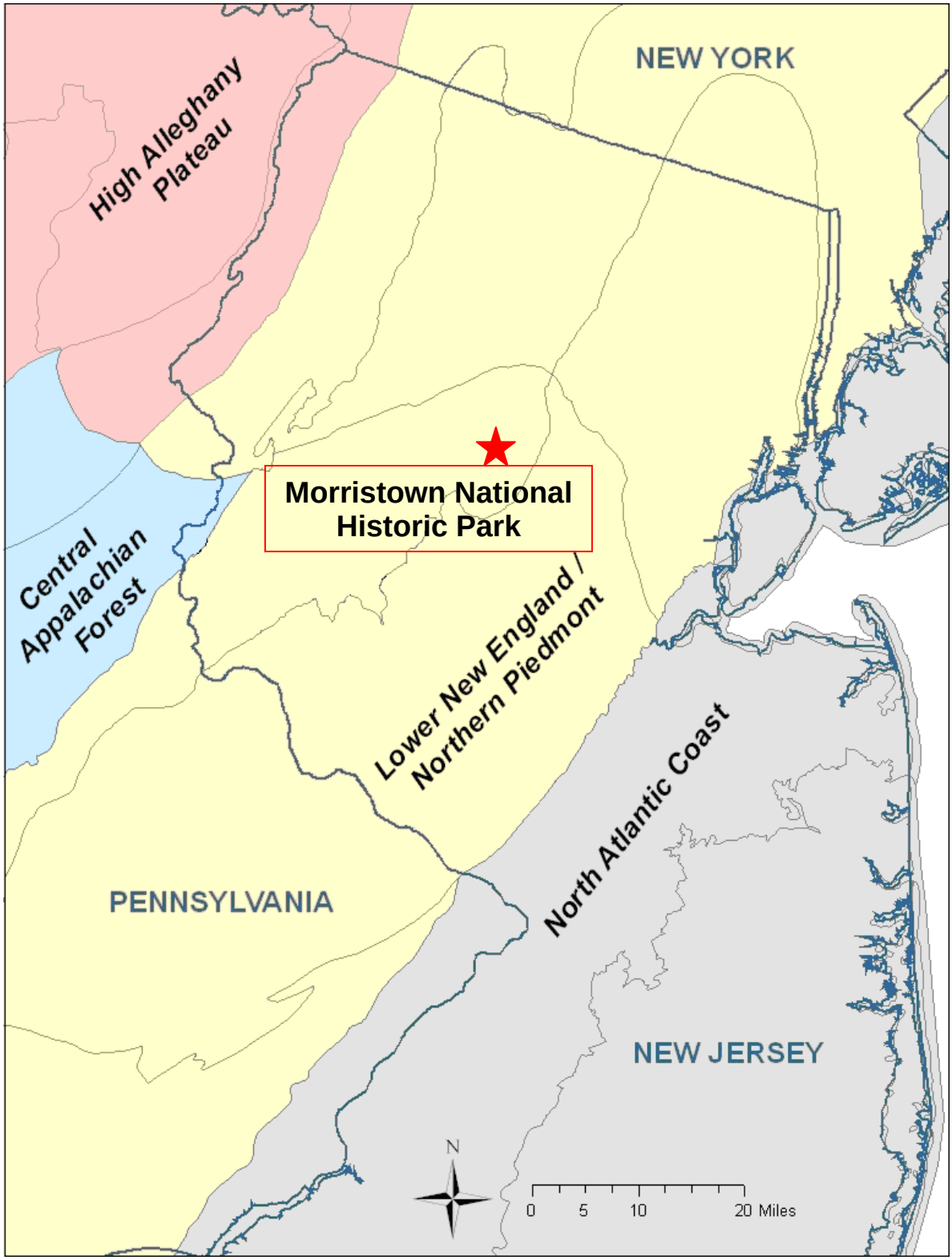

Figure 1. Location of Morristown National Historical Park in the Lower New England/Northern Piedmont Ecoregion.

Materials and Methods

Planning and Scoping

Morristown National Historical Park is considered to be a "medium-sized" park, one in which the sample area includes the entire park. The number of plots and the environmentally stratified plot placement were selected based on the identification of representative areas across the whole park. By comparison, in large parks the plot placement and stratification is focused on only a section of the park and results are extrapolated to the whole.

Several steps were taken to prepare for the classification and mapping of vegetation at Morristown National Historical Park. The project timeline, access issues, park resource management needs, current vegetation management, vegetation types of special interest, and applicable previous research conducted at the park were compiled and shared with the field team and park personnel. In addition, reconnaissance of the park's vegetation types was conducted to estimate the number and distribution of vegetation associations in the park.

Field work followed the methodology developed by the USGS/NPS Vegetation Mapping Program (http://biology.usgs.gov/npsveg/index.html). The following is a summary of these methods as applied to Morristown National Historical Park.

Preliminary Data Collection and Review of Existing Information

To determine a set of preliminary USNVC types in Morristown National Historical Park, a subset of associations was reported from the Biological and Conservation Database (now Biotics 4), the NatureServe database (NatureServe 2006). Associations that were attributed to the New York-New Jersey Hudson Highlands Subsection, 221Ae of the Lower New England / Northern Piedmont Ecoregion (Keys et al. 1995) were initially reviewed. Associations attributed to surrounding subsections were also evaluated for inclusion and added to the report as appropriate.

Three National Park Service reports on the vegetation of Morristown National Historical Park were used extensively in planning and data analysis: Ehrenfeld (1977), Ehrenfeld and Dibeler (1992), and Russell (1995). The vegetation of the Jockey Hollow and New Jersey Brigade units was surveyed by Ehrenfeld (1977) and Ehrenfeld and Dibeler (1992), respectively. In both assessments, only forested areas were surveyed. Forest areas were divided into "mature forests" and "successional forests." Representative areas were sampled for canopy and subcanopy species and shrubs. Herbaceous species were not included in the surveys. Maps were made for each identified forest type. Historical data from earlier vegetation descriptions, witness trees, land-use records, and historical accounts were used to describe ecological processes. These two reports were used to identify the initial range of forest types, identify locations for sampling, and assess recent vegetation change. The "Mixed Oak-Yellow Poplar Forest, Mixed Oak Forest, Beech-Mixed Hardwood Forest, Streamside Thicket, and Chestnut Oak Forest" of Ehrenfeld (1977) were vegetation units that could be related to existing described USNVC associations. The most aggressive exotic species were reported to be tree of heaven (*Ailanthus altissima*) and honeysuckle (*Lonicera* sp.). Privet (*Ligustrum* sp.) and Japanese barberry (*Berberis thunbergii*) were reported to have "disseminated throughout the woods," but they were noted to be not

"sufficiently aggressive to outcompete the native vegetation." Deer, while noted as abundant, were not considered to be a management problem for the forested parts of the park.

By the mid-1980s the impacts of the large deer population and the abundance of both Japanese barberry and Japanese stiltgrass (*Microstegium vimineum*) were noted (Russell 1995). Maps were constructed to describe areas with heavy invasive plant infestation versus areas either free of invasion or with low levels of invasive species. It was noted that reproduction of most tree species was limited. The installation of exclosures to monitor and assess deer browse impacts was recommended for many parts of the park.

Aerial Photography Acquisition and Processing

This project made use of existing photography rather than obtaining new aerial photos. Black and white 1:16,800 leaf-off aerial photographs of Morris County, dated April 24, 1999, were regarded at the inception of the project as sufficiently recent and of an appropriate scale and were selected for interpretation. The photos were obtained from Lockwood Mapping Company, Rochester, New York.

Metadata records for the aerial photo digital tiff files were prepared according to current Federal Geographic Data Committee standards (FGDC 1998); however, available metadata for the photographs were limited. Key information for the Morristown National Historical Park aerial photos digital files is summarized in Table 1.

Photointerpretation and Preliminary Vegetation Map Preparation

John Thompson, a NatureServe subcontractor, conducted the preliminary aerial photograph interpretation and vegetation mapping for Morristown National Historical Park. Aerial photograph interpretation of Morristown National Historical Park, Morris County, New Jersey was performed on black and white aerial photograph stereopairs at 1:16,800 scale (1 in = 1,400 ft.) using a mirror stereoscope. Aerial photograph interpretation and fieldwork were used to delineate vegetation and land use into 13 U.S. National Vegetation Classification associations and four Anderson et al. (1976) Level II (modified) land use categories (Table 2). Associations were mapped based on tone, texture, and position on the landscape. Descriptions of the association signatures on the aerial photos are provided in Appendix A.

Field Data Collection and Classification

All vegetation plot sampling followed the USGS/NPS Vegetation Mapping Program protocols (TNC and ESRI 1994b). Plots were allocated to each vegetation type known to occur in the park, or to unique signatures, with replicate plots assigned over the environmental range of the types to the extent possible. The sampling design called for an average of three plots per targeted type, for a minimum of 22 plots. Plots were subjectively placed so that they were most representative of the surrounding vegetation stand. Additional plots were taken where the vegetation type documented in the field was unclassified or less well known. Vegetation sampling was limited to the Jockey Hollow and New Jersey Brigade units of the park. No plots were allocated to either the Fort Nonsense or Washington's Headquarters units due to their small size, homogeneity of vegetation type, and similarity to the two larger units. Clasification of vegetation in the Fort

Table 1. Summary of key information for Morristown National Historical Park aerial photography digital files.

Title of metadata record:	Morristown National Historical Park
Publication date of mosaic (from metadata):	N/A
Date aerial photography was acquired:	April 24, 1999 (leaf-off)
Vendor that provided aerial photography:	Lockwood Mapping Company, Rochester, New York
Scale of photography:	1:16,800
Type of photography:	Black and white leaf-off conditions
Format of photography:	.tif and .tfw
Projection of photography:	NAD 83 UTM Zone 18

Table 2. U.S. National Vegetation Classification associations and Anderson Level II (modified) land use categories of the preliminary vegetation map for Morristown National Historical Park.

USNVC Code	USNVC Name	Common Name
CEGL006296	*Fagus grandifolia - Betula lenta - Liriodendron tulipifera - Acer saccharum* Forest	Tuliptree - Beech - Maple Forest
CEGL006921	*Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest	Northern Piedmont Mesic Oak - Beech Forest
CEGL007221	*Liriodendron tulipifera - Quercus* spp. Forest	Successional Tuliptree Forest
CEGL006599	*Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana* Forest	Northeastern Modified Successional Forest
CEGL006336	*Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest	Northeastern Dry Oak - Hickory Forest
CEGL006057	*Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest	Dry - Mesic Chestnut Oak - Red Oak Forest
CEGL007279	*Robinia pseudoacacia* Forest	Black Locust Successional Forest
CEGL006406	*Acer rubrum - Fraxinus (pensylvanica, americana) / Lindera benzoin / Symplocarpus foetidus* Forest	Southern New England Red Maple Seepage Swamp
CEGL008416	*Acer rubrum - Fraxinus americana - Fraxinus nigra - Betula alleghaniensis / Veratrum viride - Carex bromoides* Forest	Montane Basic Seepage Swamp
CEGL006566	*Quercus rubra - Tsuga canadensis - Liriodendron tulipifera / Hamamelis virginiana* Forest	Hemlock - Red Oak - Mixed Hardwood Forest
CEGL006107	*Dactylis glomerata - Phleum pratense - Festuca* spp. - *Solidago* ssp. Herbaceous Vegetation	Northeastern Old Field
CEGL006567	*Symplocarpus foetidus - Impatiens capensis* Herbaceous Vegetation	Skunk Cabbage - Orange Jewelweed Seep
CEGL004290	*Polygonum (hydropiperoides, punctatum) - Leersia (lenticularis, virginica)* Herbaceous Vegetation	Smartweed - Cutgrass Wetland
Land Use Code	**Land Use Name**	
UO	Orchards and Plantations	
UP	Pond / Reservoir	
US	Commercial and Services	
UU	Transportation, Communications, and Utilities	

Nonsense and Washington's Headquarters units was accomplished by conducting field reconnaissance prior to mapping, and confirming vegetation types using the dichotomous key following completion of the classification.

Nomenclature follows the PLANTS 3.5 Database developed by the Natural Resources Conservation Service in cooperation with the Biota of North America Program (USDA, NRCS 2006).

Field Survey

Within each polygon selected for sampling, a plot was established in an area that was most representative of the existing vegetation association (Mueller-Dombois and Ellenberg 1974). All vegetation data were collected following NatureServe's accepted natural heritage sampling protocols (Strakosch Walz 2000), with 20×20-m plots in forests and woodlands and 5×5-m plots in herbaceous vegetation. In some cases, where the polygons were too narrow to reasonably accommodate standard plot sizes, the plots were adjusted accordingly, e.g., rectangular plots rather than square plots were used to accommodate linear stands.

Plot forms used in this project are included in Appendix B. Abbreviated instructions for completing this form and definitions of the fields can be found in the USGS/NPS Vegetation Mapping Program: Field Methods for Vegetation Mapping manual (TNC and ESRI 1994b). The vegetation was visually divided into eight strata: emergent trees (variable height), tree canopy (variable height), tree subcanopy (>5 m in height), tall shrub (2–5 m), short shrub (<2 m), herbaceous, non-vascular, and vines. The percent cover was estimated for each species in each stratum using modified Braun - Blanquet cover classes (Strakosch Walz 2000). Specimens of species that were not identifiable in the field were collected for later identification. In addition to floristic information, the following environmental variables were recorded at each plot: slope, aspect, topographic position, and hydrologic regime. Surface soils, where readily visible, were described by stoniness, average soil texture, and soil drainage. Notes were taken on the plot representativeness of the surrounding vegetation and any other significant environmental information, such as landscape context, herbivory, stand health, recent disturbance, or evidence of historic disturbance. The vegetation profile and topographic position were sketched in cross-section to represent the location and setting of the plot. A digital photograph of each plot was also taken. The location of each plot was recorded with a global positioning system (GPS) unit, set to Universal Transverse Mercator Zone 18 North, North American Datum 1983, meters.

Plot sampling was conducted in the summers of 2003 and 2004. In total, 22 plots were sampled in Morristown National Historical Park (Figure 2). All vegetation types were sampled over a range of environmental variables. Sample plots were initially established at two locations so that field staff could become familiar with the sampling protocol used in this project. Before additional plots were chosen, a range of sites was visited to determine the best locations for plots. Attempts were made to sample both the floristic and physical setting variations of a community type within Morristown National Historical Park. Whenever possible, at least three examples were sampled.

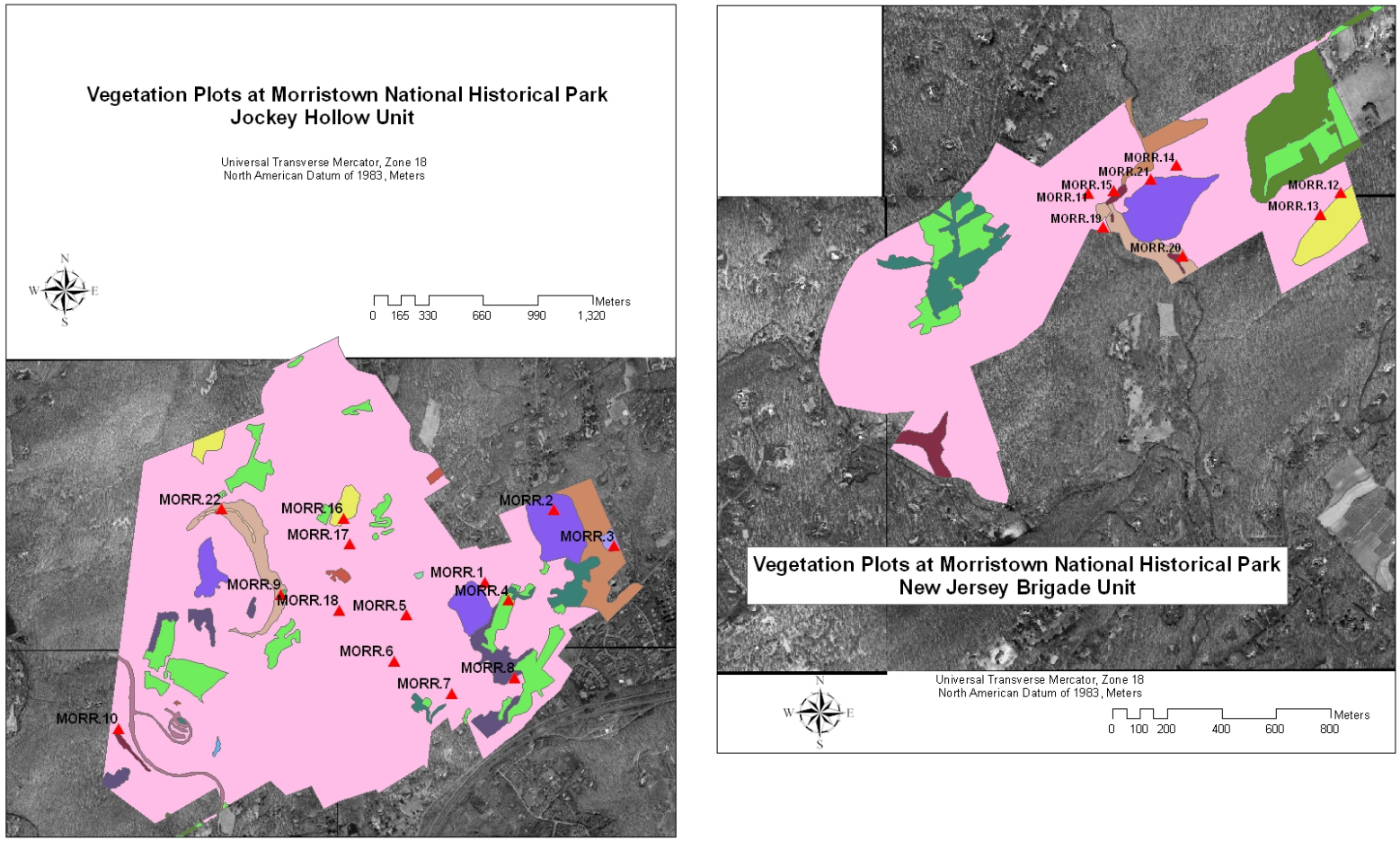

Figure 2. Locations of 22 plots sampled in the Jockey Hollow and New Jersey Brigade units of Morristown National Historical Park.

In all cases, shrub and herbaceous layers were reduced severely by deer browse. Associations that might be distinguished by distinctive shrubs and herbaceous components were obscured by browse and, to some degree, the presence of invasive species. All sample plots were established between late July and late September and sampled for all strata. It was not possible to identify all taxa to species or even to genus at that time because spring ephemerals and sedges were past a stage where field identification was possible and deer browse had reduced many taxa, including shrubs and saplings, to stubs or below-ground parts. All plots were re-visited in early June 2004 to add these species. In only a few plots was the cover of any of these taxa significant. In all plots, numerous species were added to the herbaceous stratum and, in many plots, species were added to the S2 layer (short shrub).

In many cases, stands of ambiguous identity were encountered and sampled. Additional effort was made to locate examples of expected types not readily known or located during the initial effort.

Vegetation Classification and Characterization

Park plot data (22 plots) were entered into PLOTS version 2.0 Database System (NatureServe 2006). A data dictionary for the data fields in PLOTS is included in Appendix C. Species were assigned standardized codes and names based on the PLANTS 3.5 Database developed by the National Resources Conservation Service (NRCS) in cooperation with the Biota of North America Program (BONAP) (USDA, NRCS 2006). Species and plot data for use in classification were formatted into an Excel spreadsheet for use in the PC-ORD version 4.0 Multivariate Analysis package (McCune and Mefford 1999). Because the data were collected in a way that would facilitate the structural description of the types, some species occurred in short shrub and tall shrub layers, or in tree subcanopy and canopy layers. The data were modified to collapse species that were separated into two or more shrub, tree, or herb strata into a single shrub, tree, or herb layer. However, species that occurred in separate tree or shrub or herb layers were retained. Analysis of the plots was completed in TWINSPAN and a Two Way Ordered Table was generated (Appendix D). The invasive species Japanese barberry (*Berberis thunbergii*) and Japanese stiltgrass (*Microstegium vimineum*) were excluded from the analysis.

Each plot was initially compared to the initial subset of U.S. National Vegetation Classification associations (NatureServe 2006) prior to multivariate analysis. Approximately 2/3 of the plots could be readily classified to existing associations. Data were then analyzed using multivariate analysis to test our initial classification and to further elucidate patterns in the data. We used Two-Way Indicator Species Analysis (TWINSPAN) (Hill and Gauch 1979), a program that successively divides the plots into groups that are similar in species composition. Using estimated percent cover (as opposed to cover classes), cut levels were set at 1, 6, 25, 50, and 100%. Minimum group size for division was set at five, and the maximum number of divisions was set at six. Environmental data on soil characteristics and flooding regime for each plot, as well as examination of air photos, was also used to interpret the results. Final classification of plots was informed by TWINSPAN analysis and by comparison with global descriptions. Associations were also crosswalked to the Classification of Plant Communities of New Jersey: Second Iteration (Breden et al. 2001).

Each association has a common name in the USNVC, and a park-specific common name was also created. Detailed local descriptions for each association were written based on the plot data, observation point data, photographs of each plot, and the ecologists' field experiences at Morristown National Historical Park and other nearby national parks. Global information for each association was reported from NatureServe's Biotics 4 database and augmented with new data from the park where appropriate.

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

Vegetation Map Preparation

The vegetation classification and mapping processes were conducted essentially in tandem. Mappers and ecologists conferred to review the list of potential associations, as well as the appropriate scale for mapping. Photos were viewed in stereo and preliminary polygon boundaries were delineated with a .30-mm rapidograph pen on polypropylene sleeves placed over the aerial photos. Preliminary polygons were classified and labeled with their appropriate USNVC association using the aerial photograph interpretation key and USNVC descriptions, and by conferring with NatureServe ecologists. The initial line work was also used to determine a sampling scheme for plot and observation data collection, and the USNVC association list resulting from the field work was used to aid polygon classification.

Field work was performed from 7 May 2003 to 18 September 2003 to groundtruth aerial photograph interpretation. Field consultation was provided by the NatureServe ecologist. Field work is documented on NPS Mapping Observation Point Forms (Appendix F). Original forms were provided to NatureServe and completed forms are included as deliverables as part of this project. Field work was focused on associations that did not have a unique stereoscopic signature on the aerial photographs. Draft line work with labels was submitted to NatureServe for review.

Twenty-seven mapping observation points sampled nine associations in the New Jersey Brigade and Jockey Hollow units (Table 3). Mapping observation point data were collected in conjunction with releves completed as part of the classification of ecological communities of Morristown National Historical Park. Of the observation points, thirteen were within *Fagus grandifolia* - *Betula lenta* - *Quercus* (*alba, rubra*) / *Carpinus caroliniana* Forest and four were in *Liriodendron tulipifera* - *Quercus* spp. Forest.

A Magellan Meridian Gold GPS unit was used to calculate UTM coordinates included on the Mapping Observation Point Form. GPS locations were converted to shapefiles using the DNR Garmin GPS Application (http://www.dnr.state.mn.us/mis/gis/tools/arcview/extensions/DNRGarmin/DNRGarmin.html). All observation points were mapped in ArcGIS 9.1 (Figures 3 and 4).

Table 3. Mapping observation points from the New Jersey Brigade and Jockey Hollow units of Morristown National Historical Park.

Observation Point	USNVC Code	U.S. National Vegetation Classification Association
03050701	CEGL006567	*Symplocarpus foetidus - Impatiens capensis* Herbaceous Vegetation
03050702	CEGL006921	*Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest
03050703	CEGL007279	*Robinia pseudoacacia* Forest
03050704	CEGL007221	*Liriodendron tulipifera - Quercus* spp. Forest
03050705	CEGL006567	*Symplocarpus foetidus - Impatiens capensis* Herbaceous Vegetation
03040706	CEGL006921	*Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest
03050801	CEGL006921	*Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest
03050802	CEGL007221	*Liriodendron tulipifera - Quercus* spp. Forest
03050803	CEGL006296	*Fagus grandifolia - Betula lenta - Liriodendron tulipifera - Acer saccharum* Forest
03050804	CEGL006057	*Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest
03051901	CEGL006921	*Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest
03051902	CEGL006336	*Quercus (alba, rubra, velutina)/Cornus florida / Viburnum acerifolium* Forest
03051903	CEGL007221	*Liriodendron tulipifera - Quercus* spp. Forest
03052001	CEGL006921	*Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest
03052002	CEGL006921	*Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest
03072301	CEGL006336	*Quercus (alba, rubra, velutina)/Cornus florida / Viburnum acerifolium* Forest
03072302	CEGL006921	*Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest
03072303	CEGL006921	*Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest
03072401	CEGL006599	*Prunus serotina - Liriodendron tulipifera - Acer rubrum -Fraxinus americana* Forest
03072402	CEGL007221	*Liriodendron tulipifera - Quercus* spp. Forest
03072403	CEGL006921	*Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest
03072404	CEGL006921	*Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest
03072405	CEGL006921	*Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest
03072501	CEGL006406	*Acer rubrum - Fraxinus (pensylvanica, americana) / Lindera benzoin / Symplocarpus foetidus* Forest
03072502	CEGL006921	*Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest
03072503	CEGL006296	*Fagus grandifolia - Betula lenta - Liriodendron tulipifera - Acer saccharum* Forest
03072504	CEGL006921	*Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest

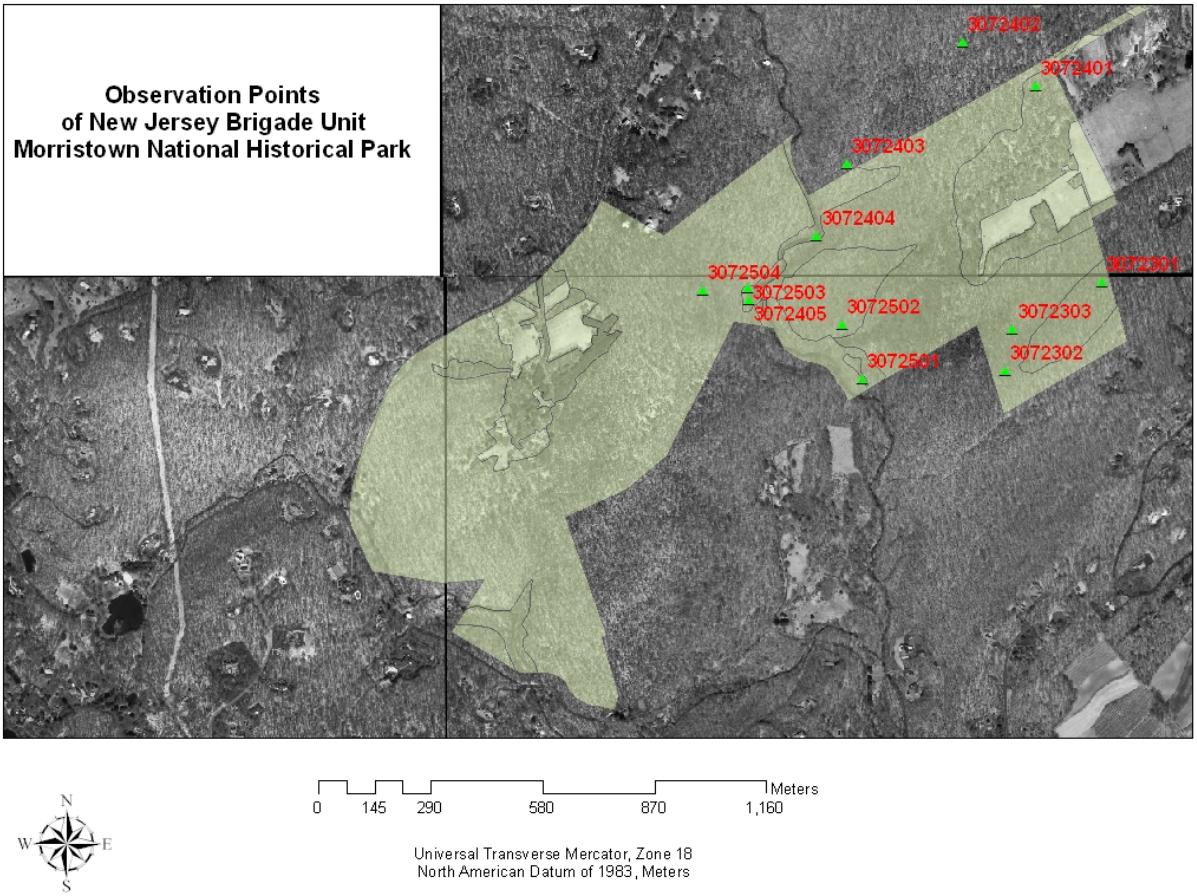

Figure 3. Mapping observation points in the New Jersey Brigade Unit of Morristown National Historical Park.

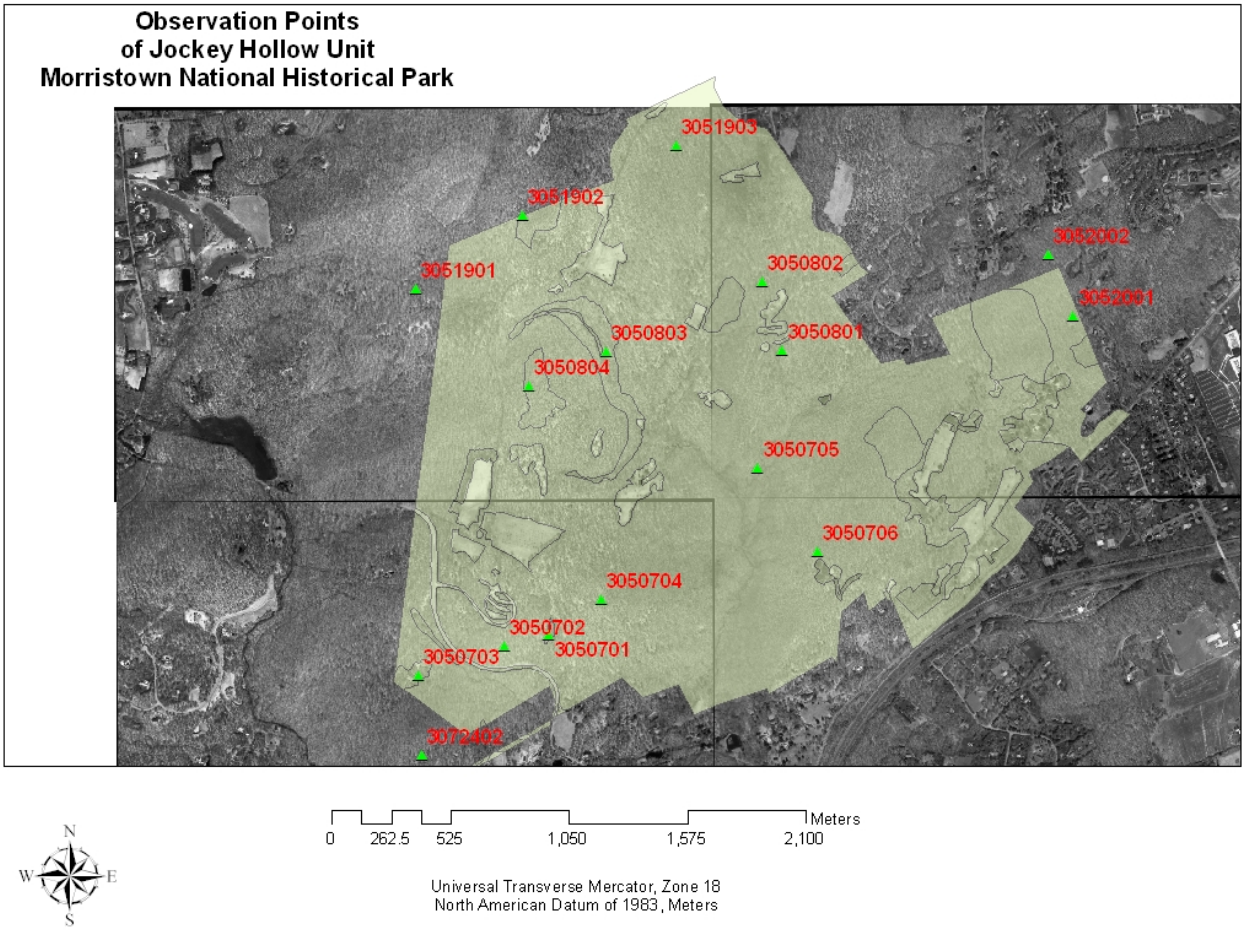

Figure 4. Mapping observation points in the Jockey Hollow Unit of Morristown National Historical Park.

Once delineations were groundtruthed and rectified, USNVC association-level polygon line work was transferred to GIS shapefiles via onscreen digitizing in ArcView v.3.2a (ESRI 1992–2000). USNVC association and Anderson Level II (modified) land use names and codes were added to the attribute table of the vegetation shapefile. A separate wetland map for the park was created from the vegetation map polygons belonging to the Saturated Cold-deciduous Forest and Saturated Temperate Perennial Forb Vegetation formations.

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. Because a photomosaic was not developed for Morristown National Historical Park, horizontal positional accuracy testing was not conducted. The USGS/NPS Vegetation Mapping Program protocols (TNC and ESRI 1994c) were followed to assess the thematic accuracy of the Morristown National Historical Park vegetation map.

Thematic Accuracy Assessment

The thematic accuracy of the association-level map for Morristown National Historical Park was assessed following the USGS/NPS Vegetation Mapping Program protocols (TNC and ESRI 1994c). Sampling was restricted to Jockey Hollow and New Jersey Brigade units. Accuracy assessment was not conducted in either the Fort Nonsense or Washington's Headquarters units due to their small size, homogeneity, and similarity to the two larger units. A stratified random sampling approach was used, distributing the sampling effort across 13 mapped associations. Polygons attributed with land use codes were not included in the accuracy assessment sampling design. In total, 73 thematic accuracy assessment sampling points were placed throughout the association-level map (Table 4).

The following rules were used to determine the number of points assigned to each association (TNC and ESRI 1994c):

Scenario A: The association is abundant. It covers more than 50 hectares of the total area and consists of at least 30 polygons. In this case, it is recommended that 30 polygons be selected at random from the set of the association's polygons. One sampling point will be assigned to each of the 30 selected polygons.

Scenario B: The association is relatively abundant. It covers more than 50 hectares of the total area but consists of fewer than 30 polygons. In this case, it is recommended that 20 polygons be selected at random from the set of the association's polygons, and that one sampling point be assigned to each of the 20 selected polygons. If the association contains less than 20 polygons, some polygons will contain multiple sampling points. The number of sampling points assigned to each polygon is determined by the relative area of that polygon compared with the other polygons in that association.

Table 4. Summary information for mapped vegetation associations and accuracy assessment sampling points[1] in Morristown National Historical Park based on the final association-level vegetation map.

Common Name	USNVC Code	Number of Polygons	Total Mapped Hectares	Number of Accuracy Assessment Sampling Points
Smartweed - Cutgrass Wetland	CEGL004290	1	0.13	1
Northeastern Old Field	CEGL006107	32	36.38	20
Dry-Mesic Chestnut Oak - Red Oak Forest	CEGL006057	4	23.70	4
Tuliptree - Beech - Maple Forest	CEGL006296	3	11.64	3
Northeastern Dry-Oak Hickory Forest	CEGL006336	3	7.91	3
Southern New England Red Maple Seepage Swamp	CEGL006406	5	2.83	5
Hemlock - Red Oak - Mixed Hardwood Forest	CEGL006566	1	0.98	1
Skunk Cabbage - Orange Jewelweed Seep	CEGL006567	1	0.24	1
Modified Successional Forest	CEGL006599	8	10.03	5
Northern Piedmont Mesic Oak - Beech Forest	CEGL006921	2	16.31	2
Northern Piedmont Mesic Oak - Beech Forest and Successional Tuliptree Forest[2]	CEGL006921/ CEGL007221	7	540.98	20
Black Locust Successional Forest	CEGL007279	6	11.19	5
Montane Basic Seepage Swamp	CEGL008416	3	0.58	3
	Total	76	662.88	73

[1] Sampling restricted to Jockey Hollow and New Jersey Brigade units.

[2] Two forest types were indistinguishable on photography and were mapped as a single map unit in most cases. Two polygons that were confirmed in the field as comprising Northern Piedmont Mesic Oak - Beech Forest were mapped as such.

Scenario C: The association is relatively rare. It covers less than 50 hectares of the total area but consists of more than 30 polygons. In this case, it is recommended that 20 polygons be selected at random from the set of the association's polygons. One sampling point will be assigned to each of the 20 selected polygons.

Scenario D: The class is rare. It has 5–30 polygons and covers less than 50 hectares of the area. In this case, it is recommended that five polygons be selected at random from the set of the association's polygons. One sampling point will be assigned to each of the five selected polygons.

Scenario E: The association is very rare. It has fewer than five polygons and occupies less than 50 hectares of the total area. In this case, it is recommended that one sampling point be assigned to each polygon.

The Generate Random Points tool in Hawth's Analysis Tools was used in ArcGIS (Beyer 2004) to randomly select the polygons in Scenarios B and C. The resulting 73 thematic accuracy assessment sampling points are depicted in Figures 5, 6, and 7. For scenario D, five polygons were chosen based on proximity to other accuracy assessment points. For types with fewer than five polygons (scenario E), all polygons were selected for assessment.

During August 2005, each accuracy assessment point was located in the field using either a Garmin 76C or Garmin GPS map 76 unit. The GPS unit was set to Universal Transverse Mercator Zone 18 North, North American Datum 1983, meters. The association at each point was then determined using the dichotomous key and the detailed vegetation descriptions. The minimum area of observation around each sampling point was a circle with a radius of 50 m. The dominant plant species in each stratum, environmental attributes, surrounding associations, rationale for classification, and other comments were noted on a field form (Appendix G). After fieldwork was completed, data from the 73 accuracy assessment points were entered into the NatureServe PLOTS 2.0 Database (NatureServe 2004).

The thematic accuracy was then tabulated using a contingency matrix that compared the mapped associations with the actual associations observed in the field. Overall percent accuracy and the Kappa index were calculated (TNC and ESRI 1994c). Overall percent accuracy was calculated by dividing the number of correctly classified accuracy assessment points by the total number of accuracy assessment points. The Kappa index is the preferred method of reporting overall thematic accuracy because it takes into account that a certain number of correct classifications will occur by chance (Foody 1992).

Errors of omission and errors of commission were also calculated for each association. Both of these errors are calculated by dividing the number of correctly classified points in one association by the total number of points sampled in that association. Errors of omission indicate the probability that an accuracy assessment point classification will be correct and are calculated by mapped vegetation type. Errors of commission indicate the probability that a mapped vegetation type actually represents the vegetation on the ground. This error is calculated by observed vegetation type (TNC and ESRI 1994c).

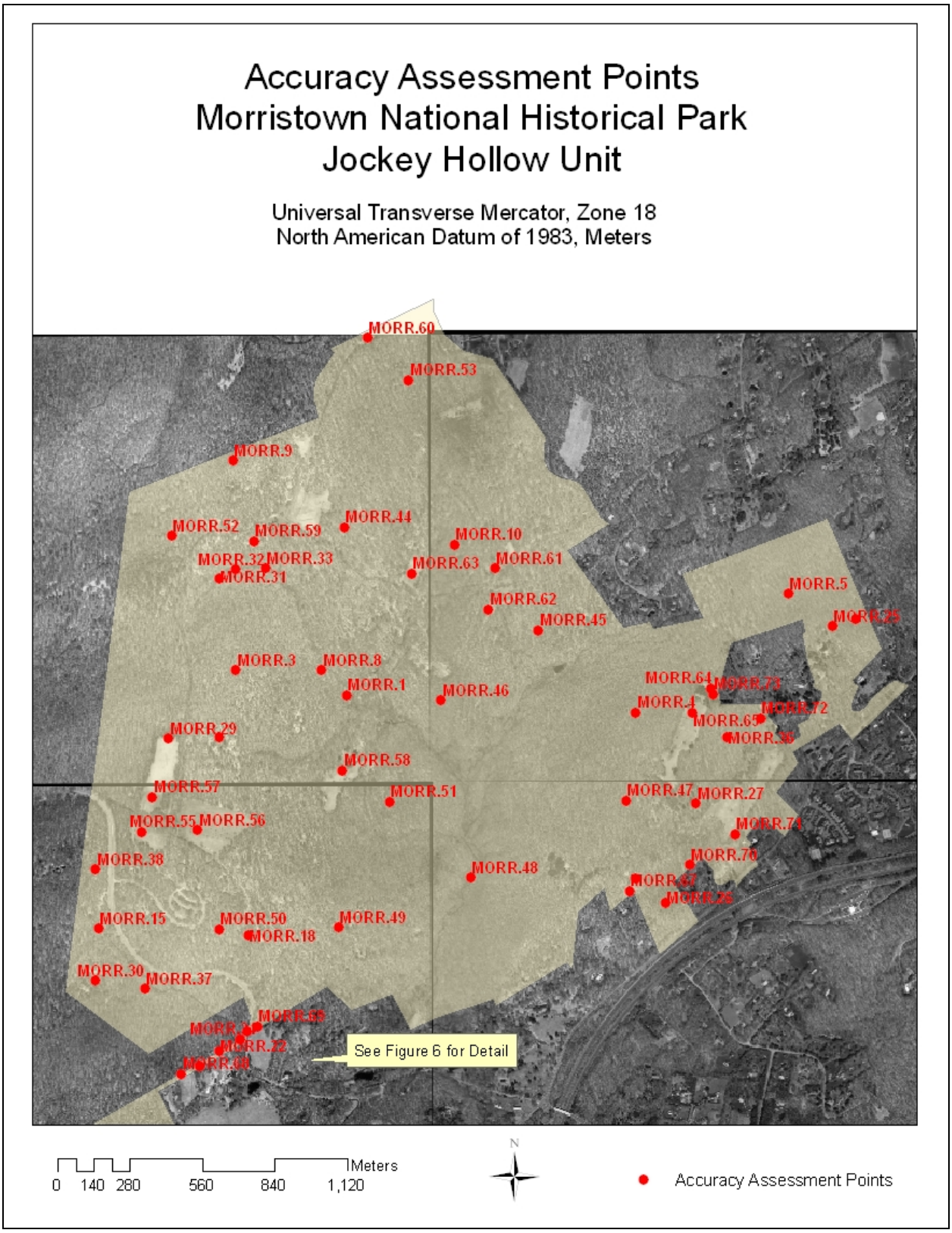

Figure 5. Location of accuracy assessment points in Morristown National Historical Park, Jockey Hollow Unit.

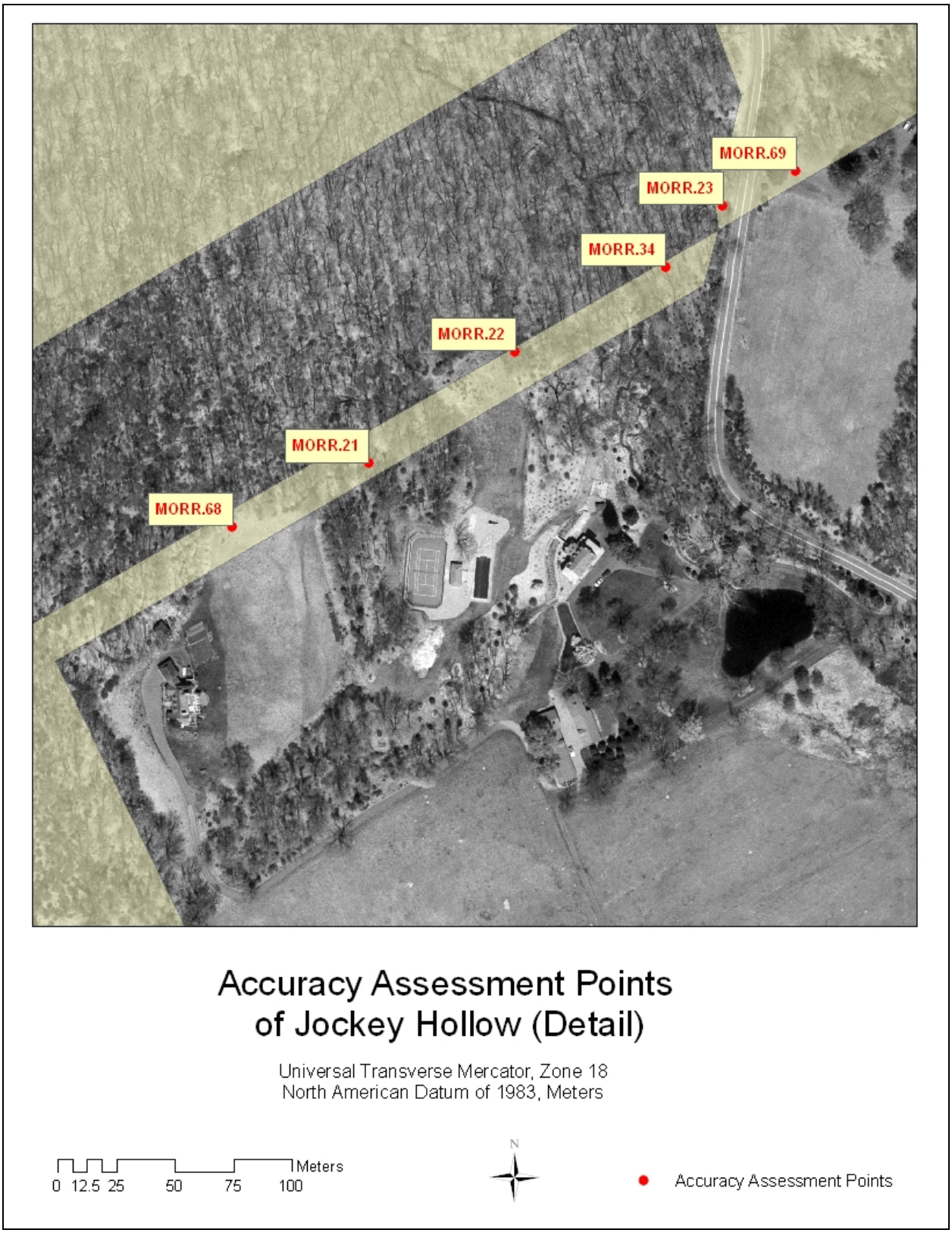

Figure 6. Location of accuracy assessment points in Morristown National Historical Park, Jockey Hollow (Detail).

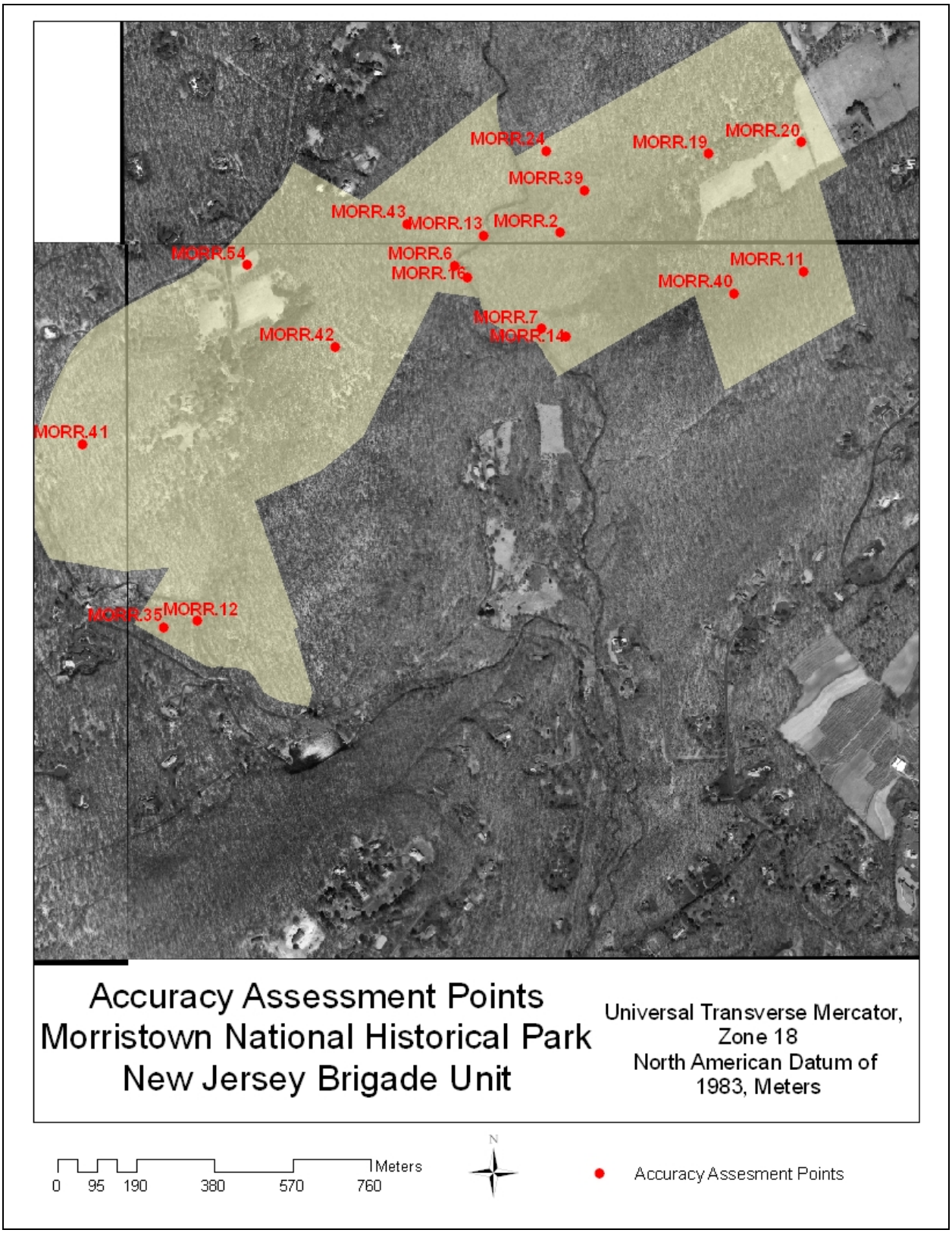

Figure 7. Location of accuracy assessment points in Morristown National Historical Park, New Jersey Brigade Unit.

Results

Vegetation Classification and Characterization

Cluster analysis grouped the plots based on species and cover. While 22 plots are insufficient to capture the variation in all of the vegetation types, TWINSPAN results successfully shows the higher-level divisions in the vegetation (Appendix D). The successive division of plots resulted first in the splitting of two plots that differed greatly from each other and from the remainder of the plots. Each plot represented one association, the Smartweed - Cutgrass Wetland (MORR.09) and the Northeastern Old Field (MORR.04). The second division yielded four plots representing red maple (*Acer rubrum*) seepage swamps. Further examination of these four plots resulted in the identification of two swamp types: three plots representing the Southern New England Red Maple Seepage Swamp (MORR.10, MORR.15, MORR.20) and one representing the Montane Basic Seepage Swamp (MORR.22). The next division separated the Black Locust Successional Forest (MORR.08).

The remaining fifteen plots are upland forest types and, for the most part, do not separate cleanly in the analysis in a way that corresponds to the USNVC, presumably due to an overlap in tree species composition and an under-representation of the heavily-browsed shrub and herbaceous layers, which are more diagnostic. One group of two plots emerged, representing the Dry-Mesic Chestnut Oak - Red Oak Forest (MORR.01, MORR.02). Three additional USNVC types are represented by single plots: Tuliptree - Beech - Maple Forest (MORR.19), Successional Tuliptree Forest (MORR.17), and Hemlock - Red Oak - Mixed Hardwood Forest (MORR.03). The most abundant forest type in the park, the Northern Piedmont Mesic Oak - Beech Forest, is represented by seven plots (MORR.05, MORR.06, MORR.07, MORR.11, MORR.14, MORR.18, MORR.21). The remaining association, the Northeastern Dry Oak - Hickory Forest, is represented by three plots (MORR.12, MORR.13, MORR.16).

Two associations were represented by observation points only and were not included in the cluster analysis. Northeastern Modified Successional Forest (one observation point) and Skunk Cabbage - Orange Jewelweed Seep (two observation points) were classified by direct comparison to existing USNVC associations.

Based on these analyses and the evaluation of the results, it was determined that the vegetation at Morristown National Historic Park can be described by 14 vegetation associations (Table 5). Eleven of these associations are forested and three are herbaceous. Ten of these types are upland community types and four are wetland communities. All associations except one are mapped. The exception, the Upland / Wetland Transitional Forest, is not discernible on aerial photography. All of the associations are either common types or ruderal (weedy) types of anthropogenic origin except one. The exception is the Montane Basic Seepage Swamp, an association of the Central Appalachian Ecoregion, ranging to the adjacent piedmont. This association is ranked G3, defined as “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)”. This association occurs at one location in Morristown National Historical Park, and it supports much higher species diversity than any of the other associations occurring in the park.

Table 5. Map classes and corresponding USNVC associations of the final association-level vegetation map for Morristown National Historical Park.

Map Class	USNVC Common Name	USNVC Scientific Name	USNVC Code
Tuliptree - Beech - Maple Forest	Tuliptree - Beech - Maple Forest	*Fagus grandifolia - Betula lenta - Liriodendron tulipifera - Acer saccharum* Forest	CEGL006296
Northern Piedmont Mesic Oak - Beech Forest	Northern Piedmont Mesic Oak - Beech Forest	*Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest	CEGL006921
Northern Piedmont Mesic Oak - Beech Forest and Successional Tuliptree Forest	Northern Piedmont Mesic Oak - Beech Forest	*Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest	CEGL006921
	Successional Tuliptree Forest	*Liriodendron tulipifera - Quercus* spp. Forest	CEGL007221
Northeastern Modified Successional Forest	Northeastern Modified Successional Forest	*Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana* Forest	CEGL006599
Northeastern Dry Oak-Hickory Forest	Northeastern Dry Oak-Hickory Forest	*Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest	CEGL006336
Chestnut Oak Forest	Dry-Mesic Chestnut Oak - Red Oak Forest	*Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest	CEGL006057
Not Mapped	Upland/ Wetland Transitional Forest	*Quercus rubra - Betula alleghaniensis / Osmunda cinnamomea* Forest	CEGL006000
Black Locust Successional Forest	Black Locust Successional Forest	*Robinia pseudoacacia* Forest	CEGL007279
Southern New England Red Maple Seepage Swamp	Southern New England Red Maple Seepage Swamp	*Acer rubrum - Fraxinus (pennsylvanica, americana) / Lindera benzoin / Symplocarpus foetidus* Forest	CEGL006406
Montane Basic Seepage Swamp	Montane Basic Seepage Swamp	*Acer rubrum - Fraxinus americana - Fraxinus nigra - Betula alleghaniensis / Veratrum viride - Carex bromoides* Forest	CEGL008416
Hemlock - Red Oak - Mixed Hardwood Forest	Hemlock - Red Oak - Mixed Hardwood Forest	*Quercus rubra - Tsuga canadensis - Liriodendron tulipifera / Hamamelis virginiana* Forest	CEGL006566
Upland Field / Meadow	Northeastern Old Field	*Dactylis glomerata - Phleum pratense - Festuca* spp. - *Solidago* spp. Herbaceous Vegetation	CEGL006107
Skunk Cabbage Woodland Seep	Skunk Cabbage - Orange Jewelweed Seep	*Symplocarpus foetidus - Impatiens capensis* Herbaceous Vegetation	CEGL006567
Herbaceous Wetland	Smartweed - Cutgrass Wetland	*Polygonum (hydropiperoides, punctatum) - Leersia (lenticularis, virginica)* Herbaceous Vegetation	CEGL004290

Association Descriptions

Fields used in the local and global descriptions are defined in Appendix H. 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 follows Anderson (1990) for nonvascular plants 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.

The association descriptions contain information on the natural communities present at Morristown National Historical Park ("Local Information") and range-wide ("Global Information"). The local descriptions are specific to their expressions at Morristown National Historical Park. The descriptions include an association, Upland / Wetland Transitional Forest, not included in the association-level map because occurrences were below the minimum mapping unit size (0.5 ha). Representative photographs taken in sampled plots of vegetation types, except Northeastern Modified Successional Forest, Upland / Wetland Transitional Forest, and Skunk Cabbage - Orange Jewelweed Seep, are provided after each description.

A list of the plants found during the vegetation plot sampling and thematic accuracy assessment sampling is located in Appendix I. An index of the plot and association photos is located in Appendix J (by photo number) and Appendix K (by plot number). A bibliography for the sources cited in the global vegetation descriptions from the USNVC is provided in Appendix L.

COMMON NAME (PARK-SPECIFIC): TULIPTREE - BEECH - MAPLE FOREST

SYNONYMS

USNVC English Name: **American Beech - Sweet Birch - Tuliptree - Sugar Maple Forest**

USNVC Scientific Name: ***Fagus grandifolia - Betula lenta - Liriodendron tulipifera - Acer saccharum* Forest**

USNVC Identifier: **CEGL006296**

LOCAL INFORMATION

Environmental Description: This vegetation occurs on lower slopes of stream corridors. Slopes above the occurrence are steep and rocky. Soils are rich with small pockets of loam among a mass of rocks generally 20–80 cm across. In one area, soils are so stony that it is not possible to set a wire flag. The general area is subject to severe deer browse. Most herbaceous species are eliminated by late summer with the exception of a few sedges and ferns. There is nearly a complete elimination shrubs and tree recruitment. The understory is very open.

Vegetation Description: The canopy is partially open (65%) with a well-developed subcanopy (50–85%). Canopy dominants include *Acer saccharum* (sugar maple), *Betula lenta* (sweet birch), *Fagus grandifolia* (American beech), and *Liriodendron tulipifera* (tuliptree). *Quercus* (oak) spp. are of minor importance and may include low cover of *Quercus alba* (white oak) or *Quercus rubra* (northern red oak). Subcanopy species include *Fagus grandifolia* (American beech), *Acer saccharum* (sugar maple), *Ostrya virginiana* (hophornbeam), and *Carpinus caroliniana* (American hornbeam). There are few shrubs and only minor tree species recruitment limited to *Acer saccharum* (sugar maple) and *Fagus grandifolia* (American beech) resprouts. Herbaceous species cover and diversity are moderately high, characterized by *Carex pensylvanica* (Pennsylvania sedge), *Carex platyphylla* (broadleaf sedge), *Chimaphila maculata* (striped prince's pine), *Arisaema triphyllum* (Jack in the pulpit), *Thelypteris noveboracensis* (New York fern), *Podophyllum peltatum* (mayapple), *Galium circaezans* (licorice bedstraw), and *Polystichum acrostichoides* (Christmas fern).

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer saccharum* (sugar maple)
Tree canopy	Broad-leaved deciduous tree	*Betula lenta* (sweet birch)
		Fagus grandifolia (American beech)
		Liriodendron tulipifera (tuliptree)
		Carya glabra (pignut hickory)
Tree subcanopy	Broad-leaved deciduous tree	*Carpinus caroliniana* (American hornbeam)
		Ostrya virginiana (hophornbeam)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)
Herb (field)	Fern or fern ally	*Polystichum acrostichoides* (Christmas fern)

Characteristic Species: *Acer saccharum* (sugar maple), *Betula lenta* (sweet birch), *Fagus grandifolia* (American beech), *Liriodendron tulipifera* (tuliptree), *Quercus alba* (white oak) *Viburnum acerifolium* (mapleleaf viburnum), *Phegopteris hexagonoptera* (broad beechfern).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NJ	SNR	.	.	[not crosswalked]	.

Local Range: Western border of Passaic River, New Jersey Brigade Unit.

Classification Comments: Severe browse by deer has obscured details for shrub and herbaceous species. There are likely other occurrences within either the park or at nearby conservation areas that may add more information about this association.
Other Comments: This association was not recognized by Ehrenfeld (1977). Hardwood stands with *Acer saccharum* (sugar maple) were included in her Mixed Oak - Yellow Poplar community.
Local Description Authors: R. E. Zaremba.
Plots: MORR.19, JThompson 03072503, JThompson 03050803.
Morristown National Historical Park Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Fagus grandifolia - Acer saccharum - (Liriodendron tulipifera)* Forest Alliance (A.227)
Alliance (English name)	American Beech - Sugar Maple - (Tuliptree) Forest Alliance
Association	*Fagus grandifolia - Betula lenta - Liriodendron tulipifera - Acer saccharum* Forest
Association (English name)	American Beech - Sweet Birch - Tuliptree - Sugar Maple Forest
Ecological System(s):	Northeastern Interior Dry-Mesic Oak Forest (CES202.592).

GLOBAL DESCRIPTION

Concept Summary: This mid- to lower slope deciduous forest of the mid-Atlantic region occurs on deep soils that are not strongly acidic. The tree canopy is characterized by a mixture of *Liriodendron tulipifera* (tuliptree), *Fagus grandifolia* (American beech), *Acer saccharum* (sugar maple), *Fraxinus americana* (white ash), *Betula lenta* (sweet birch), and other associated species, including *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Nyssa sylvatica* (blackgum), and *Carya alba* (mockernut hickory). The subcanopy, where present, is characterized by *Carpinus caroliniana* (American hornbeam), *Cornus florida* (flowering dogwood), and *Ostrya virginiana* (hophornbeam). Common species of the shrub layer include *Hamamelis virginiana* (American witchhazel) and *Lindera benzoin* (northern spicebush). The herbaceous layer is characterized by *Podophyllum peltatum* (mayapple), *Sanguinaria canadensis* (bloodroot), *Botrychium virginianum* (rattlesnake fern), *Dicentra cucullaria* (Dutchman's breeches), *Dicentra canadensis* (squirrel corn), *Allium tricoccum* (wild leek), and *Claytonia virginica* (Virginia springbeauty). Associated herbs may include *Polystichum acrostichoides* (Christmas fern), *Ageratina altissima var. altissima* (white snakeroot), and *Arisaema triphyllum* (Jack in the pulpit). Invasive species such as *Berberis thunbergii* (Japanese barberry), *Elaeagnus umbellata* (autumn olive), *Rosa multiflora* (multiflora rose), and *Alliaria petiolata* (garlic mustard) may be present and locally abundant in the shrub and herb layers. This vegetation type often occurs on land where evidence of past agriculture or silviculture is visible.
Environmental Description: This vegetation occurs on middle to lower slopes on moderately deep soils that are not extremely acidic.
Vegetation Description: The tree canopy is characterized by a mixture of *Liriodendron tulipifera* (tuliptree), *Fagus grandifolia* (American beech), *Acer saccharum* (sugar maple), *Fraxinus americana* (white ash), *Betula lenta* (sweet birch), and other associated species,

including *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Nyssa sylvatica* (blackgum), and *Carya alba* (mockernut hickory). The subcanopy, where present, is characterized by *Carpinus caroliniana* (American hornbeam), *Cornus florida* (flowering dogwood), and *Ostrya virginiana* (hophornbeam). Common species of the shrub layer include *Hamamelis virginiana* (American witchhazel) and *Lindera benzoin* (northern spicebush). The herbaceous layer is characterized by *Podophyllum peltatum* (mayapple), *Sanguinaria canadensis* (bloodroot), *Botrychium virginianum* (rattlesnake fern), *Dicentra cucullaria* (Dutchman's breeches), *Dicentra canadensis* (squirrel corn), *Allium tricoccum* (wild leek), and *Claytonia virginica* (Virginia springbeauty). Associated herbs may include *Polystichum acrostichoides* (Christmas fern), *Ageratina altissima var. altissima* (white snakeroot), and *Arisaema triphyllum* (Jack in the pulpit). Invasive species such as *Berberis thunbergii* (Japanese barberry), *Elaeagnus umbellata* (autumn olive), *Rosa multiflora* (multiflora rose), and *Alliaria petiolata* (garlic mustard) may be present and locally abundant in the shrub and herb layers.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer saccharum* (sugar maple)
		Liriodendron tulipifera (tuliptree)
Tree subcanopy	Broad-leaved deciduous tree	*Carpinus caroliniana* (American hornbeam)
		Cornus florida (flowering dogwood)
		Ostrya virginiana (hophornbeam)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Hamamelis virginiana* (American witchhazel)
		Lindera benzoin (northern spicebush)
Herb (field)	Forb	*Podophyllum peltatum* (mayapple)
Herb (field)	Fern or fern ally	*Botrychium virginianum* (rattlesnake fern)

Characteristic Species: *Acer saccharum* (sugar maple), *Allium tricoccum* (wild leek), *Betula lenta* (sweet birch), *Botrychium virginianum* (rattlesnake fern), *Carpinus caroliniana* (American hornbeam), *Claytonia virginica* (Virginia springbeauty), *Cornus florida* (flowering dogwood), *Dicentra cucullaria* (Dutchman's breeches), *Fagus grandifolia* (American beech), *Liriodendron tulipifera* (tuliptree), *Ostrya virginiana* (hophornbeam), *Podophyllum peltatum* (mayapple), *Sanguinaria canadensis* (bloodroot).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This vegetation is currently described primarily from Pennsylvania and is also documented in New Jersey. It may occur in Maryland.

States/Provinces: MD?, NJ, PA.

Federal Lands: NPS (Allegheny Portage Railroad, Delaware Water Gap, Friendship Hill, Morristown); USFWS (Erie).

CONSERVATION STATUS

Rank: GNR (6-Dec-2004).

Reasons: More information is required to determine the range and rank of this vegetation type.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

Comments: This description is based on the tuliptree - beech - maple forest of Fike (1999) as well as samples from NPS mapping projects in Pennsylvania and New Jersey. More information is required to determine the range of this type.

Similar Associations:

- *Fagus grandifolia - Acer saccharum - Liriodendron tulipifera Unglaciated* Forest (CEGL002411)--also contains *Liquidambar styraciflua, Asimina triloba, Carya cordiformis,* and *Betula lenta* is absent.
- *Fagus grandifolia - Acer saccharum* Glaciated Midwest Forest (CEGL005013)--has a shrub layer characterized by *Diervilla lonicera, Euonymus obovatus, Lonicera canadensis*, and *Betula lenta is absent.*
- *Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest (CEGL006921)--lacks *Acer saccharum,* and *Quercus* spp. are more important.

Related Concepts:

- Mixed Oak - Yellow Poplar community (Ehrenfeld 1977) I

SOURCES

Description Authors: J. Fike and L. A. Sneddon, mod. E. Largay and S. C. Gawler.

References: Eastern Ecology Working Group n.d., Ehrenfeld 1977, Fike 1999, Perles et al. 2007.

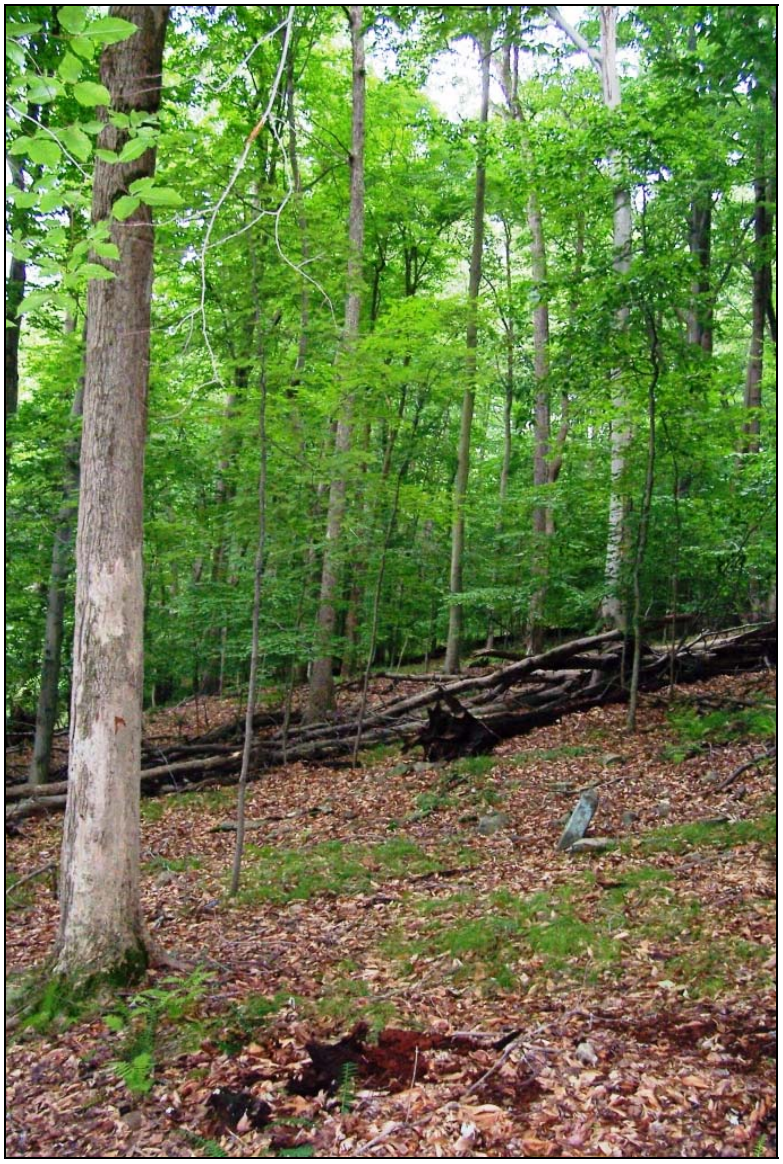

Figure 8. Tuliptree - Beech - Maple Forest in Morristown National Historical Park (plot MORR.19, photo 19-1). July 2005. NAD 1983 / UTM easting 537737, northing 4510989.

COMMON NAME (PARK-SPECIFIC): NORTHERN PIEDMONT MESIC OAK - BEECH FOREST

SYNONYMS

USNVC English Name:	**American Beech - Sweet Birch - (White Oak, Northern Red Oak) / American Hornbeam Forest**
USNVC Scientific Name:	***Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest**
USNVC Identifier:	**CEGL006921**

LOCAL INFORMATION

Environmental Description: This association occurs from low to midslope positions of hills throughout the park. Soils are extremely rocky with lenses of loam. Leaf litter is typically less than 1 cm deep but continuous over the surface. Most sites have 1–3% downed woody material and scattered decaying logs. Many sites have evidence of past logging. Deer browse is severe at all occurrences.

Vegetation Description: Canopy cover is generally high, ranging from 65–95% with an average cover of 80%. Subcanopy cover can vary from 0–50%. The canopy is dominated by *Fagus grandifolia* (American beech) and *Betula lenta* (sweet birch), with common associates including *Quercus alba* (white oak), *Quercus velutina* (black oak), *Quercus rubra* (northern red oak), and *Liriodendron tulipifera* (tuliptree). Other frequently present species include *Acer rubrum* (red maple), *Carya glabra* (pignut hickory), and *Quercus prinus* (chestnut oak). Most occurrences have dramatically reduced shrub layers. Frequently encountered species in the tall-shrub layer include *Carpinus caroliniana* (American hornbeam), *Nyssa sylvatica* (blackgum), *Hamamelis virginiana* (American witchhazel), and *Fagus grandifolia* (American beech). The short-shrub layer includes *Acer rubrum* (red maple), *Vaccinium pallidum* (Blue Ridge blueberry), and *Liriodendron tulipifera* (tuliptree) with occasional young *Carya* (hickory) saplings. Although there may be frequent seedlings of *Acer rubrum* (red maple) and *Liriodendron tulipifera* (tuliptree), few survive browse to become saplings. *Berberis thunbergii* (Japanese barberry) is present at most sites. Some locations support only a few *Berberis thunbergii* (Japanese barberry) individuals; others have a dense layer of *Berberis thunbergii* (Japanese barberry). The herbaceous layer is highly variable. Some sites support a moderate cover of *Carex pensylvanica* (Pennsylvania sedge) (20–40%), while others have less than 1% herbaceous plant cover. Other common herbaceous species include *Carex rosea* (rosy sedge), *Carex swanii* (Swan's sedge), *Carex digitalis* (slender woodland sedge), *Carex platyphylla* (broadleaf sedge), *Eurybia divaricata* (white wood aster), *Maianthemum canadense* (Canada mayflower), *Medeola virginiana* (Indian cucumber), *Arisaema triphyllum* (Jack in the pulpit), *Viola* (violet) spp., *Thelypteris noveboracensis* (New York fern), and *Polystichum acrostichoides* (Christmas fern). The cover of herbaceous plants can be very different between spring and late summer, primarily related to browse effects. *Eurybia divaricata* (white wood aster), *Maianthemum canadense* (Canada mayflower), *Medeola virginiana* (Indian cucumber), and *Viola* (violet) spp. should all be evident in late summer but are rarely encountered despite frequent occurrence in spring surveys.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Betula lenta* (sweet birch)
		Fagus grandifolia (American beech)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Carpinus caroliniana* (American hornbeam)
		Hamamelis virginiana (American witchhazel)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)

Characteristic Species: *Betula lenta* (sweet birch), *Carpinus caroliniana* (American hornbeam), *Fagus grandifolia* (American beech), *Quercus velutina* (black oak), *Betula alleghaniensis* (yellow birch), *Quercus rubra* (northern red oak), *Sassafras albidum* (sassafras), *Polystichum acrostichoides* (Christmas fern).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NJ	SNR	.	.	[not crosswalked]	.

Local Range: This association is the most abundant within both Jockey Hollow and the New Jersey Brigade. Good examples occur on the west and south sides of Mt. Kemble and along Primrose Brook. There are also good examples on the east side of the Passaic River.

Classification Comments: This association is the matrix forest at both Jockey Hollow and the New Jersey Brigade unit.

Other Comments: This association is included in several community types identified by Ehrenfeld (1977): Mixed Oak - Black Birch, Mixed Oak - Yellow Poplar, Mixed Oak - Beech, and Mixed Hardwoods. In Ehrenfeld's Mixed Oak - Beech Forest, which is in large part synonymous with this association, in 1977, shrub cover of *Viburnum acerifolium* (mapleleaf viburnum) and *Vaccinium corymbosum* (highbush blueberry) was about 25%. For the 21 plots and observation points sampled in 2003 and 2004, cover of tall shrubs varied from 0 to 45% with only four samples over 10%. In all these samples, *Fagus grandifolia* (American beech) constituted the majority of the cover. Short-shrub cover in these same 21 samples varied from 0 to 25% with only two sampled areas with short-shrub cover over 8%. The most frequently mentioned short shrub was *Berberis thunbergii* (Japanese barberry) which also generally had the high cover. *Viburnum acerifolium* (mapleleaf viburnum) does not appear in any layer in any of these 21 sampled areas. *Viburnum acerifolium* (mapleleaf viburnum) is no longer a significant part of the shrub layer, probably reflecting the effects of severe browse by deer.

Local Description Authors: R. E. Zaremba.

Plots: MORR.05, MORR.06, MORR.07, MORR.11, MORR.14, MORR.18, MORR.21, JThompson03072504, JThompson03072405, JThompson03072404, JThompson03072403, JThompson03072303, JThompson03072302, JThompson03052002, JThompson03052001, JThompson03051901, JThompson03050 801, JThompson03050706, JThompson03050702.

Morristown National Historical Park Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Fagus grandifolia* - *Quercus rubra* - *Quercus alba* Forest Alliance (A.229)

Alliance (English name)	American Beech - Northern Red Oak - White Oak Forest Alliance
Association	*Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest
Association (English name)	American Beech - Sweet Birch - (White Oak, Northern Red Oak) / American Hornbeam Forest
Ecological System(s):	Northeastern Interior Dry-Mesic Oak Forest (CES202.592).

GLOBAL DESCRIPTION

Concept Summary: This mesic hardwood forest occurs in the northern Piedmont of New Jersey, Delaware, and is likely to occur in Maryland. This association occurs on gently sloping sites, and soils may be rocky. The canopy is characterized by *Fagus grandifolia* (American beech), *Liriodendron tulipifera* (tuliptree), and *Betula lenta* (sweet birch), with associated species including *Quercus alba* (white oak), *Quercus rubra* (northern red oak), *Nyssa sylvatica* (blackgum), *Fraxinus americana* (white ash), and *Carya* (hickory) spp. The shrub layer is dominated by *Carpinus caroliniana* (American hornbeam), with lesser amounts of *Cornus florida* (flowering dogwood), *Hamamelis virginiana* (American witchhazel), and *Lindera benzoin* (northern spicebush). Other shrub associates include *Viburnum acerifolium* (mapleleaf viburnum), *Vaccinium pallidum* (Blue Ridge blueberry), *Viburnum dentatum* (southern arrowwood), and *Hamamelis virginiana* (American witchhazel). The herbaceous layer is characterized by *Polystichum acrostichoides* (Christmas fern), *Arisaema triphyllum* (Jack in the pulpit), *Thelypteris noveboracensis* (New York fern), *Mitchella repens* (partridgeberry), *Medeola virginiana* (Indian cucumber), *Polystichum acrostichoides* (Christmas fern), *Parthenocissus quinquefolia* (Virginia creeper), *Polygonatum biflorum* (smooth Solomon's seal), *Galium circaezans* (licorice bedstraw), *Botrychium virginianum* (rattlesnake fern), and *Amphicarpaea bracteata* (American hogpeanut). This association is similar to *Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / (Ilex opaca var. opaca) / Polystichum acrostichoides* Forest (CEGL006075) but is characterized by the presence of *Betula lenta* (sweet birch) and the lack or negligible presence of Coastal Plain species such as *Ilex opaca* (American holly) or *Liquidambar styraciflua* (sweetgum).

Environmental Description: This association occurs on gently sloping sites, and soils may be rocky.

Vegetation Description: These mesic hardwood forests occur north of the Coastal Plain (especially in the northern Piedmont of New Jersey). The canopy is characterized by *Fagus grandifolia* (American beech), *Liriodendron tulipifera* (tuliptree), and *Betula lenta* (sweet birch), with associated species including *Quercus alba* (white oak), *Quercus rubra* (northern red oak), *Nyssa sylvatica* (blackgum), *Fraxinus americana* (white ash), and *Carya* (hickory) spp. The shrub layer is dominated by *Carpinus caroliniana* (American hornbeam), with lesser amounts of *Cornus florida* (flowering dogwood), *Hamamelis virginiana* (American witchhazel), and *Lindera benzoin* (northern spicebush). Other shrub associates include *Viburnum acerifolium* (mapleleaf viburnum), *Vaccinium pallidum* (Blue Ridge blueberry), *Viburnum dentatum* (southern arrowwood), and *Hamamelis virginiana* (American witchhazel). The herbaceous layer is characterized by *Polystichum acrostichoides* (Christmas fern), *Arisaema triphyllum* (Jack in the pulpit), *Thelypteris noveboracensis* (New York fern), *Mitchella repens* (partridgeberry), *Medeola virginiana* (Indian cucumber), *Parthenocissus quinquefolia* (Virginia creeper), *Polygonatum biflorum* (smooth Solomon's seal), *Galium circaezans* (licorice bedstraw), *Botrychium virginianum* (rattlesnake fern), and *Amphicarpaea bracteata* (American hogpeanut).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Betula lenta* (sweet birch)
		Fagus grandifolia (American beech)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Carpinus caroliniana* (American hornbeam)

Characteristic Species: *Betula lenta* (sweet birch), *Carpinus caroliniana* (American hornbeam), *Fagus grandifolia* (American beech), *Quercus alba* (white oak), *Quercus rubra* (northern red oak).
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This vegetation occurs in the Mid-Atlantic states.
States/Provinces: DE, MD?, NJ, PA.
Federal Lands: NPS (Morristown); USFWS (Great Swamp).

CONSERVATION STATUS

Rank: GNR (7-Nov-2000).
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 2 - Moderate.
Comments: This vegetation was initially described based on GAP GT sites (SM3, SM5, SM6) within Sourland Mountain Preserve. This association is similar to *Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / (Ilex opaca var. opaca) / Polystichum acrostichoides* Forest (CEGL006075), except it occurs north of the Coastal Plain.
Similar Associations:

- *Fagus grandifolia - Betula lenta - Liriodendron tulipifera - Acer saccharum* Forest (CEGL006296).
- *Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / (Ilex opaca var. opaca) / Polystichum acrostichoides* Forest (CEGL006075).
- *Quercus rubra - Betula alleghaniensis / Osmunda cinnamomea* Forest (CEGL006000).

Related Concepts:

- Mixed Hardwoods community (Ehrenfeld 1977) I
- Mixed Oak - Beech community (Ehrenfeld 1977) I
- Mixed Oak - Yellow Poplar community (Ehrenfeld 1977) I
- Mixed oak - Black Birch community (Ehrenfeld 1977) I

SOURCES

Description Authors: L. A. Sneddon.
References: Bowman 2000, Eastern Ecology Working Group n.d., Ehrenfeld 1977.

Figure 9. Northern Piedmont Mesic Oak - Beech Forest in Morristown National Historical Park (plot MORR.06, photo 6-2). July 2005. NAD 1983 / UTM easting 539913, northing 4512773.

COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL TULIPTREE FOREST

SYNONYMS
USNVC English Name: **Tuliptree - Oak species Forest**
USNVC Scientific Name: ***Liriodendron tulipifera* - *Quercus* spp. Forest**
USNVC Identifier: **CEGL007221**

LOCAL INFORMATION

Environmental Description: This association is found on flat terrain and on lower or middle slopes of hills in areas that have been heavily logged or released from agricultural uses, such as pastures or tilled ground. It is common on Edneyville and Cokesbury soil types, which are characterized as stony with loam or gravelly loam.
Vegetation Description: The canopy of this association is tall, often over 30 m, and is strongly dominated by *Liriodendron tulipifera* (tuliptree). At some locations, it is the only tree species present. Common associates include *Quercus alba* (white oak), *Robinia pseudoacacia* (black locust),and *Ailanthus altissima* (tree of heaven). This association generally has very low diversity. *Berberis thunbergii* (Japanese barberry) is present at most sites and may be relatively abundant. Other invasive shrub species frequently present in this association include *Rosa multiflora* (multiflora rose), *Euonymus alata* (winged burning bush), and *Celastrus orbiculatus* (Asian bittersweet). Herbaceous cover can be highly variable, ranging from less than 1% to 70%. Frequent native species include *Arisaema triphyllum* (Jack in the pulpit), *Ageratina altissima var. altissima* (white snakeroot), and *Carex pensylvanica* (Pennsylvania sedge). *Microstegium vimineum* (Nepalese browntop) can, at some sites, be abundant.
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Liriodendron tulipifera* (tuliptree)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Berberis thunbergii* (Japanese barberry)

Characteristic Species: *Liriodendron tulipifera* (tuliptree), *Robinia pseudoacacia* (black locust), *Ailanthus altissima* (tree of heaven).
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NJ	SNA	.	.	[not crosswalked]	.

Local Range: This association is common at the Jockey Hollow Unit and present, but not as frequent, at the New Jersey Brigade Unit. Good examples are found along the Jockey Hollow Road near the maintenance buildings and west of the Aqueduct Trail and along the western border of the New Jersey Brigade unit abutting the Audubon Sanctuary.
Classification Comments: *Liriodendron tulipifera* (tuliptree) is common throughout both the Jockey Hollow and New Jersey Brigade units in a range of associations. It is a major component of not only this association but also other upland forest associations: *Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest (CEGL006921) and *Quercus prinus - Quercus (rubra, velutina) / Vaccinium angustifolium* Forest (CEGL006282). It is also found in lower abundance in *Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest (CEGL006336) and *Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana* Forest (CEGL006599). It also occurs in wetlands, such as *Acer rubrum - Fraxinus (pensylvanica, americana) / Lindera benzoin / Symplocarpus foetidus* Forest (CEGL006406) and *Acer rubrum - Fraxinus americana - Fraxinus nigra - Betula alleghaniensis / Veratrum viride -*

Carex bromoides Forest (CEGL008416). This association (CEGL007221) is differentiated from the other associations by a very high cover of *Liriodendron tulipifera* (tuliptree) which is often even-aged, suggesting that the site is recovering from disturbance and that *Liriodendron tulipifera* (tuliptree) had rapidly colonized the new site. Invasive species are often abundant.
Other Comments: Ehrenfeld (1977) refers to this association as the Yellow Poplar community. She characterizes the community as without other major canopy species and with little tree and shrub reproduction. Historical assessment of these sites dominated by *Liriodendron tulipifera* (tuliptree) suggests that the community developed on old agricultural sites and in areas with other types of soil disturbance. *Liriodendron tulipifera* (tuliptree) generally colonizes new sites with mineral soil. Severe disturbances such as fire and storm damage could also create new sites for *Liriodendron tulipifera* (tuliptree) recruitment. It is likely at Morristown that agricultural abandonment in the 1930s and clearcut forestry in the 1920s and 1930s created ideal conditions for *Liriodendron tulipifera* (tuliptree) recruitment from the neighboring forests and that the natural abundance of *Liriodendron tulipifera* (tuliptree) at Morristown is currently artificially high and may be reduced over time through succession to species that are capable of recruitment under shady conditions and can withstand heavy browsing by deer.
Local Description Authors: R. E. Zaremba, mod. E. F. Largay.
Plots: MORR.17, JThompson03072402, JThompson03050704, JThompson03050802.
Morristown National Historical Park Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Liriodendron tulipifera* Forest Alliance (A.236)
Alliance (English name)	Tuliptree Forest Alliance
Association	*Liriodendron tulipifera* - *Quercus* spp. Forest
Association (English name)	Tuliptree - Oak species Forest
Ecological System(s):	Southern Coastal Plain Mesic Slope Forest (CES203.476). Southern Interior Low Plateau Dry-Mesic Oak Forest (CES202.898). East Gulf Coastal Plain Northern Dry Upland Hardwood Forest (CES203.483). Allegheny-Cumberland Dry Oak Forest and Woodland (CES202.359).

GLOBAL DESCRIPTION

Concept Summary: This broadly defined semi-natural or successional community is one of several described upland associations dominated by *Liriodendron tulipifera* (tuliptree). It ranges from the southern Cumberland Plateau, Piedmont, and Interior Low Plateau of the southeastern U.S. north to the northern Piedmont of New Jersey. These successional forests often follow cropping, clearcut logging, or other severe disturbance, and are successional to mixed oak-hickory forests. Examples are common across large areas of the upland landscape which have previously been disturbed. Soils usually exhibit evidence of disturbance and may have little to no organic horizon development. Environmental setting is variable, ranging from level to gently sloping uplands to well-drained floodplains and stream terraces. Species found in stands attributable to this type may include a fairly diverse and varied composition. *Acer rubrum* (red maple), *Quercus* (oak) spp., and occasionally *Liquidambar styraciflua* (sweetgum) or *Robinia*

pseudoacacia (black locust) may be common in stands of this type; *Betula lenta* (sweet birch) often occurs at the northern end of the range. The oaks in these stands are frequently multi-stemmed, resulting from coppicing. Shrub composition is variable but may include *Sambucus nigra* ssp. *canadensis* (common elderberry) and *Vaccinium pallidum* (Blue Ridge blueberry). Herbs are likewise variable; West Virginia samples feature *Dioscorea quaternata* (fourleaf yam), *Lysimachia quadrifolia* (whorled yellow loosestrife), *Maianthemum racemosum* (feathery false lily of the valley), *Solidago curtisii*, *Symphyotrichum prenanthoides* (crookedstem aster), and *Geranium maculatum* (spotted geranium). This association differs from other described types in the alliance based on the lack of a significant pine component [see *Liriodendron tulipifera - Pinus taeda* Forest (CEGL007521)] and the absence of species affiliated with circumneutral conditions [see *Liriodendron tulipifera / (Cercis canadensis) / (Lindera benzoin)* Forest (CEGL007220)]; it is later successional and more diverse than *Liriodendron tulipifera* Forest (CEGL007218) or *Liriodendron tulipifera - Robinia pseudoacacia* Forest (CEGL007219).

Environmental Description: These semi-natural upland deciduous forests are found primarily in areas which were once clearcuts, old fields, or were cleared by fire or other natural disturbances. These successional forests often follow cropping, clearcut logging, or other severe disturbance, and are successional to mixed oak-hickory forests. Examples are common across large areas of the upland landscape which have previously been disturbed. Soils usually exhibit evidence of disturbance and may have little to no organic horizon development. Environmental setting is variable, ranging from level to gently sloping uplands to well-drained floodplains and stream terraces.

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

Most Abundant Species:

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

Characteristic Species: *Acer pensylvanicum* (striped maple), *Acer rubrum* (red maple), *Actaea racemosa* (black bugbane), *Amelanchier arborea* (common serviceberry), *Carya glabra* (pignut hickory), *Dichanthelium clandestinum* (deertongue), *Fagus grandifolia* (American beech), *Galium circaezans* (licorice bedstraw), *Geranium maculatum* (spotted geranium), *Goodyera*

pubescens (downy rattlesnake plantain), *Hamamelis virginiana* (American witchhazel), *Lycopodium digitatum* (fan clubmoss), *Medeola virginiana* (Indian cucumber), *Nyssa sylvatica* (blackgum), *Quercus falcata* (southern red oak), *Quercus rubra* (northern red oak), *Quercus velutina* (black oak), *Robinia pseudoacacia* (black locust), *Thelypteris noveboracensis* (New York fern), *Uvularia perfoliata* (perfoliate bellwort), *Vaccinium pallidum* (Blue Ridge blueberry).
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association is known from the southern Cumberland Plateau, Piedmont, and Interior Low Plateau of the southeastern U.S. and may also occur in the Upper East Gulf Coastal Plain. It ranges north to the northern Piedmont of New Jersey and adjacent Pennsylvania. It is also known from Alabama, Georgia, Kentucky, Maryland, North Carolina, South Carolina, Tennessee, West Virginia, and possibly Virginia and Delaware.
States/Provinces: AL, DE?, GA, KY, MD, NC, NJ, PA, SC, TN, VA, WV.
Federal Lands: BIA (Eastern Band of Cherokee); DOD (Camp Dawson, Fort Benning); NPS (Appomattox Court House, Big South Fork, Blue Ridge Parkway, Booker T. Washington, Chickamauga-Chattanooga?, Cowpens, Cumberland Gap, Fredericksburg-Spotsylvania, Guilford Courthouse, Kennesaw Mountain, Kings Mountain, Mammoth Cave, Morristown, Natchez Trace, New River Gorge, Ninety Six, Obed, Petersburg, Richmond, Shiloh, Valley Forge); USFS (Bankhead, Daniel Boone, Oconee?, Talladega, Talladega (Oakmulgee)?, Talladega (Talladega)).

CONSERVATION STATUS

Rank: GNA (ruderal) (19-Aug-2002).
Reasons: This forest represents early-successional vegetation and is thus not of conservation concern. This is a successional vegetation type composed of native species. Its conservation value is limited, but mature examples could provide buffer for communities of greater conservation value.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 2 - Moderate.
Comments: Within its range, it differs from other described types based on the lack of a significant pine component [see *Liriodendron tulipifera - Pinus taeda* Forest (CEGL007521)] and the absence of species affiliated with circumneutral conditions [see *Liriodendron tulipifera / (Cercis canadensis) / (Lindera benzoin)* Forest (CEGL007220)]; it is later successional and more diverse than *Liriodendron tulipifera* Forest (CEGL007218) and tends to be found on more stable soil substrates and less steep slopes than *Liriodendron tulipifera - Robinia pseudoacacia* Forest (CEGL007219).
Similar Associations:

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

Related Concepts:

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

SOURCES

Description Authors: R. E. Evans and M. Pyne, mod. L. A. Sneddon, R. White, S. C. Gawler.
References: Ehrenfeld 1977, Gallyoun et al. 1996, Keever 1973, NatureServe Ecology - Southeastern U.S. unpubl. data, Overlease 1987, Russell and Schuyler 1988, Schmalzer and DeSelm 1982, Schotz pers. comm., Southeastern Ecology Working Group n.d., TDNH unpubl. data, Vanderhorst 2001a, Vanderhorst and Streets 2006.

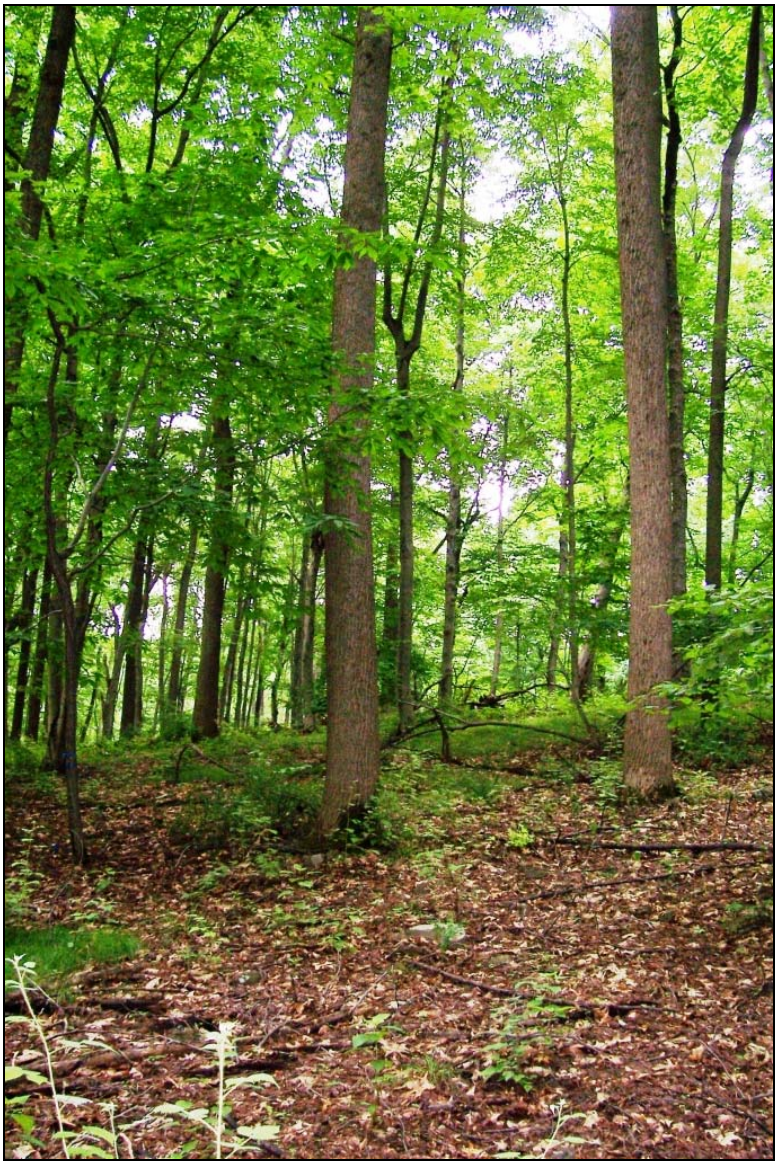

Figure 10. Successional Tuliptree Forest in Morristown National Historical Park (plot MORR.17, photo 17-1). July 2005. NAD 1983 / UTM easting 539647, northing 4513475.

COMMON NAME (PARK-SPECIFIC): NORTHEASTERN MODIFIED SUCCESSIONAL FOREST

SYNONYMS
USNVC English Name: **Black Cherry - Tuliptree - Red Maple - White Ash Forest**
USNVC Scientific Name: ***Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana* Forest**
USNVC Identifier: **CEGL006599**

LOCAL INFORMATION

Environmental Description: This association is found at sites with soil disturbances.
Vegetation Description: This successional forest association is dominated by *Quercus velutina* (black oak), *Fraxinus americana* (white ash), *Liriodendron tulipifera* (tuliptree), and *Prunus serotina* (black cherry). Understory species include *Ostrya virginiana* (hophornbeam), *Cornus florida* (flowering dogwood), and *Acer saccharum* (sugar maple). Invasive, nonnative species are abundant, including *Rosa multiflora* (multiflora rose), *Berberis thunbergii* (Japanese barberry), *Ulmus procera* (English elm), and *Rubus phoenicolasius* (wine raspberry).
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Fraxinus americana* (white ash)
		Liriodendron tulipifera (tuliptree)
		Prunus serotina (black cherry)
		Quercus velutina (black oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Rosa multiflora* (multiflora rose)

Characteristic Species: *Fraxinus americana* (white ash), *Prunus serotina* (black cherry)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NJ	SNA	.	.	[not crosswalked]	.

Local Range: The association is found at the borders of many of the managed grasslands and in areas that have been allowed to undergo succession in the last 30 years.
Classification Comments: The description for this community is based on data for only one observation point. More data are needed to characterize this association better at Morristown.
Other Comments: There is no equivalent to this association in Ehrenfeld (1977).
Local Description Authors: R. E. Zaremba.
Plots: JThompson03072401.
Morristown National Historical Park Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Prunus serotina - Acer rubrum - Amelanchier canadensis - Quercus* spp. Forest Alliance (A.237)
Alliance (English name)	Black Cherry - Red Maple - Canada Serviceberry - Oak species Forest Alliance

Association	*Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana* Forest
Association (English name)	Black Cherry - Tuliptree - Red Maple - White Ash Forest
Ecological System(s):	Central Appalachian Dry Oak-Pine Forest (CES202.591). Northeastern Interior Dry-Mesic Oak Forest (CES202.592).

GLOBAL DESCRIPTION

Concept Summary: This early-successional woody vegetation of the northeastern United States occurs on sites that are becoming reforested after having been cleared for agriculture. Environmental setting varies, but generally sites are dry-mesic to mesic, with small seepage inclusions in some examples. Physiognomy of this vegetation is highly variable, ranging from closed forest, open forest, tall dense shrubland, to more open tall shrubland. Early-successional woody species dominate the canopy in a widely variable mix, depending on geographic location. Tree species often include some combination of *Prunus serotina* (black cherry), *Liriodendron tulipifera* (tuliptree), *Fraxinus americana* (white ash), *Robinia pseudoacacia* (black locust), and *Acer rubrum* (red maple). Other associates can include *Juglans nigra* (black walnut), *Sassafras albidum* (sassafras), *Betula populifolia* (gray birch), *Juniperus virginiana* (eastern redcedar), *Acer negundo* (boxelder), *Acer saccharinum* (silver maple), *Ailanthus altissima* (tree of heaven), *Ulmus americana* (American elm), *Quercus* (oak) spp., *Betula lenta* (sweet birch), *Amelanchier* (serviceberry) spp., *Pinus strobus* (eastern white pine), and *Populus grandidentata* (bigtooth aspen). Other woody species may contribute to the canopy or form a tall-shrub layer, including *Lindera benzoin* (northern spicebush) and *Carpinus caroliniana* (American hornbeam). The low-shrub layer, if present, is usually characterized by the presence of *Rubus* (blackberry) spp. such as *Rubus flagellaris* (northern dewberry), *Rubus allegheniensis* (Allegheny blackberry), *Rubus phoenicolasius* (wine raspberry), or *Rubus hispidus* (bristly dewberry). This layer is often dominated by exotic species such as *Lonicera tatarica* (Tatarian honeysuckle), *Lonicera morrowii* (Morrow's honeysuckle), *Rhamnus cathartica* (common buckthorn), *Crataegus* (hawthorn) spp., *Rosa multiflora* (multiflora rose), and *Berberis thunbergii* (Japanese barberry). The herbaceous layer is variable, often containing grasses and forbs of both native and exotic origin. Common species include *Ageratina altissima var. altissima* (white snakeroot), *Polygonum persicaria* (spotted ladysthumb), *Impatiens capensis* (jewelweed), *Glechoma hederacea* (ground ivy), *Polystichum acrostichoides* (Christmas fern), *Calystegia sepium ssp. sepium* (hedge false bindweed), *Galium aparine* (stickywilly), *Oxalis stricta* (common yellow oxalis), *Polygonum virginianum* (jumpseed), *Dennstaedtia punctilobula* (eastern hayscented fern), *Arisaema triphyllum* (Jack in the pulpit), *Allium vineale* (wild garlic), and *Veronica officinalis* (common gypsyweed), among many others. The invasive species *Alliaria petiolata* (garlic mustard), *Microstegium vimineum* (Nepalese browntop), and *Polygonum caespitosum* (oriental ladysthumb) can be abundant in this disturbed forest type. Vines can be absent or abundant. In stands with high vine cover, the vegetation structure can be altered by the weight of the vines pulling down trees and shrubs. Common vines include *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), *Vitis labrusca* (fox grape), and the invasive vines *Celastrus orbiculata* (Asian bittersweet) and *Lonicera japonica* (Japanese honeysuckle). These forests are often young and resulted from the colonization of old agricultural fields by woody species. Recent disturbance or abundant invasive species give these forest stands a weedy character. It is unlikely that these stands will succeed to a natural plant community dominated by native species.

Environmental Description: This vegetation occurs on sites that have been cleared for agriculture or otherwise heavily modified in the past. Generally sites are dry-mesic and may have

small seepage inclusions in some examples. Occasionally this type may occur in formerly agricultural bottomlands, in which case the soils may be temporarily flooded or saturated.

Vegetation Description: Early-successional woody species dominate the canopy in a widely variable mix, depending on geographic location. Tree species often include some combination of *Prunus serotina* (black cherry), *Liriodendron tulipifera* (tuliptree), *Fraxinus americana* (white ash), *Robinia pseudoacacia* (black locust), and *Acer rubrum* (red maple). Other associates can include *Juglans nigra* (black walnut), *Sassafras albidum* (sassafras), *Betula populifolia* (gray birch), *Juniperus virginiana* (eastern redcedar), *Acer negundo* (boxelder), *Acer saccharinum* (silver maple), *Ailanthus altissima* (tree of heaven), *Ulmus americana* (American elm), *Quercus* (oak) spp., *Betula lenta* (sweet birch), *Amelanchier* (serviceberry) spp., *Pinus strobus* (eastern white pine), and *Populus grandidentata* (bigtooth aspen). Other woody species may contribute to the canopy or form a tall-shrub layer, including *Lindera benzoin* (northern spicebush) and *Carpinus caroliniana* (American hornbeam). The low-shrub layer, if present, is usually characterized by the presence of *Rubus* (blackberry) spp. such as *Rubus flagellaris* (northern dewberry), *Rubus allegheniensis* (Allegheny blackberry), *Rubus phoenicolasius* (wine raspberry), or *Rubus hispidus* (bristly dewberry). This layer is often dominated by exotic species such as *Lonicera tatarica* (Tatarian honeysuckle), *Lonicera morrowii* (Morrow's honeysuckle), *Rhamnus cathartica* (common buckthorn), *Crataegus* (hawthorn) spp., *Rosa multiflora* (multiflora rose), and *Berberis thunbergii* (Japanese barberry). The herbaceous layer is variable, often containing grasses and forbs of both native and exotic origin. Common species include *Ageratina altissima var. altissima* (white snakeroot), *Polygonum persicaria* (spotted ladysthumb), *Impatiens capensis* (jewelweed), *Glechoma hederacea* (ground ivy), *Polystichum acrostichoides* (Christmas fern), *Calystegia sepium ssp. sepium* (hedge false bindweed), *Galium aparine* (stickywilly), *Oxalis stricta* (common yellow oxalis), *Polygonum virginianum* (jumpseed), *Dennstaedtia punctilobula* (eastern hayscented fern), *Arisaema triphyllum* (Jack in the pulpit), *Allium vineale* (wild garlic), and *Veronica officinalis* (common gypsyweed), among many others. The invasive species *Alliaria petiolata* (garlic mustard), *Microstegium vimineum* (Nepalese browntop), and *Polygonum caespitosum* (oriental ladysthumb) can be abundant in this disturbed forest type. Vines can be absent or abundant. In stands with high vine cover, the vegetation structure can be altered by the weight of the vines pulling down trees and shrubs. Common vines include *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), *Vitis labrusca* (fox grape), and the invasive vines *Celastrus orbiculata* (Asian bittersweet) and *Lonicera japonica* (Japanese honeysuckle).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
		Fraxinus americana (white ash)
		Liriodendron tulipifera (tuliptree)
		Prunus serotina (black cherry)
		Robinia pseudoacacia (black locust)
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
Tall shrub/sapling	Broad-leaved deciduous tree	*Carpinus caroliniana* (American hornbeam)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Lindera benzoin* (northern spicebush)
		Rosa multiflora (multiflora rose)
Herb (field)	Forb	*Alliaria petiolata* (garlic mustard)
		Polygonum persicaria (spotted ladysthumb)
Herb (field)	Graminoid	*Microstegium vimineum* (Nepalese browntop)

Characteristic Species: *Acer rubrum* (red maple), *Alliaria petiolata* (garlic mustard), *Berberis thunbergii* (Japanese barberry), *Elaeagnus umbellata* (autumn olive), *Fraxinus americana* (white ash), *Juglans nigra* (black walnut), *Liriodendron tulipifera* (tuliptree), *Microstegium vimineum* (Nepalese browntop), *Polygonum persicaria* (spotted ladysthumb), *Prunus serotina* (black cherry), *Robinia pseudoacacia* (black locust), *Rosa multiflora* (multiflora rose), *Rubus allegheniensis* (Allegheny blackberry).
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This vegetation is currently described from Pennsylvania, New York, and New Jersey but is of broader distribution in the northeastern U.S.
States/Provinces: CT, DE, MA, NJ, NY, PA.
Federal Lands: NPS (Allegheny Portage Railroad, Boston Harbor Islands, Delaware Water Gap, Fort Necessity, Friendship Hill, Gateway, Gettysburg, Johnstown Flood, Morristown, Sagamore Hill, Saratoga, Saugus Iron Works, Upper Delaware, Valley Forge, Weir Farm); USFWS (Erie, Great Meadows?, Prime Hook).

CONSERVATION STATUS

Rank: GNA (ruderal) (29-Nov-2004).
Reasons: This vegetation is modified by human activity and not of conservation concern.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 2 - Moderate.
Comments: This vegetation is broadly defined and varies widely in composition across its range, presenting a classification challenge at the alliance level.
Similar Associations:

- *Juglans nigra / Verbesina alternifolia* Forest (CEGL007879).
- *Liriodendron tulipifera - Quercus* spp. Forest (CEGL007221)--is more strongly dominated by *Liriodendron* and is generally in a later successional state as evidenced by taller trees and more closed canopy.
- *Prunus serotina - Sassafras albidum - (Fraxinus americana) / Juniperus virginiana* Forest (CEGL004133).
- *Robinia pseudoacacia* Forest (CEGL007279).

Related Concepts:
Modified Successional Forest (Podniesinski et al. 2005) =

SOURCES

Description Authors: L. A. Sneddon, mod. S. C. Gawler and E. Largay.
References: Eastern Ecology Working Group n.d., Ehrenfeld 1977, Fike 1999, NRCS 2001b, NRCS 2004, Perles et al. 2006c, Perles et al. 2007, Podniesinski et al. 2005, Soil Conservation Service 1987.

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

SYNONYMS

USNVC English Name: **(White Oak, Northern Red Oak, Black Oak) / Flowering Dogwood / Mapleleaf Viburnum Forest**

USNVC Scientific Name: ***Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest**

USNVC Identifier: **CEGL006336**

LOCAL INFORMATION

Environmental Description: This association is found on the west and northwest upper slopes of hills. Soils are very rocky with pockets of loam. The litter layer is continuous, 1–3 cm deep, with locally high concentrations of downed woody material. There is often evidence of past logging and occasional large decomposing logs.

Vegetation Description: The canopy is generally well-formed with 80–90% cover. Dominant trees include *Quercus rubra* (northern red oak) and *Quercus alba* (white oak), *Carya glabra* (pignut hickory), *Betula lenta* (sweet birch), and *Liriodendron tulipifera* (tuliptree). Frequently occurring species include *Quercus prinus* (chestnut oak), *Quercus velutina* (black oak), *Acer rubrum* (red maple), and *Fagus grandifolia* (American beech). The shrub layer is sparse and often includes *Cornus florida* (flowering dogwood) and *Amelanchier arborea* (common serviceberry). Low shrubs are numerous but without any clear dominants. Frequently occurring shrubs include *Vaccinium pallidum* (Blue Ridge blueberry), *Mitchella repens* (partridgeberry), and *Viburnum dentatum* (southern arrowwood). Invasive species are frequent but not generally abundant. Invasive shrubs include *Berberis thunbergii* (Japanese barberry), *Lonicera japonica* (Japanese honeysuckle), and *Euonymus alata* (winged burning bush). Vines are locally common, including *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), and *Rubus hispidus* (bristly dewberry). The herbaceous layer can vary considerably among occurrences but often has high cover and high species diversity. Dominants often include *Carex pensylvanica* (Pennsylvania sedge) and *Carex rosea* (rosy sedge), *Thelypteris noveboracensis* (New York fern), *Polystichum acrostichoides* (Christmas fern), and, at a few sites, *Trichophorum planifolium* (bashful bulrush). Other frequently present species include *Viola pubescens* (downy yellow violet), *Eurybia divaricata* (white wood aster), *Trientalis borealis* (starflower), and *Solidago caesia* (wreath goldenrod).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Carya alba (mockernut hickory)*
		Quercus alba (white oak)
		Quercus rubra (northern red oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	*Cornus florida* (flowering dogwood)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)

Characteristic Species: *Cornus florida* (flowering dogwood), *Carya alba* (mockernut hickory), *Geranium maculatum* (spotted geranium), *Uvularia perfoliata* (perfoliate bellwort), *Galium circaezans* (licorice bedstraw), *Thalictrum thalictroides* (rue anemone).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NJ	S4S5	=	1	[gname][1]	Breden et al. 2001

Local Range: The best examples of this association are along the upper slopes of Jarvis Hill in the New Jersey Brigade unit.

Classification Comments: In part, the herbaceous flora sets this association apart from others at Morristown. The spring and late-summer floras are rich and diverse. Many of the species within these occurrences are dramatically modified by deer browse between late spring and early fall. The documented floristic composition of this community is significantly altered by browse, as they are at all communities at Morristown. Many of the small shrubs evident during a spring visit are not seen by late summer.

Other Comments: There is no direct equivalent for this association in Ehrenfeld (1977). Small inclusions of this association occur within *Liriodendron tulipifera - Quercus* spp. Forest (CEGL007221) and *Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest (CEGL006921). The small size of current occurrences at Morristown, primarily at the New Jersey Brigade unit, warranted the inclusion of this type in other map units.

Local Description Authors: R. E. Zaremba.

Plots: MORR.12, MORR.13, MORR.16, JThompson03072301, JThompson03051902.

Morristown National Historical Park Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Quercus alba* - (*Quercus rubra, Carya* spp.) Forest Alliance (A.239)
Alliance (English name)	White Oak - (Northern Red Oak, Hickory species) Forest Alliance
Association	*Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest
Association (English name)	(White Oak, Northern Red Oak, Black Oak) / Flowering Dogwood / Mapleleaf Viburnum Forest
Ecological System(s):	Northeastern Interior Dry-Mesic Oak Forest (CES202.592).

GLOBAL DESCRIPTION

Concept Summary: This oak-hickory forest occurs on well-drained loamy sand of midslopes in the northeastern United States. This vegetation is ecologically transitional between dry-rich oak-hickory forests of relatively high diversity and dry, acidic oak species-poor forests. *Quercus rubra* (northern red oak), *Quercus alba* (white oak), and *Quercus velutina* (black oak) are prominent in the canopy. *Quercus prinus* (chestnut oak) and *Quercus coccinea* (scarlet oak) are canopy associates in the southern portion of the range. Typical hickory species include *Carya glabra* (pignut hickory), *Carya ovata* (shagbark hickory), *Carya alba* (mockernut hickory), and *Carya ovalis* (red hickory). Other canopy associates may include *Acer rubrum* (red maple), *Sassafras albidum* (sassafras), and *Amelanchier arborea* (common serviceberry). At the northern range limit of this type, *Pinus strobus* (eastern white pine) and *Betula lenta* (sweet birch) also occur as minor associates. *Cornus florida* (flowering dogwood) is a characteristic understory tree

[1] "gname" in this field indicates that the name in the state classification is the same as that of the USNVC

in portions of the range. The shrub layer is characterized by *Viburnum acerifolium* (mapleleaf viburnum), with other frequent associates including *Hamamelis virginiana* (American witchhazel), *Vaccinium corymbosum* (highbush blueberry), *Corylus cornuta* (beaked hazelnut), and *Corylus americana* (American hazelnut). A dwarf-shrub layer may be common, but is generally not abundant, and is characterized by *Vaccinium pallidum* (Blue Ridge blueberry) and *Gaylussacia baccata* (black huckleberry), with *Vaccinium angustifolium* (lowbush blueberry) occurring more frequently to the north. The herbaceous layer is characterized by *Carex pensylvanica* (Pennsylvania sedge), *Carex rosea* (rosy sedge), *Maianthemum racemosum* (feathery false lily of the valley), *Aralia nudicaulis* (wild sarsaparilla), *Hieracium venosum* (rattlesnakeweed), *Solidago bicolor* (white goldenrod), *Desmodium glutinosum* (pointedleaf ticktrefoil), *Desmodium paniculatum* (panicledleaf ticktrefoil), *Melampyrum lineare* (narrowleaf cowwheat), *Chimaphila maculata* (striped prince's pine), *Eurybia divaricata* (white wood aster), *Danthonia spicata* (poverty oatgrass), *Aureolaria* (false foxglove) spp., *Pteridium aquilinum* (western brackenfern), *Dennstaedtia punctilobula* (eastern hayscented fern), and *Helianthemum canadense* (longbranch frostweed).

Environmental Description: This forest type occurs on well-drained loamy sand of midslopes and other dry-mesic sites.

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

Most Abundant Species:

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

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

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association occurs from Maine to Maryland.

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

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

CONSERVATION STATUS

Rank: G4G5 (24-Jan-2005).

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

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

Comments: Information not available.

Similar Associations:

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

- *Quercus velutina - Quercus alba - Carya (glabra, ovata)* Forest (CEGL002076)--also contains *Quercus ellipsoidalis* or *Quercus macrocarpa* and is of shorter stature and more open canopy.
- *Quercus velutina / Carex pensylvanica* Forest (CEGL002078)--is drier and more infertile, and lacks *Viburnum acerifolium, Hamamelis virginiana* and other shrubs.

Related Concepts:

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

SOURCES

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

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

Figure 11. Northeastern Dry-Oak Hickory Forest in Morristown National Historical Park (plot MORR.13, photo 13-2). July 2005. NAD 1983 / UTM easting 538533, northing 4511035.

COMMON NAME (PARK-SPECIFIC): DRY-MESIC CHESTNUT OAK - RED OAK FOREST

SYNONYMS

USNVC English Name: **Chestnut Oak - Northern Red Oak / American Witchhazel Forest**

USNVC Scientific Name: ***Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest**

USNVC Identifier: **CEGL006057**

LOCAL INFORMATION

Environmental Description: This association occurs on upper slopes and summits of hills. The substrate is extremely rocky with shallow pockets of sandy loam. Leaf litter is nearly continuous but very shallow. In many areas the surface is covered with exposed rocks, up to 10% cover.

Vegetation Description: The canopy is well-developed (85–90%) and dominated by *Quercus prinus* (chestnut oak). Also common are *Quercus rubra* (northern red oak), *Betula lenta* (sweet birch), and *Quercus coccinea,* (scarlet oak). *Fagus grandifolia* (American beech) is locally abundant as a subcanopy tree in some areas. Because of severe deer browse, there is a low concentration of shrubs and very few herbaceous species. Scattered shrubs include *Vaccinium pallidum* (Blue Ridge blueberry), *Chimaphila maculata* (striped prince's pine), *Acer rubrum* (red maple), and *Liriodendron tulipifera* (tuliptree). Commonly found herbaceous species include *Ageratina altissima var. altissima* (white snakeroot), *Eurybia divaricata* (white wood aster), *Maianthemum canadense* (Canada mayflower), *Carex swanii* (Swan's sedge), and *Carex pensylvanica* (Pennsylvania sedge). There is a very low concentration of mosses, limited to *Polytrichum commune* (polytrichum moss).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus prinus* (chestnut oak)
Tree subcanopy	Broad-leaved deciduous tree	*Fagus grandifolia* (American beech)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)
		Carex swanii (Swan's sedge)

Characteristic Species: *Quercus prinus* (chestnut oak), *Quercus coccinea* (scarlet oak).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NJ	SNR	=	1	*Quercus prinus - Quercus rubra - Carya (glabra, alba) / Gaylussacia baccata* Forest	Breden et al. 2001

Local Range: This association occurs on upper slopes and on hilltops. Good examples are found on the summit of Mt. Kemble and on the higher part of the hill northwest of the Aqueduct Trail parking lot.

Classification Comments: *Quercus prinus* (chestnut oak) is found in well-drained sites throughout Jockey Hollow and at many locations in the New Jersey Brigade unit, primarily on hilltops and upper slopes. This association is defined by a high cover of *Quercus prinus* (chestnut oak) and low cover of *Fagus grandifolia* (American beech) and *Liriodendron tulipifera* (tuliptree). There are many sites where it is unclear how these communities might be effectively separated, particularly in light of heavy deer browse which has obscured finer detail in shrub and herbaceous layers.

Other Comments: Ehrenfeld (1977) includes this association in the Chestnut Oak - Black Birch community. She notes that there is evidence of logging at all occurrences and that *Viburnum acerifolium* (mapleleaf viburnum), *Hamamelis virginiana* (American witchhazel), and *Lindera benzoin* (northern spicebush) are characteristic understory shrubs. "On average, 25–50% of the line transects between sample points was covered by [*Hamamelis virginiana* (American witchhazel)]." She further mentions that "the *Viburnum* (viburnum) shows signs of extensive deer browsing." In three samples taken in this community, *Viburnum acerifolium* (mapleleaf viburnum) did not appear in 2003 or 2004 surveys. It was not an evident characteristic species for this association reflecting the severity of deer browse effects.
Local Description Authors: R. E. Zaremba.
Plots: MORR.01, MORR.02, JThompson03050804, JThompson03072502.
Morristown National Historical Park Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Quercus prinus - Quercus rubra* Forest Alliance (A.250)
Alliance (English name)	Chestnut Oak - Northern Red Oak Forest Alliance
Association	*Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest
Association (English name)	Chestnut Oak - Northern Red Oak / American Witchhazel Forest
Ecological System(s):	Northeastern Interior Dry-Mesic Oak Forest (CES202.592). Central Appalachian Dry Oak-Pine Forest (CES202.591).

GLOBAL DESCRIPTION

Concept Summary: This closed-canopy, dry-mesic oak forest of the central Appalachian Mountains is a montane forest of somewhat protected rocky slopes. The canopy is codominated by *Quercus prinus* (chestnut oak) and *Quercus rubra* (northern red oak). Associated canopy species include *Liriodendron tulipifera* (tuliptree), *Acer rubrum* (red maple), *Carya glabra* (pignut hickory), *Carya ovalis* (red hickory), *Carya alba* (mockernut hickory), *Acer saccharum* (sugar maple), *Tilia americana* (American basswood), *Fagus grandifolia* (American beech), and *Betula lenta* (sweet birch). The tall-shrub layer is characterized by *Hamamelis virginiana* (American witchhazel) and *Acer pensylvanicum* (striped maple). The lower shrub layer is patchy and contains a mixture of scrambling vines, ericads, and non-ericaceous species. The herbaceous layer is usually sparse but may include *Dryopteris marginalis* (marginal woodfern), *Dioscorea quaternata* (fourleaf yam), *Eurybia divaricata* (white wood aster), *Ageratina altissima* (white snakeroot), *Polygonatum biflorum* (smooth Solomon's seal), *Solidago caesia* (wreath goldenrod), *Festuca subverticillata* (nodding fescue), *Thelypteris noveboracensis* (New York fern), *Sanicula trifoliata* (largefruit blacksnakeroot), *Prenanthes altissima* (tall rattlesnakeroot), *Polystichum acrostichoides* (Christmas fern), *Desmodium nudiflorum* (nakedflower ticktrefoil), *Galium latifolium* (purple bedstraw), *Houstonia purpurea* (Venus' pride), and *Maianthemum racemosum* (feathery false lily of the valley). This association is more or less intermediate in site conditions and composition between oak / heath forests of exposed, xeric, infertile sites and richer cove or montane oak-hickory forests of sheltered, fertile sites.

Environmental Description: Sites occupied by this dry-mesic oak forest are mostly protected rocky mountain slopes. In Central Appalachians of Virginia, West Virginia, and Maryland, the type occurs at low and middle elevations, from <300 m (1000 feet) to about 1100 m (3600 feet), reaching optimal development at 610–915 m (2000–3000 feet). Habitats are underlain by a variety of bedrock types, including metabasalt (greenstone), pyroxene-rich granitic rocks, Antietam and Tuscarora quartzites, metasiltstone and phyllite, shale, and sedimentary material (interbedded sandstone, siltstone, and shale). Among plot-sampled Mid-Atlantic stands, lower to middle slope topographic positions predominate, along with steep (mean = 27 degrees), usually concave slopes, and relatively high surface cover of outcrops, boulders, and stones. Slope aspect is variable, but the majority of aspects range from north to southeast. Soil samples collected from plots were strongly to very strongly acidic (mean pH = 4.8) but had moderately high levels of calcium (mean = 1019 ppm), reflecting the frequent occurrence of this community on moderately base-rich substrates.

Vegetation Description: The vegetation is usually a closed-canopy forest codominated by *Quercus prinus* (chestnut oak) and *Quercus rubra* (northern red oak) in variable proportions. Over the full geographic range, overstory associates are reported to include *Liriodendron tulipifera* (tuliptree), *Fraxinus americana* (white ash), *Tilia americana* (American basswood), *Betula lenta* (sweet birch), *Acer rubrum* (red maple), *Magnolia acuminata* (cucumber-tree), *Nyssa sylvatica* (blackgum), *Robinia pseudoacacia* (black locust), *Carya glabra* (pignut hickory), *Carya ovalis* (red hickory), and *Carya alba* (mockernut hickory). Less frequent, and more local, overstory and understory trees include *Acer saccharum* (sugar maple), *Amelanchier arborea* (common serviceberry), *Asimina triloba* (pawpaw), *Fagus grandifolia* (American beech), *Ostrya virginiana* (hophornbeam), and *Tsuga canadensis* (eastern hemlock). A tall-shrub layer is occasionally absent but usually characterized by *Hamamelis virginiana* (American witchhazel) and, less frequently, by *Cornus florida* (flowering dogwood) and *Acer pensylvanicum* (striped maple), the latter more common at higher elevations. The lower shrub layer contains scrambling or climbing vines of *Parthenocissus quinquefolia* (Virginia creeper), *Vitis aestivalis* (summer grape), and *Toxicodendron radicans* (eastern poison ivy), along with *Viburnum acerifolium* (mapleleaf viburnum), *Hydrangea arborescens* (wild hydrangea), *Vaccinium pallidum* (Blue Ridge blueberry), and *Vaccinium stamineum* (deerberry). In general, ericaceous species are patchy to sparse in this community. The herbaceous layer is usually sparse but may include *Dryopteris marginalis* (marginal woodfern), *Dioscorea quaternata* (fourleaf yam), *Eurybia divaricata* (white wood aster), *Ageratina altissima* (white snakeroot), *Polygonatum biflorum* (smooth Solomon's seal), *Solidago caesia* (wreath goldenrod), *Festuca subverticillata* (nodding fescue), *Thelypteris noveboracensis* (New York fern), *Sanicula trifoliata* (largefruit blacksnakeroot), *Prenanthes altissima* (tall rattlesnakeroot), *Polystichum acrostichoides* (Christmas fern), *Desmodium nudiflorum* (nakedflower ticktrefoil), *Galium latifolium* (purple bedstraw), *Houstonia purpurea* (Venus' pride), and *Maianthemum racemosum* (feathery false lily of the valley). Although not one of the more constant herbs, *Aralia nudicaulis* (wild sarsaparilla) may occasionally dominate the herb layer of this community in large, clonal patches. This association is more or less intermediate in site conditions and composition between oak / heath forests of exposed, xeric, infertile sites and richer cove or montane oak-hickory forests of sheltered, fertile sites.

Most Abundant Species: Information not available.

Characteristic Species: *Acer pensylvanicum* (striped maple), *Acer rubrum* (red maple), *Carya glabra* (pignut hickory), *Cornus florida* (flowering dogwood), *Hamamelis virginiana* (American

witchhazel), *Parthenocissus quinquefolia* (Virginia creeper), *Quercus prinus* (chestnut oak), *Quercus rubra* (northern red oak), *Sassafras albidum* (sassafras), *Viburnum acerifolium* (mapleleaf viburnum), *Vitis aestivalis* (summer grape).
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association occurs throughout the central Appalachian region of Virginia, West Virginia, Maryland, Pennsylvania, and possibly farther north. In Virginia, it is a large-patch community type in both the northern Blue Ridge and Ridge and Valley provinces. Small-patch outliers of this type occur in rocky, sheltered ravines of the northern Virginia and Maryland Piedmont.
States/Provinces: MD, NJ, PA, VA:S5, WV.
Federal Lands: NPS (Blue Ridge Parkway, C&O Canal, Catoctin Mountain, Harpers Ferry, Morristown, Shenandoah); USFS (George Washington, Jefferson).

CONSERVATION STATUS

Rank: G5 (1-Oct-2001).
Reasons: This is a widespread oak forest of the central Appalachian Mountains found on intermediate rocky slopes. It is secure within its range.

CLASSIFICATION INFORMATION

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

- *Betula lenta - Quercus prinus / Parthenocissus quinquefolia* Woodland (CEGL006565).
- *Quercus prinus - (Quercus coccinea, Quercus rubra) / Kalmia latifolia / Vaccinium pallidum* Forest (CEGL006299).
- *Quercus prinus - (Quercus rubra) - Carya* spp. / *Oxydendrum arboreum - Cornus florida* Forest (CEGL007267).
- *Quercus prinus - Quercus (rubra, velutina) / Vaccinium angustifolium* Forest (CEGL006282).
- *Quercus prinus - Quercus rubra / Vaccinium pallidum - (Rhododendron periclymenoides)* Forest (CEGL008523)--occurs on more subxeric sites and has a more prominent ericaceous shrub layer.

Related Concepts:

- *Quercus montana - Quercus rubra / Acer pensylvanicum - Hamamelis virginiana* Forest (Fleming and Moorhead 2000) F
- *Quercus montana - Robinia pseudoacacia / Ribes rotundifolium* Association (Rawinski et al. 1994) F
- *Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest (Fleming and Coulling 2001) =
- *Quercus rubra - Magnolia acuminata* Association (Fleming and Moorhead 1996) F
- *Quercus rubra - Quercus prinus - Liriodendron tulipifera / Parthenocissus quinquefolia - Dryopteris marginalis* Association (Rawinski et al. 1996) F
- Chestnut Oak - Black Birch community (Ehrenfeld 1977) =
- Chestnut Oak: 44 (Eyre 1980) B
- Chestnut oak-red oak/ericad forest: (matrix) N slopes (CAP pers. comm. 1998) F
- Red Oak - Chestnut Oak Community Type (Stephenson and Adams 1991) ?

SOURCES

Description Authors: G. Fleming and P. Coulling, mod. S. L. Neid and. G. Fleming.
References: Breden et al. 2001, CAP pers. comm. 1998, Eastern Ecology Working Group n.d., Ehrenfeld 1977, Eyre 1980, Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming and Moorhead 2000, Fleming et al. 2001, Harrison 2004, Lea 2003, Rawinski et al. 1994, Rawinski et al. 1996, Stephenson and Adams 1991, VDNH 2003, Vanderhorst 2000b.

Figure 12. Dry-Mesic Chestnut Oak - Red Oak Forest in Morristown National Historical Park (plot MORR.01, photo 1-1). July 2005. NAD 1983 / UTM easting 540460 northing 4513247.

COMMON NAME (PARK-SPECIFIC): UPLAND/WETLAND TRANSITIONAL FOREST

SYNONYMS

USNVC English Name: **Northern Red Oak - Yellow Birch / Cinnamon Fern Forest**

USNVC Scientific Name: ***Quercus rubra - Betula alleghaniensis / Osmunda cinnamomea* Forest**

USNVC Identifier: **CEGL006000**

LOCAL INFORMATION

Environmental Description: This association occurs as a very narrow linear band or in small patches along small streams at the base of rock slopes. Soils may be saturated in the spring but are generally dry through much of the growing season. Trees are stunted. The distribution of this association at Morristown is limited to Cokesbury soils, which are "extremely stony, poorly drained, and have a fragipan at a depth of 20–30 inches" (Ehrenfeld 1977).

Vegetation Description: This association is characterized by an intermixture of upland and wetland species. The overstory is sparse (10–15%) and dominated by *Liriodendron tulipifera* (tuliptree) or *Quercus rubra* (northern red oak) which are shorter than similar trees upslope that are growing in soils with better drainage. The understory is moderately dense (50–60%) dominated by *Betula alleghaniensis* (yellow birch), *Betula lenta* (sweet birch), *Liriodendron tulipifera* (tuliptree), *Acer rubrum* (red maple), and *Fagus grandifolia* (American beech). The tall-shrub layer is well-developed and dominated by *Lindera benzoin* (northern spicebush), *Hamamelis virginiana* (American witchhazel), *Vaccinium corymbosum* (highbush blueberry), *Carpinus caroliniana* (American hornbeam), and *Fraxinus americana* (white ash). The lower branches of shrubs are severely browsed by deer. The herbaceous layer is well-developed in early spring and dominated by *Symplocarpus foetidus* (skunk cabbage), *Veratrum viride* (green false hellebore), *Erythronium americanum* (dogtooth violet), *Impatiens capensis* (jewelweed), *Claytonia virginica* (Virginia springbeauty), *Arisaema triphyllum* (Jack in the pulpit), and *Viola blanda* (sweet white violet). Because of severe deer browse, there is currently no reproduction of shrubs or trees in this association, and most of the herbaceous layer is reduced to root bases by late summer.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Liriodendron tulipifera* (tuliptree)
Tree canopy	Broad-leaved deciduous tree	*Quercus rubra* (northern red oak)
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
		Betula alleghaniensis (yellow birch)
		Betula lenta (sweet birch)
		Fagus grandifolia (American beech)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Lindera benzoin* (northern spicebush)
Herb (field)	Forb	*Symplocarpus foetidus* (skunk cabbage)

Characteristic Species: *Betula alleghaniensis* (yellow birch), *Quercus rubra* (northern red oak).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NJ	SNR	.	.	[not crosswalked]	.

Local Range: This association is limited to the borders of Primrose Brook at Morristown. In late summer, it is difficult to distinguish this association from the general matrix forest, *Fagus*

grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana Forest (CEGL006921), immediately upslope. Discernable differences exist in the presence of *Betula alleghaniensis* (yellow birch) and the stunted nature of most of the trees. The shrub layer is so severely browsed that *Hamamelis virginiana* (American witchhazel) and *Lindera benzoin* (northern spicebush) individuals appear more like single-stemmed, small trees than shrubs.

Classification Comments: This association was not noted during late-summer field surveys in 2003 but was seen in an early June 2004 visit. No plots were established in this association. This description is based on observations from J. Thompson and from notes taken during the spring visit. Placement within this association is based on the environmental setting and presence of *Betula allegheniensis* (yellow birch) and *Quercus rubra* (northern red oak). Although transitional between wetland and upland, this association is classified as upland. Saturated soils of this type at Morristown National Historical Park are largely a result of the linear nature of the occurrence, with truncation of transition area into the wetland.

Other Comments: Ehrenfeld (1977) described the shrub zone of this association, referred to as the Stream Thicket community, as being well-developed with a cover of 50–75% in one sampled area and 100% in another area. She further described abundant reproduction of trees and shrubs. In 2003–2004, there was no reproduction noted of any tree or shrub species. This association, however, persists at Morristown despite severe deer browse. It would be likely to re-emerge as a clearly discernable association if deer browse pressure was reduced.

Local Description Authors: R. E. Zaremba.

Plots: None (description based on field notes of R. E. Zaremba).

Morristown National Historical Park Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Quercus rubra - (Acer saccharum)* Forest Alliance (A.251)
Alliance (English name)	Northern Red Oak - (Sugar Maple) Forest Alliance
Association	*Quercus rubra - Betula alleghaniensis / Osmunda cinnamomea* Forest
Association (English name)	Northern Red Oak - Yellow Birch / Cinnamon Fern Forest
Ecological System(s):	Northern Atlantic Coastal Plain Hardwood Forest (CES203.475).

GLOBAL DESCRIPTION

Concept Summary: This lower slope, wetland transitional forest of southern New England to New Jersey generally occurs immediately upslope from seasonally flooded acidic swamps or small drainages. It occurs on somewhat poorly drained mineral soils, with a soil moisture regime of moist to somewhat wet. The tree canopy is nearly closed, with tree height reflecting moisture availability. Dominant species include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Quercus rubra* (northern red oak), and *Quercus velutina* (black oak). Occasionally *Quercus alba* (white oak), *Quercus palustris* (pin oak), *Fagus grandifolia* (American beech), and *Tsuga canadensis* (eastern hemlock) may occur. The shrub layer includes *Hamamelis virginiana* (American witchhazel), *Vaccinium corymbosum* (highbush blueberry), *Clethra alnifolia* (coastal sweetpepperbush), *Kalmia latifolia* (mountain laurel), and *Lindera benzoin* (northern spicebush). The herbaceous layer is nearly continuous and dominated by *Osmunda cinnamomea* (cinnamon

fern), *Thelypteris noveboracensis* (New York fern), *Arisaema triphyllum* (Jack in the pulpit), and *Uvularia sessilifolia* (sessileleaf bellwort).

Environmental Description: This vegetation occurs on lower slopes, generally adjacent to wetlands. Mineral soils are somewhat poorly drained and moist to somewhat wet sandy loams. The substrate is often rocky.

Vegetation Description: The tree canopy is nearly closed, with tree height reflecting moisture availability. Dominant species include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Quercus rubra* (northern red oak), and *Quercus velutina* (black oak). Occasionally *Quercus alba* (white oak), *Quercus palustris* (pin oak), *Fagus grandifolia* (American beech), and *Tsuga canadensis* (eastern hemlock) may occur. *Liriodendron tulipifera* (tuliptree) is a common associate in the southern portion of the range. The shrub layer includes *Hamamelis virginiana* (American witchhazel), *Vaccinium corymbosum* (highbush blueberry), *Clethra alnifolia* (coastal sweetpepperbush), *Kalmia latifolia* (mountain laurel), and *Lindera benzoin* (northern spicebush). The herbaceous layer is nearly continuous and dominated by *Osmunda cinnamomea* (cinnamon fern), *Thelypteris noveboracensis* (New York fern), *Arisaema triphyllum* (Jack in the pulpit), and *Uvularia sessilifolia* (sessileleaf bellwort). *Impatiens capensis* (jewelweed), *Veratrum viride* (green false hellebore), and *Symplocarpus foetidus* (skunk cabbage) may also occur where this vegetation grades into a wetland forest.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
		Betula alleghaniensis (yellow birch)
		Quercus velutina (black oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Clethra alnifolia* (coastal sweetpepperbush)
		Hamamelis virginiana (American witchhazel)
		Lindera benzoin (northern spicebush)
		Vaccinium corymbosum (highbush blueberry)
Short shrub/sapling	Broad-leaved evergreen shrub	*Kalmia latifolia* (mountain laurel)
Herb (field)	Forb	*Arisaema triphyllum* (Jack in the pulpit)
		Uvularia sessilifolia (sessileleaf bellwort)
Herb (field)	Fern or fern ally	*Osmunda cinnamomea* (cinnamon fern)
		Thelypteris noveboracensis (New York fern)

Characteristic Species: *Arisaema triphyllum* (Jack in the pulpit), *Betula alleghaniensis* (yellow birch), *Osmunda cinnamomea* (cinnamon fern), *Quercus rubra* (northern red oak), *Thelypteris noveboracensis* (New York fern), *Uvularia sessilifolia* (sessileleaf bellwort).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: The association occurs in Connecticut, Massachusetts, New Hampshire, New Jersey, and Rhode Island.

States/Provinces: CT, MA, ME, NH, NJ, NY, RI.

Federal Lands: NPS (Boston Harbor Islands, Minute Man, Morristown, Saratoga); USFWS (Assabet River, Great Meadows, Oxbow).

CONSERVATION STATUS

Rank: GNR (1-Dec-1997).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 - Weak.

Comments: The lack of surface water and drier soil conditions during the growing season (relative to adjacent, seasonally flooded wetlands) make this forest suitable for species found more frequently in uplands.

Similar Associations:

- *Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest (CEGL006921).

Related Concepts:

- CNE mesic hardwood forest on acidic bedrock/till (Rawinski 1984) B
- Stream Thicket community (Ehrenfeld 1977) B

SOURCES

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

References: Damman and Kershner 1977, Eastern Ecology Working Group n.d., Ehrenfeld 1977, Golet et al. 1993, Metzler and Barrett 2001, NRCS 2004, Rawinski 1984, Sperduto 2000b, Sperduto and Nichols 2004.

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

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

LOCAL INFORMATION

Environmental Description: This association is found at abandoned pastures and tilled sites and at other locations with major soil disturbances.
Vegetation Description: This association has an open canopy dominated by *Robinia pseudoacacia* (black locust) and *Fraxinus americana* (white ash). Other tree species found in the canopy are only minor components. These species include *Liriodendron tulipifera* (tuliptree), *Betula lenta* (sweet birch), and *Acer rubrum* (red maple). Many sites include a high percentage of standing dead *Robinia pseudoacacia* (black locust) and *Fraxinus americana* (white ash). There are often scattered individuals of *Cornus florida* (flowering dogwood) in the understory. *Toxicodendron radicans* (eastern poison ivy) often grows high into the canopy and can be locally abundant. Invasive shrub species are common, including *Berberis thunbergii* (Japanese barberry) and *Rosa multiflora* (multiflora rose). Invasive herbaceous species are also abundant, including *Microstegium vimineum* (Nepalese browntop) and *Alliaria petiolata* (garlic mustard). *Polygonum persicaria* (spotted ladysthumb) is also common. There is scattered recruitment of *Acer rubrum* (red maple) and *Fraxinus americana* (white ash) but almost no recruitment of *Robinia pseudoacacia* (black locust).
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Fraxinus americana* (white ash)
		Robinia pseudoacacia (black locust)
Tree canopy	Vine/Liana	*Toxicodendron radicans* (eastern poison ivy)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Berberis thunbergii* (Japanese barberry)
Herb (field)	Forb	*Alliaria petiolata* (garlic mustard)
		Polygonum persicaria (spotted ladysthumb)

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

State	SRank	Rel	Conf	SName	Reference
NJ	SNA	.	.	[not crosswalked]	.

Local Range: This association is found at scattered locations at Jockey Hollow. There are good examples on the east side of Mt. Kemble and north of the Central Trail parking lot.
Classification Comments: Information not available.
Other Comments: This association is included in Ehrenfeld (1977) as one of the successional communities, related primarily to abandoned farmland in the 1950s. The two sampled plots in the 1977 study included *Liriodendron tulipifera* (tuliptree) and *Fraxinus americana* (white ash) in the canopy, as it is today, and *Cornus florida* (flowering dogwood) as the only major understory species, again as is evident in 2003 and 2004. All other tree species are only minor components.
Local Description Authors: R. E. Zaremba.
Plots: MORR.08, JThompson030507003.
Morristown National Historical Park Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Robinia pseudoacacia* Forest Alliance (A.256)
Alliance (English name)	Black Locust Forest Alliance
Association	*Robinia pseudoacacia* Forest
Association (English name)	Black Locust Forest
Ecological System(s):	Southern Interior Low Plateau Dry-Mesic Oak Forest (CES202.898). Northern Atlantic Coastal Plain Pitch Pine Barrens (CES203.269). Central Appalachian Dry Oak-Pine Forest (CES202.591).

GLOBAL DESCRIPTION

Concept Summary: This black locust semi-natural forest is found locally throughout the eastern United States. Stands often establish on old fields abandoned after agricultural cropping or pasturing or around old homesites. In some areas it occurs on post-agricultural floodplain terraces. This vegetation has also become established following the planting of *Robinia pseudoacacia* (black locust) to stabilize and enrich nutrient-poor soils that are subject to erosion. The vegetation is dominated by *Robinia pseudoacacia* (black locust). Associated woody species vary from site to site and include *Prunus serotina* (black cherry), *Juniperus virginiana* (eastern redcedar), *Ulmus americana* (American elm), *Ulmus rubra* (slippery elm), 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* (black cherry), *Juniperus 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:

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

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

Other Noteworthy Species: 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, Bluestone, 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) ?
- Successional communities (Ehrenfeld 1977) B

SOURCES

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

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

Figure 13. Black Locust Successional Forest in Morristown National Historical Park (plot MORR.08, photo 8-2). July 2005. NAD 1983 / UTM easting 540643 northing 4512674.

COMMON NAME (PARK-SPECIFIC): SOUTHERN NEW ENGLAND RED MAPLE SEEPAGE SWAMP

SYNONYMS

USNVC English Name: **Red Maple - (Green Ash, White Ash) / Northern Spicebush / Skunk-cabbage Forest**

USNVC Scientific Name: ***Acer rubrum - Fraxinus (pennsylvanica, americana) / Lindera benzoin / Symplocarpus foetidus* Forest**

USNVC Identifier: **CEGL006406**

LOCAL INFORMATION

Environmental Description: This association is found at the base of steep rocky slopes and in low areas between rocky hills. The association occurs as small, organic-soil wetlands dissected by soil mounds that are slightly higher and support more upland species. Water levels are highest in the spring, but the general area remains wet throughout the year. At times of spring runoff and high rainfall, small rivulets flow through the community. Leaf litter is locally deep; some sites have significant cover of downed wooded material. At some sites, trees are stunted with most wetland-associated tree species not exceeding 10 m.

Vegetation Description: This association is dominated by *Acer rubrum* (red maple) and *Fraxinus americana* (white ash). Other associates at much lower cover include *Fraxinus pennsylvanica* (green ash), *Ulmus rubra* (slippery elm), and *Nyssa sylvatica* (blackgum). Typical tree species found on slightly higher ground within the community include *Fagus grandifolia* (American beech), *Betula lenta* (sweet birch), *Liriodendron tulipifera* (tuliptree), and *Quercus alba* (white oak). The tall-shrub layer is diverse but has low cover. Typical species include *Lindera benzoin* (northern spicebush), *Ilex verticillata* (common winterberry), *Carpinus caroliniana* (American hornbeam), and *Acer rubrum* (red maple). *Symplocarpus foetidus* (skunk cabbage) dominates the herbaceous layer which is diverse at most sites. Typical herbaceous species include *Impatiens capensis* (jewelweed), *Carex prasina* (drooping sedge) and other *Carex* (sedge) species, *Veratrum viride* (green false hellebore), *Viola* (violet) spp., *Thelypteris noveboracensis* (New York fern), *Menispermum canadense* (common moonseed), *Onoclea sensibilis* (sensitive fern), *Pilea pumila* (Canadian clearweed), *Osmunda cinnamomea* (cinnamon fern), *Poa palustris* (fowl bluegrass), *Glyceria melicaria* (melic mannagrass), and *Polygonum arifolium* (halberdleaf tearthumb) and *Polygonum sagittatum* (arrowleaf tearthumb). Some of the more persistent rivulets support *Chrysosplenium americanum* (American golden saxifrage). Common species associated with the small upland islands include *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), and *Dryopteris marginalis* (marginal woodfern). By late summer, many sites for this community are covered with *Microstegium vimineum* (Nepalese browntop).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
		Fraxinus pennsylvanica (white ash)
		Betula lenta (sweet birch)
Herb (field)	Forb	*Symplocarpus foetidus* (skunk cabbage)

Characteristic Species: *Acer rubrum* (red maple), *Fraxinus americana* (white ash), *Nyssa sylvatica* (black gum), *Pilea pumila* (Canadian clearweed).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NJ	S3S5	=	1	[gname]	Breden et al. 2001

Local Range: This association occurs as small examples scattered along the Passaic River in the New Jersey Brigade unit and across Tempe Wick Road from the main entrance to Jockey Hollow.

Classification Comments: *Acer rubrum* (red maple) occurs through both Jockey Hollow and the New Jersey Brigade unit. This association refers only to those situations where *Acer rubrum* (red maple) is dominant and growing in seasonally saturated soil.

Other Comments: Ehrenfeld (1977) includes an *Acer rubrum* (red maple) association only as a successional community. *Lindera benzoin* (northern spicebush) is noted as the only major shrub associate.

Local Description Authors: R. E. Zaremba.

Plots: MORR.10, MORR.15, MORR.20, JThompson03072501.

Morristown National Historical Park Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Saturated cold-deciduous forest (I.B.2.N.g.)
Alliance	*Acer rubrum - Fraxinus pennsylvanica* Saturated Forest Alliance (A.3035)
Alliance (English name)	Red Maple - Green Ash Saturated Forest Alliance
Association	*Acer rubrum - Fraxinus (pennsylvanica, americana) / Lindera benzoin / Symplocarpus foetidus* Forest
Association (English name)	Red Maple - (Green Ash, White Ash) / Northern Spicebush / Skunk-cabbage Forest
Ecological System(s):	North-Central Appalachian Acidic Swamp (CES202.604). Central Appalachian Stream and Riparian (CES202.609).

GLOBAL DESCRIPTION

Concept Summary: This association is a seepage swamp dominated by *Acer rubrum* (red maple) and ranging from southern New England to Virginia. It generally occurs in saturated situations on slightly sloping hillsides, along small streams, or in basins that receive overland flooding in addition to groundwater influence. In general, these swamps are moderately acidic to moderately basic and have some seepage indicators but are not particularly species-rich. Soils are shallow to moderately deep mucks over mineral soils. *Acer rubrum* (red maple) dominates the canopy; *Fraxinus pennsylvanica* (green ash) or *Fraxinus americana* (white ash) are usually also found in the canopy. *Fraxinus nigra* (black ash) is not generally associated with this type and, if present, occurs only as scattered individuals. Other canopy or subcanopy associates may include *Liriodendron tulipifera* (tuliptree), *Quercus bicolor* (swamp white oak), *Quercus palustris* (pin oak), *Prunus serotina* (black cherry), *Fagus grandifolia* (American beech), *Betula lenta* (sweet birch), *Ulmus americana* (American elm), and *Ulmus rubra* (slippery elm). Conifers such as *Tsuga canadensis* (eastern hemlock) or *Pinus strobus* (eastern white pine) are generally absent or occur in very low abundance. The shrub layer may be fairly open to quite dense, depending on the amount of canopy closure. Shrub species commonly include *Ilex verticillata* (common winterberry), *Rhododendron viscosum* (swamp azalea), *Clethra alnifolia* (coastal

sweetpepperbush), *Lindera benzoin* (northern spicebush), *Cornus amomum* (silky dogwood), *Alnus serrulata* (hazel alder), and less commonly *Vaccinium corymbosum* (highbush blueberry), *Lyonia ligustrina* (maleberry), *Ilex montana* (mountain holly), *Toxicodendron vernix* (poison sumac), *Viburnum dentatum* (southern arrowwood), and *Viburnum nudum var. cassinoides* (withe-rod). The herbaceous layer is variable in cover; *Symplocarpus foetidus* (skunk cabbage) and *Osmunda cinnamomea* (cinnamon fern) are nearly always present. In some areas, tall ferns (*Osmunda cinnamomea* (cinnamon fern), *Onoclea sensibilis* (sensitive fern), *Osmunda regalis* (royal fern), *Thelypteris palustris* (eastern marsh fern), *Thelypteris noveboracensis* (New York fern)) form an herbaceous canopy within which other species are scattered. Microtopography is generally pronounced, resulting from tip-ups. Tree seedlings and *Sphagnum* (sphagnum) mosses are common on hummocks but do not in general form extensive carpets. Additional nonvascular species can include *Plagiomnium cuspidatum* (toothed plagiomnium moss) and *Calliergon* (calliergon moss) spp. Invasive shrubs and herbs, including *Berberis thunbergii* (Japanese barberry), *Rosa multiflora* (multiflora rose), *Lonicera morrowii* (Morrow's honeysuckle), *Alliaria petiolata* (garlic mustard), and *Microstegium vimineum* (Nepalese browntop), may be abundant.

Environmental Description: This association is a seepage swamp dominated by *Acer rubrum* (red maple) and ranging from southern New England to Virginia. It generally occurs in saturated soils on slightly sloping hillsides, along small headwater streams, or in depressions at the edges of floodplains that receive overland flooding in addition to groundwater inputs. In general, these swamps are moderately acidic to moderately basic and have some seepage indicators but are not particularly species-rich. Soils are shallow to moderately deep mucks over mineral soils. Microtopography is generally pronounced, resulting from tip-ups and the braided character of the drainage. Soil samples collected from 18 Maryland and Virginia plot samples are "intermediate" in chemistry, i.e., mean pH = 5.2, mean Ca = 1071 ppm, mean Mg = 195 ppm, mean total base saturation = 57%, but are more "basic" than "acidic" in their calcium and magnesium content.

Vegetation Description: *Acer rubrum* (red maple) dominates the canopy; *Fraxinus pennsylvanica* (green ash) or *Fraxinus americana* (white ash) are usually also found in the canopy. *Fraxinus nigra* (black ash) is not generally associated with this type and, if present, occurs only as scattered individuals. Other canopy or subcanopy associates may include *Liriodendron tulipifera* (tuliptree), *Quercus bicolor* (swamp white oak), *Quercus palustris* (pin oak), *Prunus serotina* (black cherry), *Fagus grandifolia* (American beech), *Betula lenta* (sweet birch), *Ulmus americana* (American elm), and *Ulmus rubra* (slippery elm). Conifers such as *Tsuga canadensis* (eastern hemlock) or *Pinus strobus* (eastern white pine) are generally absent or occur in very low abundance. The shrub layer may be fairly open to quite dense, depending on the amount of canopy closure. Shrub species commonly include *Ilex verticillata* (common winterberry), *Rhododendron viscosum* (swamp azalea), *Clethra alnifolia* (coastal sweetpepperbush), *Lindera benzoin* (northern spicebush), *Cornus amomum* (silky dogwood), *Alnus serrulata* (hazel alder), *Carpinus caroliniana* (American hornbeam), and less commonly *Vaccinium corymbosum* (highbush blueberry), *Lyonia ligustrina* (maleberry), *Ilex montana* (mountain holly), *Toxicodendron vernix* (poison sumac), *Viburnum dentatum* (southern arrowwood), and *Viburnum nudum var. cassinoides* (withe-rod). The herbaceous layer is variable in cover; *Symplocarpus foetidus* (skunk cabbage) and *Osmunda cinnamomea* (cinnamon fern) are nearly always present. In some areas, tall ferns (*Osmunda cinnamomea* (cinnamon fern), *Onoclea sensibilis* (sensitive fern), *Osmunda regalis* (royal fern), *Thelypteris palustris* (eastern marsh fern), *Thelypteris noveboracensis* (New York fern)) form an herbaceous canopy within

which other species are scattered. These other herbaceous species include *Impatiens capensis* (jewelweed), *Galium aparine* (stickywilly), *Geum canadense* (white avens), *Arisaema triphyllum* (Jack in the pulpit), *Carex stricta* (upright sedge), *Carex gracillima* (graceful sedge), *Carex intumescens* (greater bladder sedge), *Carex radiata* (eastern star sedge), *Carex laevivaginata* (smoothsheath sedge), *Veratrum viride* (green false hellebore), *Boehmeria cylindrica* (smallspike false nettle), *Chelone glabra* (white turtlehead), *Cardamine pensylvanica* (Pennsylvania bittercress), *Pilea pumila* (Canadian clearweed), and *Glyceria* (mannagrass) spp. At the southern end of the range in Maryland and Virginia, *Symplocarpus foetidus* (skunk cabbage) is usually greatly dominant (>50% cover) early in the growing season, with *Saururus cernuus* (lizard's tail) frequently assuming patch-dominance during the summer. Tree seedlings and *Sphagnum* (sphagnum) mosses are common on hummocks but do not in general form extensive carpets. Additional nonvascular species can include *Plagiomnium cuspidatum* (toothed plagiomnium moss) and *Calliergon* (calliergon moss) spp. Invasive shrubs and herbs, including *Berberis thunbergii* (Japanese barberry), *Rosa multiflora* (multiflora rose), *Lonicera morrowii* (Morrow's honeysuckle), *Alliaria petiolata* (garlic mustard), and *Microstegium vimineum* (Nepalese browntop), may be abundant.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Ilex verticillata* (common winterberry)
		Lindera benzoin (northern spicebush)
Herb (field)	Forb	*Symplocarpus foetidus* (skunk cabbage)
Herb (field)	Fern or fern ally	*Osmunda cinnamomea* (cinnamon fern)

Characteristic Species: *Acer rubrum* (red maple), *Clethra alnifolia* (coastal sweetpepperbush), *Fraxinus americana* (white ash), *Fraxinus pennsylvanica* (green ash), *Lindera benzoin* (northern spicebush), *Osmunda cinnamomea* (cinnamon fern), *Rhododendron viscosum* (swamp azalea), *Symplocarpus foetidus* (skunk cabbage).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This vegetation occurs in southern New England south through the mid-Atlantic states to Virginia.

States/Provinces: CT, DC, DE?, MA, MD, NH, NJ:S3S5, NY, PA, RI, VA, VT.

Federal Lands: NPS (Appomattox Court House, C&O Canal, Delaware Water Gap, Fort Necessity, Gateway, George Washington Parkway, Minute Man, Morristown, Prince William, Rock Creek, Saratoga, Upper Delaware, Weir Farm, Wolf Trap); USFWS (Great Meadows?).

CONSERVATION STATUS

Rank: G4G5 (30-Jan-2007).

Reasons: Although this is a small-patch community, its environmental requirements are quite general, and it occurs where acidic groundwater seepage emerges on the headwaters of stream drainages. The range extent crosses several ecoregions and 10 states. The major threat to this community is housing development, with disruption of groundwater source a lesser threat.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 1 - Strong.

Comments: Classification of this type at the southern end of the range is supported by analysis of a 1250-plot regional dataset compiled for the NCR and Mid-Atlantic national parks vegetation mapping project. In that analysis, this association was represented a group of 18 Maryland and Virginia plots.

Similar Associations:

- *Acer rubrum - Betula alleghaniensis / Lindera benzoin* Forest (CEGL006936).
- *Acer rubrum - Fraxinus nigra - (Tsuga canadensis) / Tiarella cordifolia* Forest (CEGL006502).
- *Acer rubrum / Nemopanthus mucronatus - Vaccinium corymbosum* Forest (CEGL006220).
- *Acer rubrum / Rhododendron viscosum - Clethra alnifolia* Forest (CEGL006156).

Related Concepts:

- Inland Red Maple Swamp (Breden 1989) B
- Palustrine Broad-leaved Deciduous Forested Wetlands (PFO1) (Cowardin et al. 1979) ?
- Red or Silver Maple-Green Ash Swamp (Thompson 1996) ?
- Southern New England stream bottom forest (Rawinski 1984) ?

SOURCES

Description Authors: L. A. Sneddon, mod. S. C. Gawler and G. P. Fleming.

References: Breden 1989, Breden et al. 2001, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Ehrenfeld 1977, Enser 1993, Golet et al. 1993, Harrison 2004, Metzler and Barrett 2001, NRCS 2001b, NRCS 2004, Rawinski 1984, Reschke 1990, Sperduto and Nichols 2004, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000.

Figure 14. Southern New England Red Maple Seepage Swamp in Morristown National Historical Park (plot MORR.20, photo 20-1). July 2005. NAD 1983 / UTM easting 538027, northing 4510883.

COMMON NAME (PARK-SPECIFIC): MONTANE BASIC SEEPAGE SWAMP

SYNONYMS

USNVC English Name: **Red Maple - White Ash - Black Ash - Yellow Birch / American False Hellebore - Bromelike Sedge Forest**

USNVC Scientific Name: ***Acer rubrum - Fraxinus americana - Fraxinus nigra - Betula alleghaniensis / Veratrum viride - Carex bromoides* Forest**

USNVC Identifier: **CEGL008416**

LOCAL INFORMATION

Environmental Description: This association occurs at a stream headwaters in a low basin with irregular topography and a dendritic pattern of small streams. The site of this association includes small patches of upland, seepage areas and periodic, very small streams. Some of the upland patches include large rocks and loamy soil; other upland patches have been created over time by accumulated organics around tree bases. Soils in the seepage area are very loose and organic. Some streambeds are gravelly. These sites are very diverse in terms of microhabitat and therefore also species.

Vegetation Description: The canopy of this association is dominated by *Liriodendron tulipifera* (tuliptree), *Betula alleghaniensis* (yellow birch), and *Fagus grandifolia* (American beech) which all occupy the upland patches. The subcanopy is dominated by *Acer rubrum* (red maple), *Fraxinus pennsylvanica* (green ash), *Carya glabra* (pignut hickory), and *Tilia americana* (American basswood). The shrub layer is moderately well-developed compared to other sites at Morristown, with *Sambucus nigra* ssp. *canadensis* (common elderberry), *Rhododendron viscosum* (swamp azalea), and *Vaccinium pallidum* (Blue Ridge blueberry). The herbaceous layer is extremely diverse and is dominated by *Symplocarpus foetidus* (skunk cabbage), *Veratrum viride* (green false hellebore), *Carex siccata* (dryspike sedge), *Carex bromoides* (bromelike sedge), *Impatiens capensis* (jewelweed), *Amphicarpaea bracteata* (American hogpeanut), *Viola pubescens* (downy yellow violet) and *Viola sororia* (common blue violet), *Arisaema triphyllum* (Jack in the pulpit), *Osmunda cinnamomea* (cinnamon fern) and *Osmunda regalis* (royal fern), *Pilea pumila* (Canadian clearweed), *Lysimachia ciliata* (fringed loosestrife), and *Scutellaria galericulata* (marsh skullcap). *Chrysosplenium americanum* (American golden saxifrage) is also found in some of the small gravel-bottomed stream channels.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Betula alleghaniensis* (yellow birch)
		Acer rubrum (red maple)
		Liriodendron tulipifera (tuliptree)
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
		Carya alba (pignut hickory)
		Fraxinus pennsylvanica (green ash)
		Tilia americana (American basswood)
Herb (field)	Forb	*Symplocarpus foetidus* (skunk cabbage)
		Amphicarpaea bracteata (American hogpeanut)
		Impatiens capensis (jewelweed)
Herb (field)	Graminoid	*Carex digitalis* (slender woodland sedge)
		Carex bromoides (bromelike sedge)
		Carex foena (dryspike sedge)
Herb (field)	Fern or fern ally	*Thelypteris noveboracensis* (New York fern)

Characteristic Species: *Betula alleghaniensis* (yellow birch).

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

State	SRank	Rel	Conf	SName	Reference
NJ	SNR	.	.	[not crosswalked]	.

Local Range: An example of this association is found between the Soldiers Hut and Aqueduct trails. No other sites for this association were noted during field work.
Classification Comments: Information not available.
Other Comments: While deer were seen in this area during both visits, the general herbaceous vegetation appears to be less decimated than in other parts of the park. There are nearby open grassy areas, and the flora appears to be naturally very rich and diverse, both of which may contribute to a high survival rate of herbaceous species in this area. The shrub layer is, however, dramatically altered by deer browse, as it is in all parts of the park. There is no equivalent to this association in Ehrenfeld (1977). Current occurrences are small and were likely noted as a part of other communities, principally the Stream Thicket community.
Local Description Authors: R. E. Zaremba.
Plots: MORR.22.
Morristown National Historical Park Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Saturated cold-deciduous forest (I.B.2.N.g.)
Alliance	*Fraxinus nigra - Acer rubrum* Saturated Forest Alliance (A.347)
Alliance (English name)	Black Ash - Red Maple Saturated Forest Alliance
Association	*Acer rubrum - Fraxinus americana - Fraxinus nigra - Betula alleghaniensis / Veratrum viride - Carex bromoides* Forest
Association (English name)	Red Maple - White Ash - Black Ash - Yellow Birch / American False Hellebore - Bromelike Sedge Forest
Ecological System(s):	Central Appalachian Stream and Riparian (CES202.609).

GLOBAL DESCRIPTION

Concept Summary: This community type occupies groundwater-saturated stream headwaters, large spring seeps and runs, and lateral areas in ravine and stream bottoms where groundwater emerges at the base of slopes. It is most frequent and best developed on Catoctin Formation metabasalt (greenstone) of the northern Blue Ridge and other base-rich substrates. Soil chemistry data indicate moderately high calcium and magnesium levels. Overstory composition is mixed, with *Acer rubrum* (red maple), *Fraxinus americana* (white ash), and *Liriodendron tulipifera* (tuliptree) the most abundant species. *Fraxinus nigra* (black ash) is a frequent overstory associate but more abundant and sometimes dominant in the understory, along with young *Acer rubrum* (red maple) and *Fraxinus americana* (white ash). With increasing elevation, *Betula alleghaniensis* (yellow birch) becomes increasingly important, codominating most stands above 760 m (2500 feet) in Virginia and in the Catoctin Mountains of Maryland. Minor tree associates include *Betula lenta* (sweet birch) and *Tilia americana* (American basswood). Canopy closure is often incomplete (mean stratum cover = 60–80%), most evidently because of blowdowns. Very wet microhabitats that impede the establishment and firm rooting of trees may also contribute to a somewhat open canopy. Shrub stratum diversity is moderately high; *Lindera benzoin* (northern

spicebush) is usually the most abundant species, and considerable stratum cover is contributed by tree saplings. Other frequently occurring true shrubs are *Alnus serrulata* (hazel alder), *Carpinus caroliniana* (American hornbeam), *Hamamelis virginiana* (American witchhazel), *Ilex verticillata* (common winterberry), and *Sambucus nigra* ssp. *canadensis* (common elderberry). Except in local areas where shrubs are dense, herbaceous cover is high (mean stratum cover = 90%). One or both of the early-maturing forbs *Symplocarpus foetidus* (skunk cabbage) (mostly at lower elevations) and *Veratrum viride* (green false hellebore) are usually dominant over substantial areas. Because of microtopographic diversity, herbaceous patch-mosaics are typical in this vegetation. More-or-less constant, sometimes locally abundant species include *Eurybia schreberi* (Schreber's aster), *Caltha palustris* (yellow marsh marigold), *Carex bromoides* (bromelike sedge), *Carex gynandra* (nodding sedge), *Carex prasina* (drooping sedge), *Chelone glabra* (white turtlehead), *Chrysosplenium americanum* (American golden saxifrage), *Cinna arundinacea* (sweet woodreed), *Dryopteris carthusiana* (spinulose woodfern), *Dryopteris goldiana* (Goldie's woodfern), *Glyceria striata* (fowl mannagrass), *Impatiens capensis* (jewelweed), *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis var. spectabilis* (royal fern), *Ranunculus recurvatus* (blisterwort), *Saxifraga pensylvanica* (eastern swamp saxifrage), *Packera aurea* (golden ragwort), *Sphenopholis pensylvanica* (swamp wedgescale), *Thalictrum pubescens* (king of the meadow), and *Viola cucullata* (marsh blue violet). Moss cover is often significant but only rarely includes *Sphagnum* (sphagnum) spp. (not recorded in Virginia plots). Typical upland mesophytes commonly occur in well-drained hummock microhabitats and contribute to relatively high species-richness values for this type of wetland.

Environmental Description: This community type occupies groundwater-saturated stream headwaters, large spring seeps and runs, and lateral areas in ravine and stream bottoms where groundwater emerges at the base of slopes. Hydrologically, these habitats are classified as "groundwater slope wetlands," where seepage discharged at the ground surface is drained away as streamflow (Golet et al. 1993). Habitats are usually more-or-less narrow and elongate, with considerable exposed boulders and cobble alluvium. Soils are predominantly mineral, but local areas of organic muck sometimes accumulate in depressions. The ground surface is slightly sloping (mean slope = 3 degrees), and drainage is usually via small, intricately braided channels with intervening hummocks. Moss mats on boulders and cobble deposits commonly provide a rooting medium for herbaceous species, and "sedge tussocks" (especially of *Carex bromoides* (bromelike sedge) and *Carex prasina*) are conspicuous features of these swamps. Soils collected from 25 Virginia and Maryland plot samples ranged from strongly acidic to neutral in pH, with moderately high calcium (mean = 1358 ppm) and magnesium (mean = 211 ppm) levels. This community is most frequent and best developed on Catoctin Formation metabasalt (greenstone) of the northern Blue Ridge. There, it occurs locally in small patches (<12 hectares [30 acres]) at elevations from about 275 to 850 m (900–2800 feet) and occasionally up to 975 m (3200 feet) (Ludwig et al. 1993). It has also been documented in northwestern Virginia in the Massanutten Mountains and western Ridge and Valley region, and in the western Piedmont of both Virginia and Maryland. A somewhat isolated and disjunct occurrence is documented from the Dismal Creek valley in Giles County, in the southwestern Virginia Ridge and Valley. This is probably one of the southernmost occurrences for both the community type and *Fraxinus nigra* (black ash), a tree of pronounced northern distribution. The few known Ridge and Valley occurrences are associated with sites where Devonian or Silurian limestones are interbedded with sandstone and shale. While surficial outcrops of limestone are not evident at these sites, it is clear from

both soil samples and floristic evidence that the wetlands are being supplied with calcium by groundwater.

Vegetation Description: Overstory composition is mixed, with *Acer rubrum* (red maple), *Fraxinus americana* (white ash), and *Liriodendron tulipifera* (tuliptree) the most abundant species. *Fraxinus nigra* (black ash) is a frequent overstory associate but more abundant and sometimes dominant in the understory, along with young *Acer rubrum* (red maple) and *Fraxinus americana* (white ash). With increasing elevation, *Betula alleghaniensis* (yellow birch) becomes increasingly important, codominating most stands above 760 m (2500 feet) in Virginia and in the Catoctin Mountains of Maryland. Minor tree associates include *Betula lenta* (sweet birch) and *Tilia americana* (American basswood). Almost all trees in plot-sampled stands were <50 cm dbh and most were <40 cm dbh; but scattered *Liriodendron* (tuliptree) specimens >80 cm dbh occur, and in one plot such an individual tree accounts for the high canopy cover of this species. Canopy closure is often incomplete (mean stratum cover = 60–80%), most evidently because of blowdowns. Very wet microhabitats that impede the establishment and firm rooting of trees may also contribute to a somewhat open canopy. Shrub stratum diversity is moderately high; *Lindera benzoin* (northern spicebush) is usually the most abundant species, and considerable stratum cover is contributed by tree saplings. Other frequently occurring true shrubs are *Alnus serrulata* (hazel alder), *Carpinus caroliniana* (American hornbeam), *Hamamelis virginiana* (American witchhazel), *Ilex verticillata* (common winterberry), and *Sambucus nigra* ssp. *canadensis* (common elderberry). Except in local areas where shrubs are dense, herbaceous cover is high (mean stratum cover = 90%). One or both of the early-maturing forbs *Symplocarpus foetidus* (skunk cabbage) (mostly at lower elevations) and *Veratrum viride* (green false hellebore) are usually dominant over substantial areas. Because of microtopographic diversity, herbaceous patch-mosaics are typical in this vegetation. More-or-less constant, sometimes locally abundant species include *Eurybia schreberi* (Schreber's aster), *Caltha palustris* (yellow marsh marigold), *Carex bromoides* (bromelike sedge), *Carex gynandra* (nodding sedge), *Carex prasina* (drooping sedge), *Chelone glabra* (white turtlehead), *Chrysosplenium americanum* (American golden saxifrage), *Cinna arundinacea* (sweet woodreed), *Dryopteris carthusiana* (spinulose woodfern), *Dryopteris goldiana* (Goldie's woodfern), *Glyceria striata* (fowl mannagrass), *Impatiens capensis* (jewelweed), *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis var. spectabilis* (royal fern), *Ranunculus recurvatus* (blisterwort), *Saxifraga pensylvanica* (eastern swamp saxifrage), *Packera aurea* (golden ragwort), *Sphenopholis pensylvanica* (swamp wedgescale), *Thalictrum pubescens* (king of the meadow), and *Viola cucullata* (marsh blue violet). Moss cover is often significant, but only rarely includes *Sphagnum* (sphagnum) spp. (not recorded in Virginia plots). Typical upland mesophytes commonly occur in well-drained hummock microhabitats and contribute to relatively high species richness values for this type of wetland (n = 60 taxa per 400 square meters for 25 plot samples).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
		Fraxinus americana (white ash)
		Liriodendron tulipifera (tuliptree)
Tree subcanopy	Broad-leaved deciduous tree	*Fraxinus nigra* (black ash)
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	*Lindera benzoin* (northern spicebush)
Herb (field)	Forb	*Symplocarpus foetidus* (skunk cabbage)
		Veratrum viride (green false hellebore)

Characteristic Species: *Acer rubrum* (red maple), *Athyrium filix-femina* ssp. *asplenioides* (asplenium ladyfern), *Caltha palustris* (yellow marsh marigold), *Cardamine pensylvanica*

(Pennsylvania bittercress), *Carex bromoides* (bromelike sedge), *Carex gynandra* (nodding sedge), *Carex laevivaginata* (smoothsheath sedge), *Carex prasina* (drooping sedge), *Carex scabrata* (eastern rough sedge), *Carex scoparia* (broom sedge), *Carex seorsa* (weak stellate sedge), *Chelone glabra* (white turtlehead), *Chrysosplenium americanum* (American golden saxifrage), *Cinna arundinacea* (sweet woodreed), *Dryopteris carthusiana* (spinulose woodfern), *Dryopteris cristata* (crested woodfern), *Eurybia schreberi* (Schreber's aster), *Fraxinus americana* (white ash), *Fraxinus nigra* (black ash), *Huperzia lucidula* (shining clubmoss), *Ilex verticillata* (common winterberry), *Impatiens capensis* (jewelweed), *Lindera benzoin* (northern spicebush), *Onoclea sensibilis* (sensitive fern), *Osmunda regalis* var. *spectabilis* (royal fern), *Packera aurea* (golden ragwort), *Poa paludigena* (bog bluegrass), *Ranunculus hispidus* var. *caricetorum* (bristly buttercup), *Rosa palustris* (swamp rose), *Sambucus nigra* ssp. *canadensis* (common elderberry), *Saxifraga micranthidifolia* (lettuceleaf saxifrage), *Saxifraga pensylvanica* (eastern swamp saxifrage), *Sphenopholis pensylvanica* (swamp wedgescale), *Symplocarpus foetidus* (skunk cabbage), *Thalictrum pubescens* (king of the meadow), *Thelypteris noveboracensis* (New York fern), *Trautvetteria caroliniensis* (Carolina bugbane), *Trillium cernuum* (whip-poor-will flower), *Veratrum viride* (green false hellebore), *Veronica americana* (American speedwell), *Veronica anagallis-aquatica* (water speedwell), *Viola cucullata* (marsh blue violet), *Vitis labrusca* (fox grape).

Other Noteworthy Species:

Species	GRank	Note
Euphorbia purpurea (Darlington's glade spurge)	G3	
Platanthera grandiflora (greater purple fringed orchid)	VA S1	
Poa paludigena (bog bluegrass)	G3	
Symphyotrichum praealtum var. *angustior* (willowleaf aster)	VA S1	

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: The probable range of this community type encompasses the Central Appalachian region of Pennsylvania, Maryland, Virginia, and West Virginia. In Virginia, it is found primarily in the northern half of the mountains, apparently reaching its southern limits in Giles County. In Maryland, it its distribution is centered in the Catoctin Mountains. The majority of occurrences are on the northern Blue Ridge, but the type is also scattered in suitable habitats of the Ridge and Valley province and western Piedmont.

States/Provinces: DE?, MD, NJ, VA:S2, WV?

Federal Lands: NPS (Blue Ridge Parkway, Catoctin Mountain, Morristown, Shenandoah); USFS (George Washington, Jefferson).

CONSERVATION STATUS

Rank: G3 (17-Apr-2000).

Reasons: This association has a narrow geographic range and is further limited by its small patch sizes and requirement for special, very localized wetlands. The type is confined to groundwater-saturated, base-rich habitats that are large enough to support forest vegetation.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

Comments: Classification of this type is supported by analysis of a 1250-plot regional dataset assembled for the NCR vegetation mapping project. In that analysis, this association is represented by 25 Virginia and Maryland plots that perform as a tight group in all analytical

procedures. Distinct floristic features of calcareous seepage swamps include the prevalence of *Fraxinus* (ash) spp. (especially *Fraxinus nigra* (black ash)) and nutrient-demanding species, among the most diagnostic of which are *Caltha palustris* (yellow marsh marigold), *Carex bromoides* (bromelike sedge), *Carex laevivaginata* (smoothsheath sedge), *Pilea fontana* (lesser clearweed), *Poa paludigena* (bog bluegrass), *Ranunculus hispidus var. caricetorum* (bristly buttercup), *Saxifraga pensylvanica* (eastern swamp saxifrage), and *Trillium cernuum* (whip-poor-will flower). These communities lack the *Sphagnum* (sphagnum) mosses that characterize acidic groundwater wetlands. Moreover, many vascular plants that are common in or diagnostic of acidic seepage swamps are absent or unimportant (e.g., *Pinus rigida* (pitch pine), *Nyssa sylvatica* (blackgum), *Viburnum nudum var. nudum* (possumhaw), *Parnassia asarifolia* (kidneyleaf grass of Parnassus), *Platanthera ciliaris* (yellow fringed orchid), *Platanthera clavellata* (small green wood orchid), *Rubus hispidus* (bristly dewberry), *Lycopodium obscurum* (rare clubmoss), *Carex debilis var. debilis* (white edge sedge), and *Carex folliculata* (northern long sedge)) (Fleming and Van Alstine 1999).

Additionally, the spectrum of stands representing this association in Virginia shows a clear elevation gradient, with *Symplocarpus foetidus* (skunk cabbage) and *Fraxinus nigra* (black ash) decreasing in frequency and abundance and *Betula alleghaniensis* (yellow birch) assuming codominance as elevation increases. In landscapes with suitably base-rich substrates such as Catoctin metabasalt, this type may intergrade with the higher elevation *Tsuga canadensis - Betula alleghaniensis / Veratrum viride - Carex scabrata - Oclemena acuminata* Forest (CEGL008533) in a transitional zone from about 760 to 900 m (2500–3000 feet) elevation.

Similar Associations:

- *Acer rubrum - Nyssa sylvatica / Ilex verticillata - Vaccinium fuscatum / Osmunda cinnamomea* Forest (CEGL007853)--acidic seepage swamp of the same Central Appalachian region; develops on sandstone and quartzite substrates and has higher component of acidophiles, e.g., Nyssa sylvatica, Vaccinium spp., Pinus rigida, Rubus hispidus, etc.; calciphilic species such as *Caltha palustris, Carex bromoides, Fraxinus nigra*, etc. are very sparse to absent.
- *Fraxinus nigra - Acer rubrum / Rhamnus alnifolia / Carex leptalea* Saturated Forest (CEGL007441)--basic seepage swamp of the High Allegheny Mountains of Maryland, Pennsylvania, and West Virginia; more northern and fen-like compared to CEGL008416.

Related Concepts:

- *Acer rubrum - Fraxinus americana - Fraxinus nigra / Carex bromoides - Carex prasina - (Caltha palustris)* Forest (Fleming and Coulling 2001) =
- *Acer rubrum - Fraxinus nigra / Caltha palustris - Carex bromoides* Forest (Fleming 1999) =
- Black Ash - American Elm - Red Maple: 39 (Eyre 1980) B

SOURCES

Description Authors: G. P. Fleming.

References: Ehrenfeld 1977, Eyre 1980, Fleming 1999, Fleming and Coulling 2001, Fleming and Van Alstine 1999, Fleming et al. 2001, Golet et al. 1993, Gould and Berdine 1998, Harrison 2004, Lea 2003, Ludwig et al. 1993, Southeastern Ecology Working Group n.d., VDNH 2003, VDNH unpubl. data.

Figure 15. Montane Basic Seepage Swamp in Morristown National Historical Park (plot MORR.22, photo 22-1). July 2005. NAD 1983 / UTM easting 538875 northing 4513687.

COMMON NAME (PARK-SPECIFIC): HEMLOCK - RED OAK - MIXED HARDWOOD FOREST

SYNONYMS

USNVC English Name: **Northern Red Oak - Eastern Hemlock - Tuliptree / American Witchhazel Forest**

USNVC Scientific Name: ***Quercus rubra - Tsuga canadensis - Liriodendron tulipifera / Hamamelis virginiana* Forest**

USNVC Identifier: **CEGL006566**

LOCAL INFORMATION

Environmental Description: This association is located on a steep, rocky east-facing slope about midslope. Soils are very rocky and acidic. The hemlocks are all dead but were locally abundant in the past. There are numerous holes dug in the slope, possibly by fox. Soils are thin and there is a high cover of exposed rock (about 60%). The canopy is very open as a result of the loss of the hemlocks. There is a high cover of downed woody debris (10%). Deer were noted on the steep slope during each of the four visits to the site.

Vegetation Description: The canopy of this community is dominated by *Betula lenta* (sweet birch) and *Quercus rubra* (northern red oak). The sampled plot contained nine dead *Tsuga canadensis* (eastern hemlock) that remained standing with a dbh ranging from 25 to 40 cm. There were also numerous downed dead *Tsuga canadensis* (eastern hemlock), mostly with smaller diameters. The canopy is very open. Minor canopy associates include *Quercus prinus* (chestnut oak) and *Liriodendron tulipifera* (tuliptree). Shrubs are sparse (<1%), including *Vaccinium pallidum* (Blue Ridge blueberry), *Mitchella repens* (partridgeberry), and *Chimaphila maculata* (striped prince's pine). Herbaceous species cover is also low, including *Carex pensylvanica* (Pennsylvania sedge), *Ageratina altissima var. altissima* (white snakeroot), *Dennstaedtia punctilobula* (eastern hayscented fern), and *Thelypteris noveboracensis* (New York fern).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Betula lenta* (sweet birch)
		Quercus rubra (northern red oak)

Characteristic Species: *Carex pensylvanica* (Pennsylvania sedge), *Quercus rubra* (northern red oak), *Dennstaedtia punctilobula* (eastern hayscented fern).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NJ	SNR	.	.	[not crosswalked]	.

Local Range: This association is found only along the east-facing slope on the eastern side of the park above Bailey Hollow Road.

Classification Comments: The *Tsuga canadensis* (eastern hemlock) at Jockey Hollow on the hillside overlooking Bailey Hollow Road has died within the past ten years from infection by the hemlock woolly adelgid. The community currently has both standing and downed dead *Tsuga canadensis* (eastern hemlock). Deer browse in the area is high and may limit tree species recruitment. The community has not yet adjusted to the loss of *Tsuga canadensis* (eastern hemlock). It is unclear what community will occupy this part of the park in the future. Currently, the site is not extremely weedy but neither is it filling in with other tree or shrub species.

Other Comments: This association is equivalent to Ehrenfeld's (1977) Mixed Hemlock - Hardwoods, described in Appendix B. She describes a small stand in the northeastern corner of the park, the only stand of cool, moist hillsides and ravines. She noted "the canopy consists of approximately 50% hemlock and 50% mature hardwood species including red oak, black oak, beech, black birch, hickory, yellow poplar and red maple. Dogwood is present in the understory, and sapling-sized trees of both hemlock and hardwood species were seen," a description considerably different from what currently exists.
Local Description Authors: R. E. Zaremba.
Plots: MORR.03.
Morristown National Historical Park Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Mixed evergreen-deciduous forest (I.C.)
Physiognomic Group	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.)
Physiognomic Subgroup	Natural/Semi-natural mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.)
Formation	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a.)
Alliance	*Tsuga canadensis - Liriodendron tulipifera* Forest Alliance (A.413)
Alliance (English name)	Eastern Hemlock - Tuliptree Forest Alliance
Association	*Quercus rubra - Tsuga canadensis - Liriodendron tulipifera / Hamamelis virginiana* Forest
Association (English name)	Northern Red Oak - Eastern Hemlock - Tuliptree / American Witchhazel Forest
Ecological System(s):	Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593).

GLOBAL DESCRIPTION

Concept Summary: This closed-canopy, dry-mesic deciduous forest occurs on deep, moist to well-drained loams and silt loams on northern and eastern midslopes and coves. The canopy is dominated by a variety of oaks, hickories and conifers, including *Quercus rubra* (northern red oak), *Acer saccharum* (sugar maple), *Fagus grandifolia* (American beech), *Quercus alba* (white oak), *Quercus velutina* (black oak), *Betula lenta* (sweet birch), *Carya alba* (mockernut hickory), *Fraxinus americana* (white ash), and *Liriodendron tulipifera* (tuliptree), with notable presence of *Tsuga canadensis* (eastern hemlock) and/or *Pinus strobus* (eastern white pine). The subcanopy and shrub layer consists of *Ostrya virginiana* (hophornbeam), *Carpinus caroliniana* (American hornbeam), *Kalmia latifolia* (mountain laurel), *Hamamelis virginiana* (American witchhazel), *Vaccinium pallidum* (Blue Ridge blueberry), *Amelanchier laevis* (Allegheny serviceberry), *Lindera benzoin* (northern spicebush), *Viburnum acerifolium* (mapleleaf viburnum), and *Viburnum recognitum* (southern arrowwood). The herbaceous layer is characterized by *Maianthemum racemosum* (feathery false lily of the valley), *Gaultheria procumbens* (eastern teaberry), *Mitchella repens* (partridgeberry), *Chimaphila maculata* (striped prince's pine), *Thelypteris noveboracensis* (New York fern), *Dennstaedtia punctilobula* (eastern hayscented fern), *Maianthemum canadense* (Canada mayflower), and *Podophyllum peltatum* (mayapple).
Environmental Description: This vegetation occurs on deep, moist to well-drained loams and silt loams on northern and eastern midslopes and coves. Soils may be rocky, and slopes may be steep.
Vegetation Description: The canopy has a notable presence of *Tsuga canadensis* (eastern hemlock) and/or *Pinus strobus* (eastern white pine). Sharing dominance with these conifers is a

variety of oaks and hickories including *Quercus rubra* (northern red oak), *Acer saccharum* (sugar maple), *Fagus grandifolia* (American beech), *Quercus alba* (white oak), *Quercus velutina* (black oak), *Betula lenta* (sweet birch), *Carya alba* (mockernut hickory), *Fraxinus americana* (white ash), *Liriodendron tulipifera* (tuliptree). The subcanopy and shrub layer consists of *Ostrya virginiana* (hophornbeam), *Carpinus caroliniana* (American hornbeam), *Kalmia latifolia* (mountain laurel), *Hamamelis virginiana* (American witchhazel), *Amelanchier laevis* (Allegheny serviceberry), *Lindera benzoin* (northern spicebush), *Viburnum acerifolium* (mapleleaf viburnum), and *Viburnum recognitum* (southern arrowwood). The herbaceous layer is characterized by *Maianthemum racemosum* (feathery false lily of the valley), *Gaultheria procumbens* (eastern teaberry), *Maianthemum canadense* (Canada mayflower), and *Podophyllum peltatum* (mayapple).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus strobus* (eastern white pine)
		Tsuga canadensis (eastern hemlock)
Tree canopy	Broad-leaved deciduous tree	*Liriodendron tulipifera* (tuliptree)
		Quercus rubra (northern red oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Hamamelis virginiana* (American witchhazel)
Herb (field)	Dwarf-shrub	*Gaultheria procumbens* (eastern teaberry)
Herb (field)	Forb	*Maianthemum racemosum* (feathery false lily of the valley)
		Podophyllum peltatum (mayapple)

Characteristic Species: *Hamamelis virginiana* (American witchhazel), *Liriodendron tulipifera* (tuliptree), *Pinus strobus* (eastern white pine), *Quercus rubra* (northern red oak), *Tsuga canadensis* (eastern hemlock).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This vegetation occurs in New Jersey and Pennsylvania and may occur in adjacent states.

States/Provinces: NJ, PA.

Federal Lands: NPS (Morristown).

CONSERVATION STATUS

Rank: G4? (29-Sep-2004).

Reasons: Within its range, this community type occurs extensively in suitable habitats. Occurrences are subject to compositional modification by outbreaks of hemlock woolly adelgid (*Adelges tsugae*), an exotic insect pest that causes decline and eventual mortality of *Tsuga canadensis* (eastern hemlock).

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

Comments: Information not available.

Similar Associations:

- *Quercus rubra - Acer saccharum - Liriodendron tulipifera* Forest (CEGL006125).
- *Tsuga canadensis - Fagus grandifolia - Quercus (prinus, alba)* Forest (CEGL006474).

Related Concepts:

- Mixed Hemlock - Hardwoods community (Ehrenfeld 1977) =

SOURCES

Description Authors: L. A. Sneddon.

References: Anderson et al. 1998, Eastern Ecology Working Group n.d., Ehrenfeld 1977, Fike 1999.

Figure 16. Hemlock - Red Oak - Mixed Hardwood Forest in Morristown National Historical Park (plot MORR.03, photo 3-1). July 2005. NAD 1983 / UTM easting 541242 northing 4513465.

COMMON NAME (PARK-SPECIFIC): NORTHEASTERN OLD FIELD

SYNONYMS

USNVC English Name: **Orchard Grass - Timothy - Fescue species - Goldenrod species Herbaceous Vegetation**

USNVC Scientific Name: ***Dactylis glomerata* - *Phleum pratense* - *Festuca* spp. - *Solidago* spp. Herbaceous Vegetation**

USNVC Identifier: **CEGL006107**

LOCAL INFORMATION

Environmental Description: This association occurs at sites mowed annually by the park as a part of the historic site or for parking. These sites generally have fewer rocks near the surface compared to other parts of the park. Some sites were tilled; some were orchards; some were hay fields or pastures. Soils are generally sandy loam.

Vegetation Description: This association is dominated by native as well as nonnative grasses. Species vary among sites. Typical grass species found in this association include *Phleum pratense* (timothy), *Dichanthelium clandestinum* (deertongue), *Agrostis hyemalis* (winter bentgrass), *Dactylis glomerata* (orchardgrass), *Anthoxanthum odoratum* (sweet vernalgrass), *Lolium perenne* (perennial ryegrass), *Tridens flavus* (purpletop tridens), *Schizachyrium scoparium* (little bluestem), and *Sorghastrum nutans* (Indiangrass). Other common herbaceous species include *Asclepias syriaca* (common milkweed), *Symphyotrichum dumosum* (rice button aster), *Achillea millefolium* (common yarrow), *Dianthus armeria* (Deptford pink), *Galium* (bedstraw) sp., *Linaria vulgaris* (butter and eggs), *Oxalis stricta* (common yellow oxalis), and *Apocynum cannabinum* (Indianhemp). Unusual species noted in Morristown grasslands include *Asclepias tuberosa* (butterfly milkweed) and *Asclepias viridiflora* (green comet milkweed), *Monarda fistulosa* (wild bergamot), and *Pycnanthemum virginianum* (Virginia mountainmint).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Cynodon dactylon* (Bermuda grass)
		Lolium perenne (perennial ryegrass)
		Agrostis hyemalis (winter bentgrass)
		Phleum pratense (timothy)
		Schizachyrium scoparium (little bluestem)

Characteristic Species: A suite of nonnative grasses and forbs characterizes this vegetation.

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NJ	SNA	.	.	[not crosswalked]	.

Local Range: Good examples are located on the south side of Mt. Kemble, on the west side of Jarvis Hill, and at the Wick Farm orchard.

Classification Comments: Information not available.

Other Comments: Herbaceous associations were not included in Ehrenfeld (1977).

Local Description Authors: R. E. Zaremba.

Plots: MORR.04.

Morristown National Historical Park Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c.)
Alliance	*Dactylis glomerata* - *Rumex acetosella* Herbaceous Alliance (A.1190)
Alliance (English name)	Orchard Grass - Common Sheep Sorrel Herbaceous Alliance
Association	*Dactylis glomerata* - *Phleum pratense* - *Festuca* spp. - *Solidago* spp. Herbaceous Vegetation
Association (English name)	Orchard Grass - Timothy - Fescue species - Goldenrod species Herbaceous Vegetation
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This broadly defined vegetation type includes pastures and post-agricultural fields and is largely composed of nonnative cool-season grasses and herbs (generally of European origin) in the early stages of succession. The fields are typically mowed at least annually. Physiognomically, these grasslands are generally comprised of mid-height (1–3 feet tall) grasses and forbs, with occasional scattered shrubs. Species composition varies from site to site, depending on land-use history and perhaps soil type, but in general this vegetation is quite wide-ranging in northeastern and Midwestern states and at higher elevations (610–1220 m [2000–4000 feet]) in the southeastern states. Dominant grasses vary from site to site but generally feature the nominal species. Other graminoid associates may include *Agrostis stolonifera* (creeping bentgrass), *Agrostis hyemalis* (winter bentgrass), *Elymus repens* (quackgrass), *Bromus inermis* (smooth brome), *Bromus tectorum* (cheatgrass), *Lolium perenne* (perennial ryegrass), *Poa pratensis* (Kentucky bluegrass), *Poa compressa* (Canada bluegrass), *Schizachyrium scoparium* (little bluestem) (not in abundance), and *Anthoxanthum odoratum* (sweet vernalgrass). Forbs scattered among the grasses are varied but include *Hieracium* (hawkweed) spp., *Oxalis stricta* (common yellow oxalis), *Achillea millefolium* (common yarrow), *Asclepias syriaca* (common milkweed), *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago nemoralis* (gray goldenrod), *Solidago juncea* (early goldenrod), *Solidago canadensis* (Canada goldenrod), *Solidago canadensis var. scabra* (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* (clover) spp., and many others.

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

Vegetation Description: In addition to *Dactylis glomerata* (orchardgrass) and *Phleum pratense* (timothy), these grassy fields are characterized by graminoids including *Agrostis stolonifera* (creeping bentgrass), *Agrostis hyemalis* (winter bentgrass), *Elymus repens* (quackgrass), *Bromus inermis* (smooth brome), *Bromus tectorum* (cheatgrass), *Lolium perenne* (perennial ryegrass), *Poa pratensis* (Kentucky bluegrass), *Poa compressa* (Canada bluegrass), *Schizachyrium scoparium* (little bluestem) (not in abundance), and *Anthoxanthum odoratum* (sweet vernalgrass). Forbs scattered among the grasses are varied but include *Hieracium* (hawkweed) spp., *Oxalis*

stricta (common yellow oxalis), *Achillea millefolium* (common yarrow), *Asclepias syriaca* (common milkweed), *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago nemoralis* (gray goldenrod), *Solidago juncea* (early goldenrod), *Solidago canadensis* (Canada goldenrod), *Solidago canadensis var. scabra* (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* (clover) spp., and many others.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Rumex acetosella* (common sheep sorrel)
Herb (field)	Graminoid	*Dactylis glomerata* (orchardgrass)
		Festuca rubra (red fescue)
		Phleum pratense (timothy)

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

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

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

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

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

CONSERVATION STATUS

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

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

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 - Weak.

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

Similar Associations:

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

Related Concepts: Information not available.

SOURCES

Description Authors: S. C. Gawler.

References: Clark 1986, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Ehrenfeld 1977, Elliman 2003, Keever 1979, NRCS 2004, Newbold et al. 1988, Perles et al. 2006a, Perles et al. 2006b, Perles et al. 2006c, Perles et al. 2007, Sneddon et al. 1995, TDNH unpubl. data.

Figure 17. Northeastern Old Field in Morristown National Historical Park (plot MORR.04, photo 4-2). July 2005. NAD 1983 / UTM easting 540607 northing 4513140.

COMMON NAME (PARK-SPECIFIC): SKUNK CABBAGE - ORANGE JEWELWEED SEEP

SYNONYMS
USNVC English Name: **Skunk Cabbage - Orange Jewelweed Herbaceous Vegetation**
USNVC Scientific Name: ***Symplocarpus foetidus - Impatiens capensis* Herbaceous Vegetation**
USNVC Identifier: **CEGL006567**

LOCAL INFORMATION

Environmental Description: This association occurs primarily along steeply sloping lower slope drainages and along the borders of small streams. The substrate is rocky with organic soils saturated in the spring and drier in the late summer. The forest canopy varies based on local conditions, generally reflecting overhanging trees from the adjacent upland forest. In some more permanently wet sites, wetland trees and shrubs may line the drainages.
Vegetation Description: This association is dominated by *Symplocarpus foetidus* (skunk cabbage). Frequent associates include *Veratrum viride* (green false hellebore), *Carex canescens* (silvery sedge), *Carex bromoides* (bromelike sedge), *Impatiens capensis* (jewelweed), *Viola sororia* (common blue violet), *Arisaema triphyllum* (Jack in the pulpit), *Maianthemum canadense* (Canada mayflower), and *Panax trifolius* (dwarf ginseng). *Sphagnum* spp. (Sphagnum) and *Leucocobyrum* spp. are locally abundant. This small patch type is sometimes not readily evident by late summer, after senescence of *Symplocarpus foetidus* (skunk cabbage).
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Symplocarpus foetidus* (skunk cabbage)

Characteristic Species: *Symplocarpus foetidus* (skunk cabbage), *Impatiens capensis* (jewelweed), *Pilea pumila* (clearweed).
Other Noteworthy Species: None.
Subnational Distribution with Crosswalk data:

State	SRank	Rel	Conf	SName	Reference
NJ	SNR	.	.	[not crosswalked]	.

Local Range: There are good examples of this association along the west side of Mt. Kemble, along the upper edges of Primrose Brook, and in the many of the small drainages into the Passaic River in the New Jersey Brigade Unit.
Classification Comments: This association is found adjacent to forest associations occurring on lower slopes: Northern Piedmont Mesic Oak - Beech Forest (CEGL006921) and Upland / Wetland Transitional Forest (CEGL006000).
Other Comments: This association equates in part with Erhenfeld's (1977) Stream Thicket community.
Local Description Authors: R. E. Zaremba.
Plots: JThompson03050705; JThompson03050701.
Morristown National Historical Park Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial forb vegetation (V.B.)
Physiognomic Group	Temperate or subpolar perennial forb vegetation (V.B.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar perennial forb vegetation (V.B.2.N.)
Formation	Saturated temperate perennial forb vegetation (V.B.2.N.f.)
Alliance	*Symplocarpus foetidus* - *Caltha palustris* Saturated Herbaceous Alliance (A.1694)
Alliance (English name)	Skunk-cabbage - Yellow Marsh-marigold Saturated Herbaceous Alliance
Association	*Symplocarpus foetidus* - *Impatiens capensis* Herbaceous Vegetation [Provisional]
Association (English name)	Skunk Cabbage - Orange Jewelweed Herbaceous Vegetation
Ecological System(s):	Northern Atlantic Coastal Plain Dry Hardwood Forest (CES203.475).

GLOBAL DESCRIPTION

Concept Summary: This small seepage wetland vegetation occurs in low-lying areas such as streamheads, lower slope drainages, and the borders of small streams where groundwater emerges. The substrate is mucky, with rocks and boulders often visibly protruding above the surface. Little quantitative data exist for this vegetation, although casual observation suggests it is quite common in the northeastern United States. Typically, this vegetation is shaded by tree species of higher ground and surrounding edges of the community, but these species are not characteristic of the vegetation and vary widely among occurrences. *Lindera benzoin* (northern spicebush) may occur, particularly at the edges. Characteristic herbaceous species are *Symplocarpus foetidus* (skunk cabbage), *Impatiens capensis* (jewelweed), and *Arisaema triphyllum* (Jack in the pulpit). Other common associates are variable but may include *Veratrum viride* (green false hellebore), *Pilea pumila* (clearweed), *Cardamine pensylvanica* (Pennsylvania bittercress), *Saxifraga pensylvanica* (Eastern swamp saxifrage), *Carex canescens* (silvery sedge), *Caltha palustris* (yellow marsh marigold), and *Viola sororia* (common blue violet).

Environmental Description: This small seepage wetland vegetation occurs in low-lying areas such as streamheads, lower slope drainages, and the borders of small streams where groundwater emerges. The substrate is mucky, with rocks and boulders often visibly protruding above the surface.

Vegetation Description: *Lindera benzoin* (northern spicebush) may occur, particularly at the edges. Characteristic herbaceous species are *Symplocarpus foetidus* (skunk cabbage), *Impatiens capensis* (jewelweed), and *Arisaema triphyllum* (Jack in the pulpit). Other common associates are variable but may include *Veratrum viride* (green false hellebore), *Pilea pumila* (clearweed), *Cardamine pensylvanica* (Pennsylvania bittercress), *Saxifraga pensylvanica* (Eastern swamp saxifrage), *Carex canescens* (silvery sedge), *Caltha palustris* (yellow marsh marigold), and *Viola sororia* (common blue violet).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Symplocarpus foetidus* (skunk cabbage)

Characteristic Species: *Symplocarpus foetidus* (skunk cabbage), *Impatiens capensis* (jewelweed), *Arisaema triphyllum* (Jack in the pulpit).

Other Noteworthy Species: None.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This vegetation occurs in the northeastern United States.
States/Provinces: CT, MA, MD?, ME, NH, NJ, NY, PA, RI, VT.
Federal Lands: NPS (Morristown).

CONSERVATION STATUS

Rank: GNR (8-Jul-1999).
Reasons: This association has not been ranked pending rangewide data collection and analysis.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 3 - Weak.
Comments: Information not available.
Similar Associations:

- *Chrysosplenium americanum* Herbaceous Vegetation (CEGL006193) – occurs with flowing groundwater seeps
- *Onoclea sensibilis - (Adiantum pedatum) - Impatiens capensis - Carex plantaginea* Herbaceous Vegetation [Provisional] (CEGL006409) – occurs in northern hardwood forests of northern New England and has a richer flora.

Related Concepts:

- Stream thicket community (Ehrenfeld 1977) B

SOURCES

Description Authors: L. A. Sneddon.
References: Eastern Ecology Working Group n.d., MNNHP 1993, White and Madany 1978.

COMMON NAME (PARK-SPECIFIC): SMARTWEED - CUTGRASS WETLAND

SYNONYMS

USNVC English Name: **(Swamp Smartweed, Dotted Smartweed) - (Catchfly Cutgrass, White Cutgrass) Herbaceous Vegetation**

USNVC Scientific Name: ***Polygonum (hydropiperoides, punctatum) - Leersia (lenticularis, virginica)* Herbaceous Vegetation**

USNVC Identifier: **CEGL004290**

LOCAL INFORMATION

Environmental Description: This association is limited to one small impounded wetland along the Aqueduct Brook near where it flows into Primrose Brook. The soils are organic and permanently saturated. There is flow through the wetland throughout the year. The surface of the wetland mat floats during high water periods.

Vegetation Description: This association is dominated by *Leersia virginica* (whitegrass) and *Polygonum hydropiperoides* (swamp smartweed). *Typha latifolia* (broadleaf cattail) and *Scirpus cyperinus* (woolgrass) are minor components. Other sedges include *Carex siccata* (dryspike sedge) and *Carex crinita* (fringed sedge). *Polygonum arifolium* (halberdleaf tearthumb) and *Polygonum sagittatum* (arrowleaf tearthumb) are also common. *Impatiens capensis* (jewelweed) is scattered throughout. In the late summer the community is dominated by *Microstegium vimineum* (Nepalese browntop).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Polygonum hydropiperoides* (swamp smartweed)
Herb (field)	Graminoid	*Leersia virginica* (whitegrass)
		Microstegium vimineum (Nepalese browntop)

Characteristic Species: *Leersia virginica* (whitegrass), *Polygonum hydropiperoides* (swamp smartweed).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
NJ	SNR	.	.	[not crosswalked]	.

Local Range: The only example of this community is found near the Aqueduct Trail parking lot. There are other areas in the park that have similar vegetation, but they are all extremely small and mostly linear borders of impounded wetlands or ponds.

Classification Comments: Information not available.

Other Comments: Herbaceous associations were not included in Ehrenfeld (1977).

Local Description Authors: R. E. Zaremba.

Plots: MORR.09.

Morristown National Historical Park Inventory Notes: Information not available.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial forb vegetation (V.B.)
Physiognomic Group	Temperate or subpolar perennial forb vegetation (V.B.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar perennial forb vegetation (V.B.2.N.)

Formation	Seasonally flooded temperate perennial forb vegetation (V.B.2.N.h.)
Alliance	*Polygonum* spp. (section *Persicaria*) Seasonally Flooded Herbaceous Alliance (A.1881)
Alliance (English name)	Smartweed species Seasonally Flooded Herbaceous Alliance
Association	*Polygonum (hydropiperoides, punctatum) - Leersia (lenticularis, virginica)* Herbaceous Vegetation
Association (English name)	(Swamp Smartweed, Dotted Smartweed) - (Catchfly Cutgrass, White Cutgrass) Herbaceous Vegetation
Ecological System(s):	East Gulf Coastal Plain Small Stream and River Floodplain Forest (CES203.559). East Gulf Coastal Plain Depression Pondshore (CES203.558). South-Central Interior Small Stream and Riparian (CES202.706).

GLOBAL DESCRIPTION

Concept Summary: This association incorporates vegetation of beaver ponds and other semipermanent impoundments in the Piedmont, South Atlantic Coastal Plain, Upper East Gulf Coastal Plain, scattered localities in the Blue Ridge, and possibly other adjacent provinces. Stands of this vegetation are dominated by some combination of *Polygonum punctatum* (dotted smartweed), *Polygonum hydropiperoides* (swamp smartweed), *Leersia lenticularis* (catchfly grass), and/or *Leersia virginica* (whitegrass). Other herbaceous species present include *Saururus cernuus* (lizard's tail), *Proserpinaca* (mermaidweed) sp., *Bidens aristosa* (bearded beggarticks), and *Xanthium strumarium* (rough cockleburr). Scattered individuals of *Cephalanthus occidentalis* (common buttonbush) and *Acer saccharinum* (silver maple) may be present. A Piedmont North Carolina example contains *Impatiens capensis* (jewelweed), *Boehmeria cylindrica* (smallspike false nettle), and the exotic *Murdannia keisak* (wartremoving herb).

Environmental Description: This association incorporates vegetation of beaver ponds and other semipermanent impoundments.

Vegetation Description: Stands of this vegetation are dominated by some combination of *Polygonum punctatum* (dotted smartweed), *Polygonum hydropiperoides* (swamp smartweed), *Leersia lenticularis* (catchfly grass), and/or *Leersia virginica* (whitegrass). Other herbaceous species which may be present include *Polygonum densiflorum* (denseflower knotweed), *Saururus cernuus* (lizard's tail), *Proserpinaca* (mermaidweed) sp., *Sparganium americanum* (American bur-reed), *Typha latifolia* (broadleaf cattail), *Scirpus cyperinus* (woolgrass), *Lobelia cardinalis* (cardinalflower), *Onoclea sensibilis* (sensitive fern), *Penthorum sedoides* (ditch stonecrop), *Boehmeria cylindrica* (smallspike false nettle), *Sambucus nigra* ssp. *canadensis* (common elderberry), *Bidens aristosa* (bearded beggarticks), and *Xanthium strumarium* (rough cockleburr). Scattered individuals of *Cephalanthus occidentalis* (common buttonbush) and *Acer saccharinum* (silver maple) or other woody plants may be present. Examples which have become dried-out (through drought and/or beaver dam failure) may exhibit greater dominance by *Leersia* (cutgrass) rather than *Polygonum* (knotweed). The combination of *Polygonum punctatum - Leersia virginica* was first noted, but the combination of *Polygonum hydropiperoides* (swamp smartweed) and *Leersia lenticularis* (catchfly grass) has also been observed in the Oconee National Forest.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Polygonum hydropiperoides* (swamp smartweed) *Polygonum punctatum* (dotted smartweed)
Herb (field)	Graminoid	*Leersia lenticularis* (catchfly grass) *Leersia virginica* (whitegrass)

Characteristic Species: *Leersia lenticularis* (catchfly grass), *Leersia virginica* (whitegrass), *Polygonum hydropiperoides* (swamp smartweed), *Polygonum punctatum* (dotted smartweed).

Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This association is found in the Coastal Plain, Ridge and Valley, and other interior provinces from Tennessee and Alabama to the Carolinas. The full extent of its distribution is not known.
States/Provinces: AL, GA, KY?, MS, NC, NJ, PA, SC, TN.
Federal Lands: DOD (Fort Benning); NPS (Chickamauga-Chattanooga, Friendship Hill, Great Smoky Mountains, Morristown, Natchez Trace, Shiloh); USFS (Bankhead, Daniel Boone?, Oconee, Talladega (Oakmulgee)?, Talladega (Talladega)?, Talladega?).

CONSERVATION STATUS

Rank: G4? (21-Dec-2000).
Reasons: This association is found in the Coastal Plain and Interior from Tennessee and Alabama to the Carolinas. The full extent of its distribution is not known. This is not a rare community type, but it is threatened by filling of wetlands.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 2 - Moderate.
Comments: Documented from a beaver pond in the floodplain of Owl Creek, Shiloh National Battlefield, Tennessee, on soils of the Collins silt loam; also from documented on Bailey Island in the ACE Basin (C. Aulbach-Smith pers. comm.). Also seen in the Bankhead National Forest, Alabama, and the Oconee National Forest, Georgia.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES

Description Authors: M. Andreu and M. Tukman.
References: Aulbach-Smith pers. comm., Ehrenfeld 1977, Gallyoun et al. 1996, NatureServe Ecology - Southeastern U.S. unpubl. data, Schotz pers. comm., Southeastern Ecology Working Group n.d., TDNH unpubl. data.

Figure 18. Smartweed - Cutgrass Wetland in Morristown National Historical Park (plot MORR.09, photo 9-1). July 2005. NAD 1983 / UTM easting 539234 northing 4513174.

Association-level Vegetation Map Production

Following data analysis and finalizing of the classification, attributing the map class for each delineated polygon was finalized in 2006. Draft polygon labels were changed to reflect the final classification, and unlabeled polygons were attributed. Map classes (attributes) were assigned and polygon boundaries were revised as needed, based on information from plot data, field observations, aerial photography signatures, and topography derived from the 3-dimensional image seen through the stereoscope. Although no additional plots were taken, vegetation at Fort Nonsense and Washington's Headquarters was confirmed in the field using the vegetation key. All map classes, with the exception of a single combined map class of two forest types, Northern Piedmont Mesic Oak - Beech Forest and Successional Tuliptree Forest, are equivalent to one USNVC association or Anderson Level II (modified) land use category. Two polygons that were confirmed in the field were mapped as Northern Piedmont Mesic Oak - Beech Forest. Map classes are designated by the last four digits of the USNVC code(s) and park-specific common name as noted in Table 5. Anderson Level II land use cover classes are noted in Table 6.

Appendix A provides descriptions of aerial photo signatures. A one-to-one relationship between unique photo signature and association is rarely achieved in photointerpretation. At Morristown National Historical Park, the same photo signature was shared by the two dominant forest types, and since the park is largely forested, large areas of the park (seven polygons) are mapped to a single map class, Northern Piedmont Mesic Oak - Beech Forest and Successional Tuliptree Forest. In some cases, it is possible to recognize the latter association when the stout, dark trunks of tuliptrees (*Liriodendron tulipifera*) can be clearly seen. However, the type cannot be consistently recognized, as the trees are often obscured by shadows or steep slopes.

Two other forest types also share the same signature with the Northern Piedmont Mesic Oak - Beech Forest and Successional Tuliptree Forest, but they can be effectively mapped using additional information. The Northeastern Dry Oak - Hickory Forest is an uncommon type in the park, and is found on hill crests or relatively steep slopes. This characteristic, augmented with field work, provided sufficient information to delineate it on the map. The Hemlock - Red Oak - Mixed Hardwood Forest presented an unusual case. Because the eastern hemlock (*Tsuga canadensis*) trees are now dead, the current forest resembles the other upland deciduous forests in signature. However, this type was previously known from a single area in the park. Targeting this area with additional field work allowed for mapping this type despite similarities in signature.

Table 6. Anderson Level II (modified) land use categories of the final association-level vegetation map for Morristown National Historical Park.

Land Use Category	Land Use Code
Orchards and Plantations	UO
Pond / Reservoir	UP
Commercial and Services	US
Transportation, Communications, and Utilities	UU

The final vegetation map is depicted in Figure 19, and a summary of the association distribution and abundance is provided in Table 7. Metadata for the vegetation shapefile, the plot location shapefile, the accuracy assessment sampling point location shapefile, and the digital aerial photographic images were prepared according to Federal Geographic Data Committee standards and have been provided as deliverables with this report.

Mapped wetland associations in the Jockey Hollow and New Jersey Brigade units are shown in Figures 20 and 21, respectively. No wetlands were mapped in the other two units. The wetland maps do not indicate all wetlands of the park; however, as there are likely to be inclusions of small wetlands falling below minimum mapping unit within larger forested polygons.

Accuracy Assessment

Thematic Accuracy

There are two sources of potential error in mapping:

1. user's error, also known as errors of commission, indicates the percentage of polygons on the map that were mislabeled. This number is conveyed in the row totals of the contingency table.
2. producer's error, also known as errors of omission, indicates the percentage of polygons of that type that were under mapped. Errors of omission indicate that in addition to the polygons on the map with the correct label, there are others that should also have the same label.

Based on the contingency matrix (Table 8), the overall percent accuracy of the final association-level map was 68.5%, falling below the USGS/NPS vegetation mapping protocol requirement of 80%. Thirteen of the fourteen associations included in the classification were mapped (Upland / Wetland Transitional Forest was not mapped). Three associations attained 100% user's and producer's accuracy: Hemlock - Red Oak - Mixed Hardwood Forest, Smartweed - Cutgrass Wetland, and Skunk Cabbage - Orange Jewelweed Seep. Other classes achieving 100% user's accuracy included Black Locust Successional Forest, Montane Basic Seepage Swamp, Dry-Mesic Chestnut Oak - Red Oak Forest, and Northeastern Old Field. The Southern New England Seepage Swamp attained a fairly high user's accuracy of 75%, and the Northern Piedmont Mesic Oak - Beech Forest and Successional Tuliptree Forest map unit reached 60% user's accuracy.

Three forest associations had low user's accuracy. Tuliptree - Beech - Maple Forest, at 50% correct, was mapped incorrectly as either Northern Piedmont Mesic Oak - Beech Forest or Dry-Mesic Chestnut Oak - Red Oak Forest. Northeastern Modified Successional Forest, at 25% correct, was confused with Black Locust Successional Forest and Northeastern Old Field. Northeastern Dry Oak - Hickory Forest achieved only 33% user's accuracy, and was mapped incorrectly as the Northern Piedmont Mesic Oak - Beech Forest and Successional Tuliptree Hardwood Forest map unit. The Northeastern Modified Successional Forest achieved only 25% user's accuracy. In all, however, nine map units (eight associations and one combined map unit of two associations) had user's accuracies of greater than 60%, and eight achieved at least 70%.

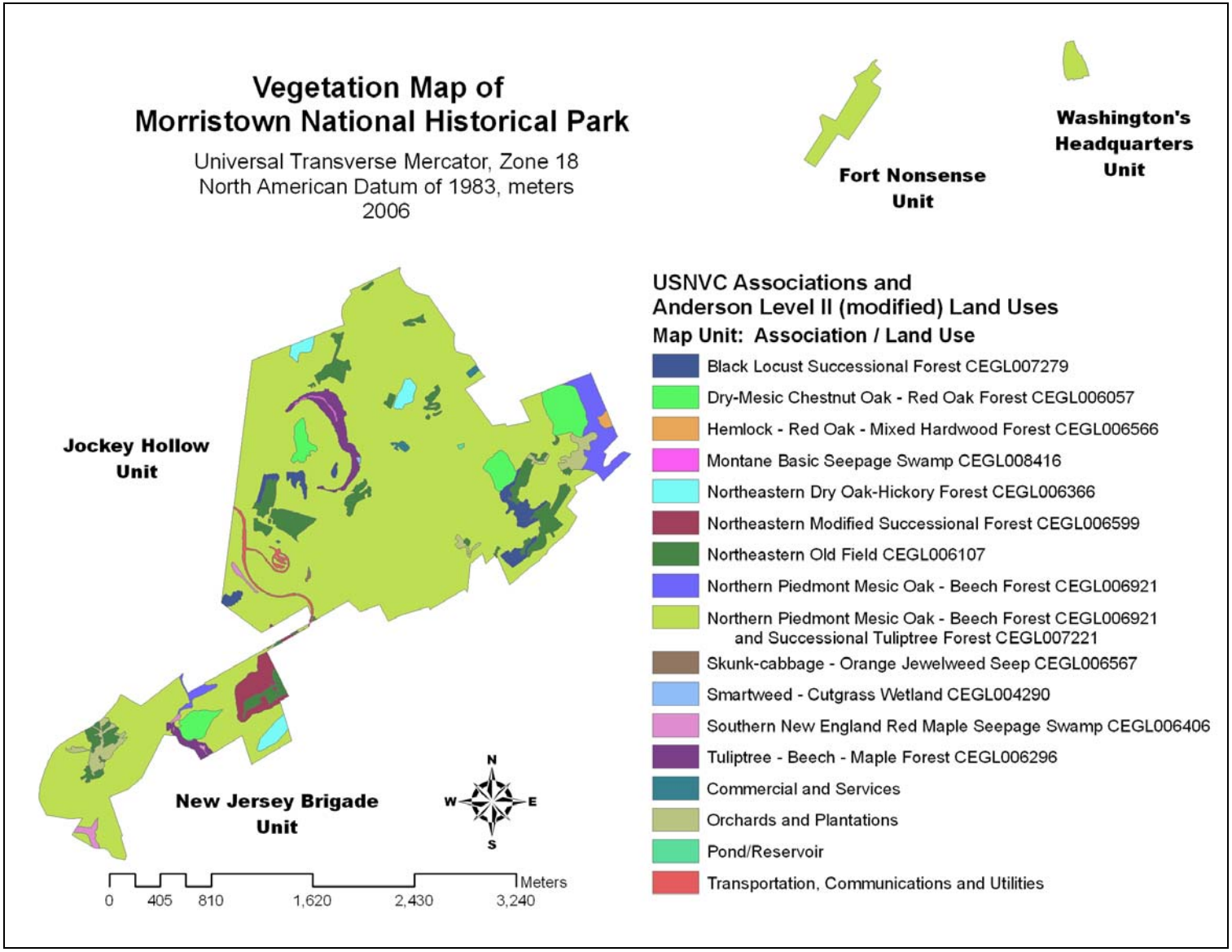

Figure 19. USNVC associations and Anderson Level II (modified) land use categories of the final association-level vegetation map for Morristown National Historical Park, 2006.

Table 7. Number of polygons and total mapped hectares within the park boundary for the map classes of the final association-level vegetation map of Morristown National Historical Park, 2006.

Map Class Name	USNVC or Land Use Code	Number of Polygons	Total Mapped Hectares[1]
Smartweed - Cutgrass Wetland	CEGL004290	1	0.13
Northeastern Old Field	CEGL006107	33	36.35
Dry-Mesic Chestnut Oak - Red Oak Forest	CEGL006057	4	25.00
Tuliptree - Beech - Maple Forest	CEGL006296	2	11.64
Northeastern Dry Oak - Hickory Forest	CEGL006336	3	7.90
Southern New England Red Maple Seepage Swamp	CEGL006406	5	2.79
Hemlock - Red Oak - Mixed Hardwood Forest	CEGL006566	1	0.98
Skunk Cabbage - Orange Jewelweed Seep	CEGL006567	1	0.24
Northeastern Modified Successional Forest	CEGL006599	6	10.02
Northern Piedmont Mesic Oak - Beech Forest	CEGL006921	2	16.30
Northern Piedmont Mesic Oak - Beech Forest and Successional Tuliptree Forest	CEGL006921/ CEGL007221	8	568.26
Black Locust Successional Forest	CEGL007279	6	11.75
Montane Basic Seepage Swamp	CEGL008416	3	0.58
Upland / Wetland Transitional Forest	CEGL006000	0	0
Orchards and Plantations	UO	6	11.20
Pond/Reservoir	UP	1	0.15
Commercial and Services	US	3	1.28
Transportation, Communications and Utilities	UU	1	4.04
Total in park		86	710.61

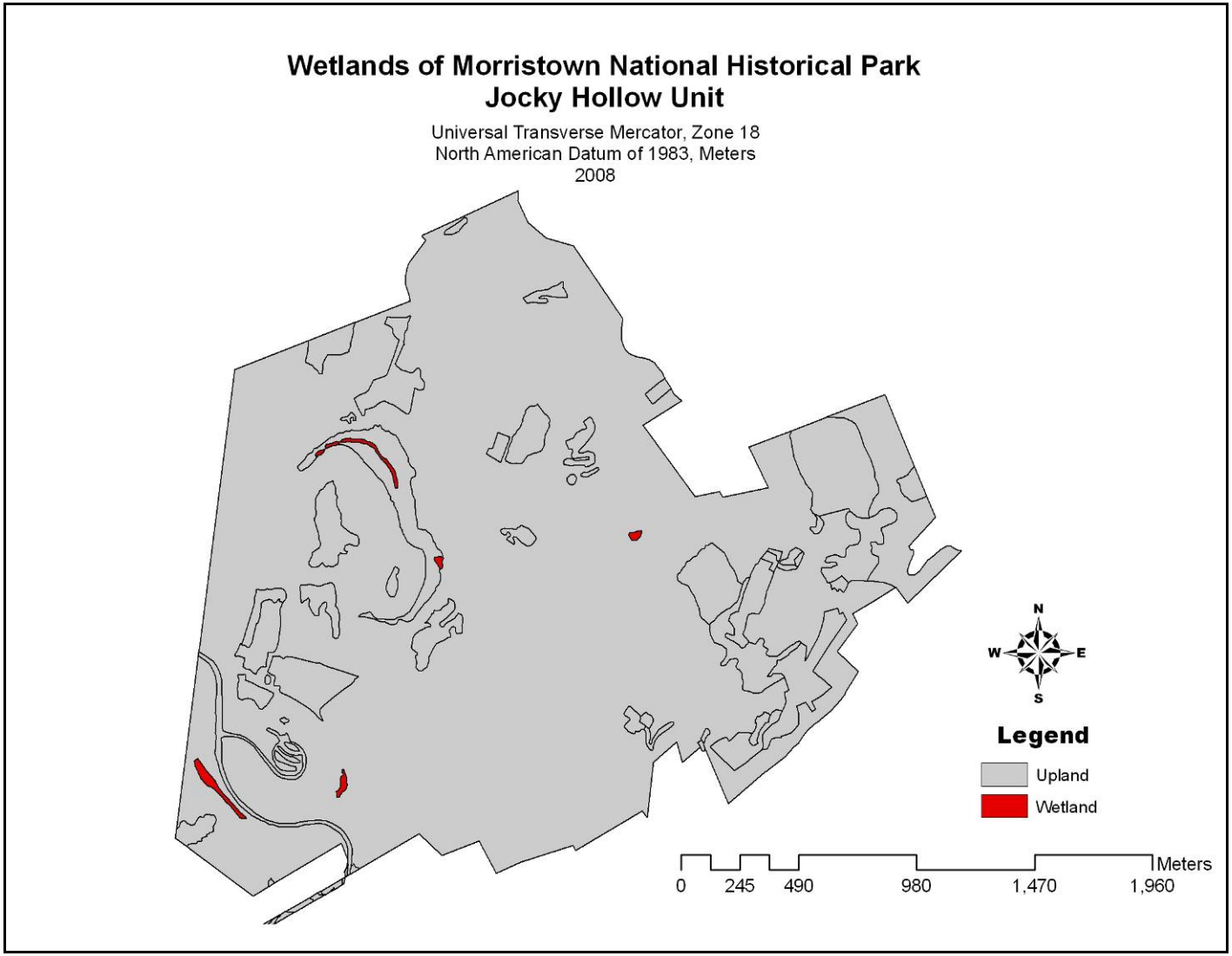

Figure 20. Wetland polygons (associations belonging to Saturated USNVC formations) in Morristown National Historical Park, Jockey Hollow Unit.

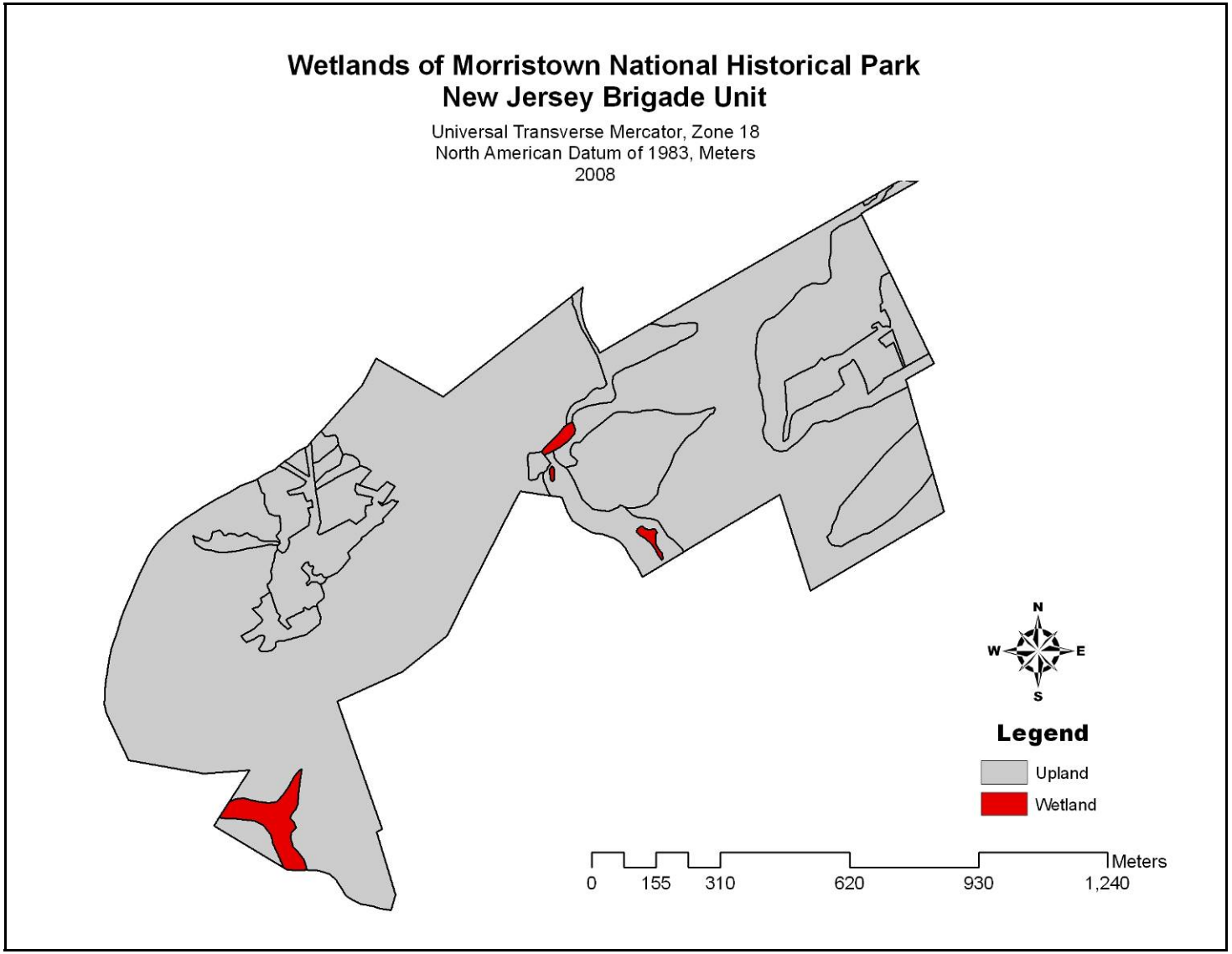

Figure 21. Wetland polygons (associations belonging to Saturated USNVC formations) in Morristown National Historical Park, New Jersey Brigade Unit.

Table 8. Contingency table and calculated errors for thematic accuracy assessment of the final association-level vegetation map of Morristown National Historical Park.

Accuracy Assessment Observation↓	Mapped Vegetation Association												Total	Error of Comission (% correct)
	Black Locust Succes-sional Forest	Montane Basic Seepage Swamp	Hemlock - Red Oak - Mixed Hard-wood Forest	Smart weed - Cutgrass Wetland	Dry - Mesic Chestnut Oak - Red Oak Forest	Northeastern Dry Oak - Hickory Forest	Northeastern Modified Succes-sional Forest	Northern Piedmont Mesic Oak - Beech Forest and Successional Tuliptree Forest	Skunk Cabbage - Orange Jewel weed Seep	Southern New England Red Maple Seepage Swamp	Tuliptree - Beech - Maple Forest	North-eastern Old Field		
Black Successional Locust Forest	2												2	100.0%
Montane Basic Seepage Swamp		2											2	100.0%
Hemlock - Red Oak - Mixed Hardwood Forest			1										1	100.0%
Smartweed - Cutgrass Wetland				1									1	100.0%
Dry - Mesic Chestnut Oak - Red Oak Forest					2								2	100.0%
Northeastern Dry Oak - Hickory Forest					1	2		3					6	33.3%
Northeastern Modified Successional Forest	2						2	1				3	8	25.0%
Northern Piedmont Mesic Oak - Beech Forest and Successional Tuliptree Forest	1				1	1	3	16		2	1	1	26	61.5%
Skunk Cabbage - Orange Jewelweed Seep									1				1	100.0%
Southern New England Red Maple Seepage Swamp								1		3			4	75.0%
Tuliptree - Beech - Maple Forest		1						1			2		4	50.0%
Northeastern Old Field												16	16	100.0%
Total	5	3	1	1	4	3	5	22	1	5	3	20	73	
Error of Omission (% correct)	40.0%	66.7%	100.0%	100.0%	50.0%	66.7%	40.0%	72.7%	100.0%	60.0%	66.7%	80.0%		

this was likely GPS error; very close to mapped type

two of these points were likely GPS error; very close to mapped type

Total Points Correct	50
Total Points	73
Overall Accuracy	68.49%
Kappa Index	61.13%
90% confidence interval	+/- 10%

Results for producer's error, or errors of omission, were similar. In addition to the three associations that had achieved 100%, five map units were greater than 66% correct. These included Northeastern Old Field (80%), Northern Piedmont Mesic Oak - Beech and Successional Tuliptree Forest map unit (73%); and Montane Basic Seepage Swamp, Northeastern Dry Oak - Hickory Forest, and Tuliptree - Beech - Maple Forest (all 67% accurate). Southern New England Red Maple Seepage Swamp achieved 60% accuracy.

Three associations had low producer's accuracy, indicating that they were under-represented on the map. Dry-Mesic Chestnut Oak - Red Oak Forest was only 50% accurate, which means that for every mapped polygon of this type, there is another polygon of this type that is mapped as another type in error. Two successional forest types, Black Locust Successional Forest and Northeastern Modified Successional Forest, attained only 40% producer's accuracy, meaning each was considerably under-mapped.

Project Deliverables

Final products of the vegetation mapping project are shown in Table 9. All products have been delivered to the National Park Service by NatureServe with this report.

Table 9. Summary of products resulting from the Morristown National Historical Park vegetation classification and mapping project.

Product	FGCD-complaint spatial metadata
Aerial photos, including flight line map and photoindex[1]	Yes
Orthophotos as paper copy and in digital format	Yes
Annotated field forms with vegetation plot sampling data	Not applicable
Vegetation plot sampling data in the PLOTS 2.0 database	Not applicable
Differentially corrected GPS locations of vegetation plots	Yes
Annotated field forms with thematic accuracy assessment data	Not applicable
Thematic accuracy assessment data in the PLOTS 2.0 database	Yes
Differentially corrected GPS locations of thematic accuracy assessment sampling points	Yes
Annotated field forms of observation points	Not applicable
Differentially corrected GPS locations of observation points	Yes
Digital photos representative of all vegetation types	Yes
Final map of vegetation associations as paper copy and in digital format	Yes
Final report as paper copy and in digital format	Not applicable

[1] Flight line and photo index was not available from Lockwood Mapping Company so is not included

Discussion

Vegetation Classification and Characterization

The most common forest types in the Morristown National Historical Park are two USNVC associations, Northern Piedmont Mesic Oak - Beech Forest and Successional Tuliptree Forest. These associations are represented as a single map class because they share the same aerial photo signature and are not easily differentiated remotely. The two forest types form a matrix that extends throughout the park. Further, the two associations are closely related ecologically and may represent different successional states of a single forest type; however, this cannot be confirmed without additional research. Both associations are characterized by an abundance of tuliptree (*Liriodendron tulipifera*) and both occur in broadly similar ecological settings. It is possible to differentiate the two forest types with considerable fieldwork and using the 1977 forest type maps produced by Ehrenfeld (1977) as a reference. The National Park Service digitized maps of Ehrenfeld's (1977) successional forests, mature forests, and broad forest types, but a digital map of the more narrowly defined forest communities[2] as described by Ehrenfeld (1977) is not available. Since these maps are now thirty years old and did not have the benefit of GIS technology, we did not use them extensively here to further delineate the two types on the map. However, the Ehrenfeld maps and vegetation map can be used together, judiciously, for management purposes. Figure 22 depicts the Ehrenfeld (1977) mature forest map overlain on the 2006 final association-level vegetation map.

Comparison of the current vegetation descriptions to those of Ehrenfeld (1977) forest communities reveals a striking difference in the understory compositions of most vegetation types. Ehrenfeld's (1977) Mixed Oak - Yellow Poplar Community is equivalent to the USNVC association Tuliptree - Beech - Maple Forest. The overstory tree composition in each type description is essentially the same. The understory of the Ehrenfeld description is more diverse, noting the presence of flowering dogwood (*Cornus florida*), a species not present in the USNVC local description. Flowering dogwood (*Cornus florida*) is also included in other community descriptions by Ehrenfeld, but this species is of very low importance in the 2003 and 2004 vegetation plots. The Ehrenfeld description includes a relatively high number of seedlings per acre, also comprised of flowering dogwood (*Cornus florida*), as well as American witchhazel (*Hamamelis virginiana*), northern spicebush (*Lindera benzoin*), mapleleaf viburnum (*Viburnum acerifolium*), red maple (*Acer rubrum*), and other species of the tree canopy. In contrast, the USNVC local information notes low tree recruitment, comprised of American beech (*Fagus grandifolia*) and sugar maple (*Acer saccharum*).

The USNVC type Northern Piedmont Mesic Oak - Beech Forest is comprised of two Ehrenfeld (1977) types: the Mixed Oak - Beech Community and the Mixed Hardwoods, in part. The tree canopy of the USNVC type encompasses the same canopy composition of the two Ehrenfeld types. The description of the USNVC type notes that the shrub layer is poorly developed but made up of many of the same species as the Ehrenfeld types. However, flowering dogwood (*Cornus florida*) and white ash (*Fraxinus americana*), both listed in the Ehrenfeld Mixed

[2] Mixed Oak – Yellow Poplar Community; Mixed Oak – Beech Community; Mixed Hardwoods, Stream Thicket Community, Successional Communities, Yellow Poplar Community, and Chestnut Oak – Black Birch Community

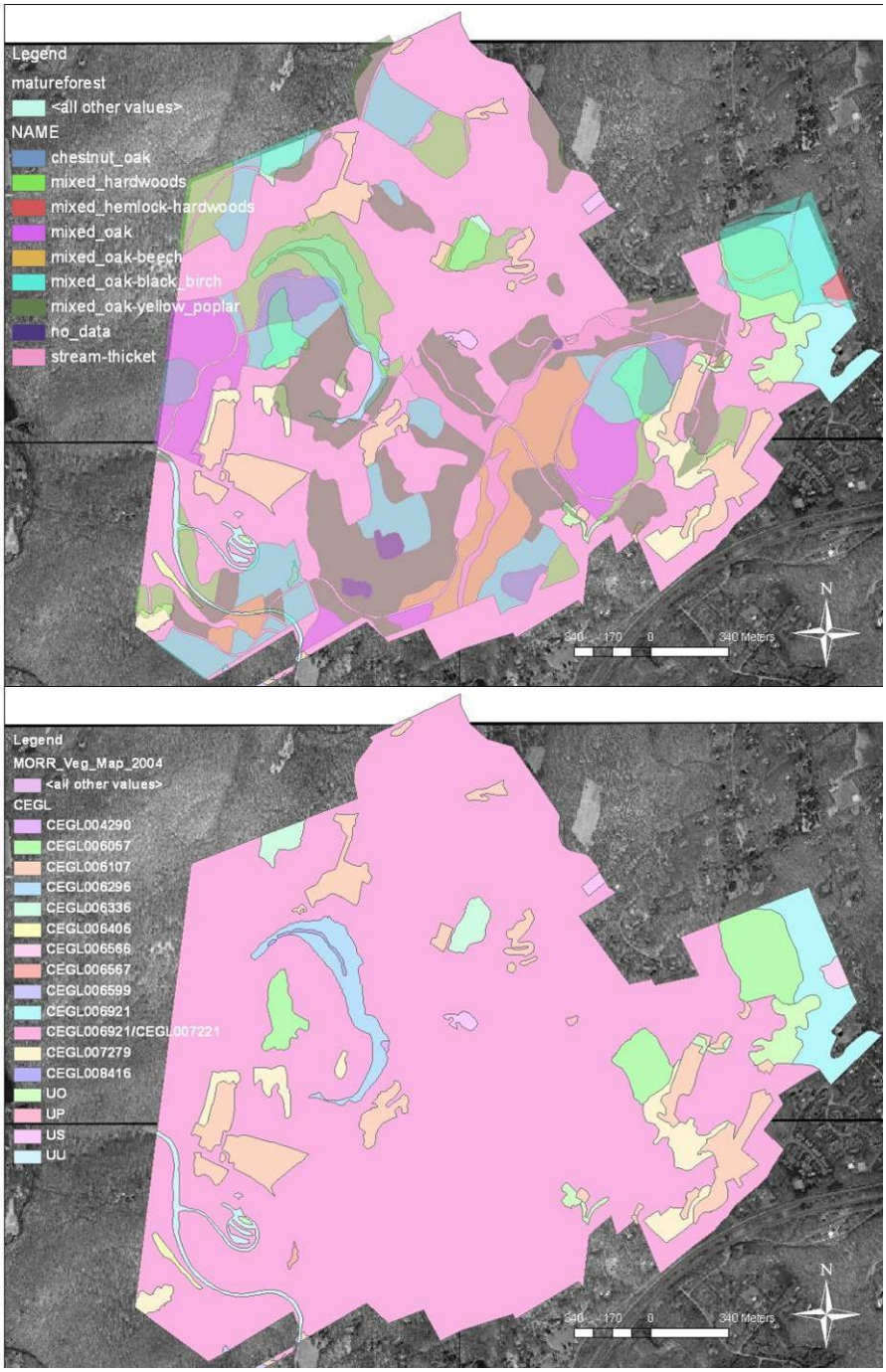

Figure 22. Mature forest types of Ehrenfeld (1977) superimposed on the final association-level vegetation map (top); the final association-level map is included as a reference (bottom).

Hardwood type, are absent in the USNVC local description. Perhaps the most notable difference is in the seedling composition. The USNVC description notes the presence of frequent seedlings of red maple (*Acer rubrum*) and tuliptree (*Liriodendron tulipifera*), whereas Ehrenfeld lists an abundance of seedlings, including those of white ash (*Fraxinus americana*), northern spicebush (*Lindera benzoin*), American witchhazel (*Hamamelis virginiana*), and mapleleaf viburnum (*Viburnum acerifolium*). One additional important difference is the abundance of Japanese barberry (*Berberis thunbergii*) in the USNVC description, whereas this species is not listed in either of Ehrenfeld's types. Ehrenfeld does note that this species "has become disseminated throughout the woods" but that it is not "sufficiently aggressive to outcompete the native vegetation." This condition is clearly not the case today, as Japanese barberry (*Berberis thunbergii*) is the dominant low shrub in portions of the park.

The USNVC type Successional Tuliptree Forest is equivalent to Ehrenfeld's (1977) Yellow Poplar Community. Both descriptions note tuliptree as the dominant tree canopy species. The USNVC description notes an occasional stem of northern spicebush (*Lindera benzoin*) and American witchhazel (*Hamamelis virginiana*). Japanese barberry (*Berberis thunbergii*) is a dominant shrub in these forests today, while Ehrenfeld lists this species as a minor component. Northern spicebush (*Lindera benzoin*) was noted to be common in the Ehrenfeld description.

The Stream Thicket Community of Ehrenfeld (1977) is comprised of three USNVC types: the Upland / Wetland Transitional Forest (which was indistinguishable on aerial photographs and so is not included on the map); the Montane Basic Seepage Swamp; and the Skunk Cabbage - Orange Jewelweed Seep. Although the shrub layer is moderately well-developed in the Montane Basic Seepage Swamp, in none of the three USNVC types can the physiognomy be described as "thicket." In particular, the Skunk Cabbage - Orange Jewelweed Seep is an herbaceous type, shaded only by overhanging trees of the adjacent uplands. It is likely that the extant vegetation structure is a result of deer browsing.

Since Ehrenfeld (1977) did not describe the herbaceous component of the communities, it is not possible to determine whether the composition of today's herbaceous layer is substantially different than it appeared 30 years ago. However, the differences in shrub and understory layers are notable, both in density and in composition. In particular, northern spicebush (*Lindera benzoin*) and flowering dogwood (*Cornus florida*) are of much less importance today than in 1977. It is likely that the change has arisen as a result of excessive deer browse, a problem that is common in forests of the northeast, particularly those fragmented stands that are near urban areas.

Another notable difference in the forests since the Ehrenfeld (1977) work is the loss of eastern hemlock *(Tsuga canadensis*) trees to woolly adelgid in the eastern portion of the park. The type is currently mapped as Hemlock - Red Oak - Mixed Hardwood Forest because it can still be recognized as this type, but the eastern hemlock (*Tsuga canadensis*) trees are now dead and the canopy is considerably more open as a result.

A total of 179 plant species was recorded in the vegetation plots. A complete list of the scientific names, common names, and family for the vascular plant species identified in the vegetation sampling plots and in the accuracy assessment plots is included in Appendix I. No state-listed or federally-listed plants species were encountered in or near the vegetation plots; however, this project was not intended to include a full floristic survey of the park.

A final point should be made regarding the identification and distribution of narrowleaf bittercress (*Cardamine impatiens*) and Pennsylvania bittercress (*C. pensylvanica*) at Morristown National Historical Park. Field visits to Morristown's 22 vegetation plots during the fall of 2003 found Pennsylvania bittercress to be present on six plots, but did not find narrowleaf bittercress, a nonnative invasive. Later review of the literature showed evidence that narrowleaf bittercress had been present on MORR since the late 1990s, but remained largely misidentified due to its similarities with the native and locally common Pennsylvania bittercress (Shaw and Patterson 2006). Subsequent personal communications with the MORR's natural resource manager (Robert Masson), local contract botanist (Karl Anderson), and NPS Northeast Temperate Inventory and Monitoring Network plant ecologist (Kate Miller) - all actively engaged in vegetation monitoring on Morristown - reinforced the possibility that narrowleaf bittercress was underrepresented during the 2003 surveys of the plots. Although voucher specimens were not collected during 2003 plot visits, it is clear that narrowleaf bittercress was present on the park and in some cases (particularly in the uplands) may have been misidentified as Pennsylvania bittercress at the time of this study.

Vegetation Map Production

The final vegetation map portrays large sections of Morristown National Historical Park as a single map class comprised of two forest associations. It may be possible, with intensive fieldwork, to further delineate the two types in a park of this relatively small size. If it is important to monitor the two forest types as individual units, this effort may be warranted. However, as the two forest types may be successional stages of each other, retaining the single map unit may be the more pragmatic course.

The quality, scale, and season of aerial photography limits the detail that can be portrayed on a map. Additional detail can usually be obtained by using multiple sets of photography (fall color, true color, color infrared, etc.) portraying varying growing seasons. In this case, the scale and quality were adequate, but black and white photography imposes limitations in recognizing tree species. True-color fall imagery may provide enough information to delineate the two forest types more fully.

Accuracy Assessment

As noted in the results, overall accuracy of the map was calculated to be 74%, and the Kappa Index was calculated to be 71%. Although this degree of accuracy is short of the USGS/NPS Vegetation Mapping Program standards, the relatively broad confidence interval of 9.4% implies that the accuracy could be as high as 80.4% or as low as 61.6%. A greater number of accuracy assessment points may increase the precision of the accuracy calculation if this were desired. However, vegetation mapping is not a precise endeavor, as vegetation does not usually exhibit discreet boundaries. The map portrays much valuable information that can be applied for management or monitoring, with the understanding of the map limitations portrayed in the accuracy assessment results.

Accuracy of this map can be increased by further combining associations into map classes. For example, the Northeastern Dry Oak - Hickory Forest achieved a low producer's and user's accuracy. Combining this association with the Northern Piedmont Mesic Oak - Beech Forest / Successional Tuliptree Forest map unit would achieve an overall map accuracy of 79%, very

close to the 80% standard. In addition, the combined map unit would achieve a 91% producer's accuracy and 79% user's accuracy. However, doing so would result in considerable loss of information, yielding a map overwhelmingly dominated by a single map class. It is recommended instead to retain the information of the 2006 map and refine the map with additional field work over time as needed.

Another possible manipulation, mapping at the alliance level of the USNVC, would not result in higher accuracy because each association is a member of a different alliance. In general, alliances are of broader geographic distribution and span greater climatic and environmental variation than do the component associations. Different associations within an alliance do not usually occur at the same site, but instead occur over the range of the alliance, which often spans many states. There are numerous exceptions, however. For example, large sites of great topographic diversity, where climatic changes are associated with elevation, can yield two associations of the same alliance. The small size of Morristown National Historical Park and the low topographic diversity do not yield more than one association of each alliance, and reattributing each polygon by alliance would yield exactly the same set of polygons.

Recommendations for Future Projects

If restoration to native, or close to native, forest condition is a goal of management activity, two problems should be addressed. The first is invasive exotic plants that are particularly problematic in the abandoned agricultural fields, on forest edges, along trails and roads, and in the interior of some forest stands. The most common and problematic species is Japanese barberry (*Berberis thunbergii)*, which has been established and has become the dominant shrub in portions of the park. A second issue is the threat presented by deer browse to tree regeneration in all native forest communities. Additional research will be required to determine exact desired conditions, but this need does not preclude the immediate benefit of active management of exotic species and protection of the forests from excessive deer browse.

The eastern hemlock (*Tsuga canadensis)* population at Morristown National Historical Park was not historically very large, and is somewhat isolated from other eastern hemlock stands. Re-establishment of hemlock and active management for woolly adelgid may be feasible in this small stand, if desired.

Literature Cited

Anderson, J. R., E. E. Hardy, J. T. Roach, and R. E. Witmer. 1976. A land use and land cover classification system for use with remote sensor data. Geological Survey Professional Paper 964. United States Government Printing Office, Washington, DC. 28 pp.

Anderson, L. E. 1990. A checklist of Sphagnum in North America north of Mexico. Bryologist 93:500–501.

Anderson, L. E., H. A Crum, and W. R. Buck. 1990. List of mosses of North America north of Mexico. Bryologist 93:448–499.

Beyer, H. L. 2004. Hawth's Analysis Tools for ArcGIS. Available at http://www.spatialecology.com/htools.

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.

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(1):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(2):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(4):396–400.

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 B. J. Dibeler. 1992. Vegetation of the New Jersey Brigade Area of Morristown National Historical Park—Final Report. Technical Report NPS/NAROSS/NRTR—92/13. Department of the Interior. North Atlantic Region. Boston, MA.

Environmental Systems Research Institute, Inc. (ESRI). 1992–2000. ArcView 3.2a. 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(4):467–549.

Federal Geographic Data Committee (FGDC). 1998. Content standard for digital geospatial metadata (FGDC-STD-001-1998). Retrieved October 2001 from http://www.fgdc.gov/metadata/contstan.html.

Federal Geographic Data Committee (FGDC). 1996. FGDC Vegetation classification and information standards. Federal Geographic Data Committee, Reston, VA. 31 pp.

Foody, G. M. 1992. On the compensation for chance agreement in image classification accuracy assessment. Photogrammetric Engineering and Remote Sensing 58(10):1459–1460.

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, USA. 126 pp.

Hill, M. O., and H. G. Gauch. 1979. TWINSPAN – A FORTRAN program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes. Cornell University, Ithaca, NY.

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 the North American Flora. Version 1.0. North Carolina Botanical Garden, Chapel Hill, NC.

Keys, J. E., Jr., C. A. Carpenter, S. L. Hooks, F. G. 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). Atlanta, GA, USDA Forest Service, presentation scale 1:3,500,000, colored.

McCune, B., and J. B. Mefford. 1999. PC-ORD. Multivariate Analysis of Ecological Data, Version 4. MjM Software Design. Gleneden Beach, OR.

Mueller-Dombois, D., and H. Ellenberg. 1974. Aims and methods of vegetation ecology. New York: Wiley.

National Park Service (NPS). 2003. Resource Inventories. Last accessed 18 November 2004. http://www.nature.nps.gov/protectingrestoring/IM/resourceinventories.htm.

NatureServe. 2004. Plots Database System. Version 2.0. NatureServe, Arlington, VA.

NatureServe. 2006. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 7 March 2006.

Russell, E. W. B. 1995. Recommendations for Land Management—Jockey Hollow Area—Morristown National Historical Park. Technical Report. NPS/NESORNR/NRTR/95-30. National Park Service. New England System Support Office. Boston, MA.

Shaw, S., and W. A. Patterson, III. May 2006. Strategies for Managing the Forest at Morristown National Historical Park. Technical Report NPS/NER/NRTR--2006/040. National Park Service. Boston, MA.

Stotler, R., and B. Crandall-Stotler. 1977. A checklist of the liverworts and hornworts of North America. Bryologist 80:405–428.

Strakosch Walz, K. Editor. 2000. Instruction Manual on Heritage Field Methodology: Documenting Ecological Communities. New Jersey Natural Heritage Program. Trenton, NJ. 86 pp.

The Nature Conservancy and Environmental Systems Research Institute (TNC and ESRI). 1994a. USGS/NPS Vegetation Mapping Program: Standardized National Vegetation Classification System. 188 pp. 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.

The Nature Conservancy and Environmental Systems Research Institute (TNC and ESRI). 1994b. USGS/NPS Vegetation Mapping Program: Field Methods for Vegetation Mapping. 92 pp. 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.

The Nature Conservancy and Environmental Systems Research Institute (TNC and ESRI). 1994c. USGS/NPS Vegetation Mapping Program: Accuracy Assessment Procedures. 71pp. 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.

United States Department of Agriculture, Natural Resources Conservation Service (USDA, NRCS). 2006. 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 70874-4490 USA.

Appendix A. Aerial photograph interpretation descriptions for USNVC vegetation associations at Morristown National Historical Park.

Photointerpretation Descriptions

Smartweed - Cutgrass Wetland
Polygonum (hydropiperoides, punctatum) - Leersia (lenticularis, virginica) Herbaceous Vegetation
Small wetland, low on landscape, herbaceous vegetation has light tone and smooth texture. Water appears dark in a dendritic pattern.

Northeastern Old Field
Dactylis glomerata - Phleum pratense - Festuca spp. - *Solidago* spp. Herbaceous Vegetation
Herbaceous vegetation has light tone and smooth texture, most boundaries are rectilinear, but some have small trees invading along edges. Buildings may be included in a few fields.

Dry - Mesic Chestnut Oak - Red Oak Forest
Quercus prinus - Quercus rubra / Hamamelis virginiana Forest
Deciduous forest occurs on hilltops and higher elevations. Generally, trees of this type have smaller crowns than other mature forests.

Tuliptree - Beech - Maple Forest
Fagus grandifolia - Betula lenta - Liriodendron tulipifera - Acer saccharum Forest
Occurs on wetter soils than the *Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest, therefore, has a darker tone than that other association. This type is found along streams and rivers.

Northeastern Dry Oak-Hickory Forest
Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium Forest
Occurs on either a steep slope, or on the crest of a hill. It can be differentiated from other associations via fieldwork.

Southern New England Red Maple Seepage Swamp
Acer rubrum - Fraxinus (pensylvanica, americana) / Lindera benzoin / Symplocarpus foetidus Forest
This association occurs low on the landscape, along a stream corridor. This type has the dark tone of a wetland. It can be differentiated from other wetland types via fieldwork.

Hemlock - Red Oak - Mixed Hardwood Forest
Quercus rubra - Tsuga canadensis - Liriodendron tulipifera / Hamamelis virginiana Forest
Due to a lack of eastern hemlock (*Tsuga canadensis*), this association was differentiated via fieldwork and by delineating a slope where eastern hemlock (*Tsuga canadensis*) was formerly a dominant tree.

Skunk Cabbage - Orange Jewelweed Seep
Symplocarpus foetidus - Impatiens capensis Herbaceous Vegetation
This association has a dark tone of a wetland and occurs low on the landscape along streams. It is differentiated via fieldwork from other wetland types that occur along streams.

Northeastern Modified Successional Forest
Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana Forest
The signature of this association is masked by the dark signature of dense stands of Japanese barberry (*Berberis thunbergii*). Dominant trees have small crowns compared to surrounding forest trees. Most patches of this association are adjacent to fields. The stands appear to be early successional and the signature of the association is most like that of Black Locust (*Robinia pseudoacacia*) Successional Forest.

Northern Piedmont Mesic Oak - Beech Forest
Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana Forest
Based on fieldwork, patches of this association were differentiated from the matrix forest, a mosaic of *Fagus grandifolia-Betula lenta-Quercus (alba, rubra)/Carpinus caroliniana* Forest and *Liriodendron tulipifera-Quercus* spp. Forest.

Northern Piedmont Mesic Oak - Beech Forest and Successional Tuliptree Forest
Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana Forest and *Liriodendron tulipifera - Quercus* spp. Forest
The combination and overlap of these two associations form the matrix forest of Jockey Hollow and the New Jersey Brigade Units of Morristown National Historical Park. Generally, tuliptree (*Liriodendron tulipifera*) has very stout, dark trunks and can be differentiated from other trees, but this signature becomes obscured by shadows and steep slopes, etc. Based on the observation points and releves, it appears that these two associations could be differentiated with additional fieldwork.

Black Locust Successional Forest
Robinia pseudoacacia Forest
Several patches of this type were heavily invaded by Japanese stiltgrass (*Microstegium vimineum*), therefore they had a light tone. The dominance of black locust (*Robinia pseudoacacia*) gave this association a coarse signature. Most patches were adjacent to fields and are early successional.

Montane Basic Seepage Swamp
Acer rubrum - Fraxinus americana - Fraxinus nigra - Betula alleghaniensis / Veratrum viride - Carex bromoides Forest

Patches of this association occur on the upper reaches of the west branch of Primrose Brook. It can be differentiated from other wetland associations via fieldwork.

Upland / Wetland Transitional Forest (was not mapped)

Appendix B. Vegetation Plot Sampling Form.

NPS Vegetation Mapping Project — Form 3: Quantitative Community Characterization

A. General Information

Plot Number: _____ Park Name: _____

Survey date: _____ Surveyors: _____

Easting: _ _ _ _ _ _ E Northing: _ _ _ _ _ _ _ N EPE/APE:_____ DOP:_____ Map datum:_____ Zone:_____

B. Environmental Description

Representative sketch of stand and landscape position

Picture No.:_____

Slope: _____

Aspect: _____

Elevation: _____

Stoniness:

__ Stone free <0.1%

__ Moderately stony 0.1-1%

__ Stony 3-15%

__ Very stony 15-50%

__ Exceedingly stony 50-90%

__ Stone piles >90%

Topographic position:

__ Interfluve (ridgetop) __ Low slope

__ High slope __ Toe slope

__ High level __ Low level

__ Midslope __ Channel wall

__ Backslope __ Channel bed

__ Step in slope __ Basin Floor

__ Other: _____

Hydrologic regime:

__ Permanently flooded

__ Semi-permanently flooded

__ Seasonally flooded

__ Intermittently flooded

__ Temporarily flooded

__ Artificially flooded

__ Saturated (wet, but never flooded)

Average soil texture:

__ sand __ clay loam

__ sandy loam __ clay

__ loam __ peat

__ silt loam __ muck

__ other:_____

Soil drainage:

__ Rapidly drained

__ Well drained

__ Moderately well drained

__ Somewhat poorly drained

__ Poorly drained

__ Very poorly drained

Soil profile description: note depth, texture, and color of each horizon. Note significant changes such as depth to mottling, depth to water table, root penetration depth

Horizon	Depth	Texture	Color	pH	Comments

Unvegetated surface:

____ % Bedrock

____ % Litter, duff

____ % Large rocks (>10 cm)

____ % Wood (>1 cm)

____ % Small rocks (0.2-10 cm)

____ % Water

____ % Sand (0.1-2 mm)

____ % Bare soil

____ % Other:_____

Plot representativeness: Note homogeneity of vegetation in plot versus rest of community

Environmental Comments: Note surrounding vegetation, landscape context, herbivory, stand health, recent/historic anthropogenic evidence, etc.

B. Vegetation

Cowardin System: _____ Terrestrial: _____ Palustrine: _____ Estuarine: _____ Plot number: _____ Plot dimensions: _____

Leaf Type	Leaf Phenology	Plysiognomic Type								height	% cover
__ Broad-leaf	__ Deciduous	__ Forest		__ Woodland					T1 Emergent tree		
__ Semi-borad-leaf	__ Semi-deciduous	__ Sparse Woodland		__ Scrub Thicket					T2 Tree canopy		
__ Semi-needle-leaf	__ Semi-evergreen	__ Shrubland		__ Sparse Woodland					T3 Tree sub-canopy		
__ Needle-leaf	__ Evergreen	__ Dwarf Shrubland		__ Dwarf Scrub Thicket					S1 Tall shrub		
__ Broad-leaf herbaceous	__ Perennial	__ Sparse Dwarf Shrubland		__ Herbaceous					S2 Short shrub		
__ Graminoid	__ Annual	__ Non-Vascular		__ Sparsely Vegetated					H Herbaceous		
__ Pteridophyte									N Non-vascular		
R = 1 or few	(+) = occasional	1 = <5%	2- = 5-12%	2+ = 13-25%	3 = 26-50%	4 = 51-75%	5 = 76+%		E Epiphyte		
									V Vine / liana		

Species / percent cover: starting with uppermost stratum, list all species and % cover for each in the stratum. For forest and woodlands, list on a separate line below each tree species the DBH of all trees above 10 cm diameter.

Appendix C. Data dictionary for fields in PLOTS 2.0 Database.

This data dictionary describes the primary tables and their variables in the Plots 2.0 database holding the vegetation plots data.

Table	**Field**	**Meaning**	**Comment re MORR**
Plots	Plot Code	unique identifier assigned by PLOTS using 4-letter park code and sequential numbers	
Plots	Field Plot Name	plot as identified on field form	
Plots	County		
Plots	SubPlot	was plot a sub-unit of a larger plot?	
Plots	SubPlot Parent Code	identifier of larger plot if this is a subplot	n/a for MORR
Plots	Air Photo Number	reference number for aerial photo that covers the plot area	
Plots	Polygon Code	identifier of polygon on vegetation map in which plot falls	
Plots	Map Unit	name of map class for polygon in which plot falls	
Plots	Classified Community Name	standard association name from the U.S. National Vegetation Classification	
Plots	USNVC ELCODE	standard element code from the U.S. National Vegetation Classification	
Plots	Sublocation	narrative for location of plot within the park	
Plots	Quad Name	name of USGS 7.5' quadrangle in which plot falls	
Plots	Quad Code	standardized code for USGS quadrangle	
Plots	Coord System	coordinate system used for geographic location of plots: "1" if UTM, "2" if latitude/longitude	
Plots	GPS File	name of file in which coordinates are stored	
Plots	GPS Techniques	type of GPS unit used to secure location plus any applicable comments	
Table	Field	meaning	comment re MORR
Plots	Field UTM X	X UTM coordinate as recorded in field	
Plots	Field UTM Y	Y UTM coordinate as recorded in field	
Plots	Corrected UTM X	corrected X UTM coordinate if post-processing is used	n/a for MORR as no post-processing was used
Plots	Corrected UTM Y	corrected Y UTM coordinate if post-processing is used	n/a for MORR as no post-processing was used
Plots	UTM Zone	UTM zone	
Plots	Survey Date	date field data were taken	
Plots	Surveyors	field personnel	
Plots	Plot Directions	detailed directions to plot using ground landmarks	
Plots	X Dimension	length of side of plot in m	
Plots	Y Dimension	width of plot in m	
Plots	Plot Shape	square, rectangular, round, etc.	Combination for MORR
Plots	Photos	yes/no	
Plots	Roll Number	roll number for film photos	

Table	Field	Meaning	Comment re MORR
Plots	Frame Number	frame number for film photos; file name for digital photos	
Plots	Permanent	is plot permanent? Yes/no	
Plots	Representativeness	narrative for how representative of community plot seems to be	
Plots	Elevation	plot average elevation above mean sea level	in meters
Plots	Elevation Units	"1" = meters, "2" = feet	
Plots	GPS Datum	Datum used by GPS	NAD83 for MORR
Plots	GPS Accuracy	as recorded in field	
Plots	Slope	slope category (pick-list)	Flat = 0º; Gentle = 0–5º; Moderate = 6–14º; Somewhat steep = 15–25º; Steep = 27–45º; Very steep = 45–69º; Abrupt = 70–100º; Overhanging/sheltered = 100º
Plots	Precise Slope	slope measurement	in degrees
Plots	Slope range	range of slope, where uphill and downhill values are given	
Plots	Aspect	aspect category (pick-list)	Flat; Variable; N 338-22º; NE 23-67º; E 68-112º; SE 113-157º; S 158-202º; SW 203-247º; W 248-292º; NW 293-337º
Plots	Precise Aspect	measured aspect in True degrees	
Plots	Topo Position	topographic position of plot (pick-list)	Crest/Summit/Ridge; Upper/Shoulder Slope; High Plateau; Middle Slope; Slope step (terracette); Lower Slope; Toe slope; Low level/terrace; Channel wall; Channel bed; Depression
Plots	Landform	landform on which plot occurs (pick-list)	Bar; Basin; Beach; Bluff/bank; Channel; Cliff; Cove; Delta; Dome; Drumlin; Dune; Escarpment; Esker; Estuary; Flat; Floodplain; Gorge; Hill; Kame; Kettle; Lake /pond; Ledge; Moraine; Mountain; Outwash plain; Oxbow; Plain; Plateau; Ravine; Ridge; Saddle; Swale; Talus; Terrace; Valley; Other
Plots	Surficial Geology	geologic setting (pick-list)	Bedrock; Talus; Glacial till; Moraine; Esker/outwash; Glacial delta; Lacustrine; fluvial; Marine; Aeolian; Other
Plots	Cowardin System	broad wetland classification from Cowardin 1979	Upland, Palustrine, Estuarine, Riverine, Lacustrine
Plots	Hydro Regime	hydrologic regime (wetlands only)	Permanently Flooded; Semipermanently Flooded; Seasonally Flooded; Saturated; Temporarily Flooded; Intermittently Flooded; Tidally Flooded
Plots	Salinity/Halinity		
Plots	Hydrology Evidence	notes on evidence used to deduce hydrologic regime	

Table	Field	Meaning	Comment re MORR
Plots	Environmental Comments	narrative description of the habitat	
Plots	Landscape Comments	narrative description of the surrounding area	
Plots	Soil Taxon/Descriptio n	narrative of soil profile	
Plots	Soil Texture	soil texture class	sand; sandy loam; loam; silt loam; silt; clay loam; clay; peat; muck
Plots	Soil Depth	depth to obstruction	
Plots	Soil Depth Units	1=meters, 2=cm, 3=feet, 4=inches	cm
Plots	Soil Drainage	drainage category (pick-list)	rapidly drained; well drained; moderately well drained; somewhat poorly drained; poorly drained; very poorly drained
Plots	% Bedrock	% unvegetated ground surface covered	
Plots	% Large Rocks	% unvegetated ground surface covered	
Plots	% Small Rocks	% unvegetated ground surface covered	
Plots	% Sand	% unvegetated ground surface covered	
Plots	% Litter, Duff	% unvegetated ground surface covered	
Plots	% Wood	% unvegetated ground surface covered	
Plots	% Water	% unvegetated ground surface covered	
Plots	% Bare Soil	% unvegetated ground surface covered	
Table	Field	meaning	comment re MORR
Plots	% Other	if "other" is used as a ground surface cover category	
Plots	% Other Description	if "other" is used as a ground surface cover category	
Plots	Leaf Phenology	Of dominant stratum	Evergreen, Cold-deciduous, Mixed evergreen-cold-deciduous, Herb - annual, Herb - perennial
Plots	Leaf Type	Of dominant stratum	Broad-leaved, Needle-leaved, Microphyllous, Graminoid, Broad-leaved herbaceous, Pteridophyte, Nonvascular
Plots	Physio Class	physiognomic Class according to USNVC hierarchy; applies to dominant stratum (highest stratum with at least 25% cover)	Forest (>60% tree canopy -crowns overlapping), Woodland (25%–60% open tree canopy), Shrubland (<25% trees, and shrubby cover >0.5 m tall greater than other strata), Dwarf Shrubland (<25% trees, and shrubby cover <0.5 m tall greater than other strata), Herbaceous (herb cover exceeds that of other strata), Nonvascular (nonvascular cover exceeds that of other strata), or Sparse vegetation (total vegetation <25%)
Plots	T1 Hgt	height of emergent tree layer	in meters if applicable
Plots	T1 Cover	% cover of emergent tree layer	cover classes (for all strata): 5%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%

Table	Field	Meaning	Comment re MORR
Plots	T2 Hgt	height of tree canopy layer	
Plots	T2 Cover	% cover of tree canopy layer	
Plots	T3 Hgt	height of tree subcanopy layer	
Plots	T3 Cover	% cover of tree subcanopy layer	
Plots	S1 Hgt	height of tall shrub layer	
Plots	S1 Cover	% cover of tall shrub layer	
Plots	S2 Hgt	height of short shrub layer	
Plots	S2 Cover	% cover of short shrub layer	
Plots	S3 Hgt	height of dwarf shrub layer	
Plots	S3 Cover	% cover of dwarf shrub layer	
Plots	H Hgt	height of herb layer	
Plots	H Cover	% cover of herb layer	
Plots	N Cover	% cover of non-vascular layer	
Plots	V Hgt	height of vine layer, if present	
Plots	V Cover	% cover of vine layer	
Plots	Other Measure1 Defined	Explanation of other measure of species presence	
Plots	Other Measure2 Defined	Explanation of other measurement used for species presence	
Plots	Animal Use Evidence		
Plots	Disturbance Comments	narrative on natural and anthropogenic disturbance	
Plots	Other Comments		
Plots	Update	When record was last updated (using Plots 2.0 interface)	does not apply to values directly manipulated in tables
Plots	User	initials of person entering record	
Plots	Species Counter	number of plant species recorded in plot	
Plots	Optional Fields Defined	narrative defining any optional fields that are used	
Plots	Provisional Community Name	community name assigned in field or before final analyses	
Plots-Species	Plot Code	unique identifier assigned by PLOTS using 4-letter park code and sequential numbers	provides link to Plots table
Plots-Species	Plot Species Counter	Unique integer sequence for species within this plot	
Plots-Species	Plant Symbol	from USDA Plants db table	
Plots-Species	Scientific Name	Accepted Latin name of the plant species	
Plots-Species	Common Name		
Plots-Species	Family		
Plots-Species	Specimen Number	if collected	
Plots-Species	Used PLANTS	Yes if name came from the PLANTS database	
Plots-Species	Source	From Plant List table: SS or NS	
Plots-Species	Within Plot	yes/no: Species is present within the Plot boundaries	
Plots-Species	Stratum Sort	Major sort order of strata	to sort from highest to lowest or vice versa

Table	Field	Meaning	Comment re MORR
Plots-Species	Stratum	Stratum this species being recorded in	T1 = Emergent; T2 = Tree Canopy; T3 = Tree Subcanopy; S1 = Tall Shrub; S2 = Short Shrub; H = Herbaceous; N = Nonvascular plant; V = Vine/liana
Plots-Species	Strat-Simple	simplified stratum	Tree, Shrub, Herb, Non-vasc, Vine
Plots-Species	Diagnostic	yes/no: Species is a known diagnostic for the community	
Plots-Species	Range Cover	midpoint of cover class	cover classes (for all strata): <1 / 1–5% / 6–10% / 11–25% / 26–50% / 51–75% / 76–100%
Plots-Species	Real Cover	if % cover measured directly	not used at MORR
Plots-Species	Other Measure1	Other measure of species presence	CalculatedCover: from relativized basal area (Keeton data) * total canopy cover
Plots-Species	Other Measure2	Other measure of species presence	not used at MORR
Plots-Species	DBH	Diameter at breast height for all trees above 10 cm diameter (comma delimited)	recorded on field forms
Plots-Species	Update	When record was last updated (using Plots 2.0 interface)	does not apply to values directly manipulated in tables
Plots-Species	User	initials of person entering record	
Plots-Species	SciName-Field	scientific name used on field form	names standardized to Kartesz (1999) (updated NPS names are in "Scientific Name" field)

Appendix D. Results of Morristown National Historical Park TWINSPAN plot data analysis.

```
ORDER OF SAMPLES
MORR.9    |   MORR.8   |    MORR.10   |   MORR.20  |   MORR.15  |  MORR.22  |
MORR.11   |   MORR.18  |    MORR.5    |   MORR.16  |   MORR.1   |  MORR.6   |
MORR.12   |   MORR.17  |    MORR.1    |   MORR.2   |   MORR.3      MORR.7   |
MORR.13   |   MORR.14  |
MORR.21   |   MORR.4   |
```

Plots are labeled vertically, and associations are coded by color. Characteristic species for each type are also labeled in the corresponding color. For species that are characteristic in more than one association, the species is bolded, and the number indicating relative cover coded with the same color as the association.

TWO-WAY ORDERED TABLE

Smartweed – Cutgrass Wetland
Black Locust Successional Forest
Southern New England Red Maple Seepage Swamp
Montane Basic Seepage Swamp
Northern Piedmont Mesic Oak – Beech Forest
Northeastern Dry Oak – Hickory Forest
Tuliptree – Beech – Maple Forest
Successional Tuliptree Forest
Dry-Mesic Chestnut Oak – Red Oak Forest
Hemlock – Red Oak – Mixed Hardwood Forest
Northeastern Old Field

```
                                          MMMMMMMMMMMMMMMMMMMMMMMM
                                          OOOOOOOOOOOOOOOOOOOOOOOO
                                          RRRRRRRRRRRRRRRRRRRRRRRR
                                          RRRRRRRRRRRRRRRRRRRRRRRR
                                            121211 11 11    112
                                          980052185696271237 3414

Toxicodendron radicans                    -2211111-11111-1111--1  0000
Parthenocissus quinquefolia               --121111-11-11--111--1  0000
Impatiens capensis                        1-12-2----------------  000100
Carex foena                               1--1-3----------------  000100
Glyceria melicaria                        1--1------------------  000100
Nyssa sylvatica                           --211--3------1-------  000101
Fraxinus pennsylvanica                    --23------------------  000101
Robinia pseudoacacia                      -5-----------1--------  000101
Fraxinus americana                        -3--321-----1---------  000101
Polygonum persicaria                      -1---1----------------  000101
Menispermum canadense                     --1-1-1---------------  000101
Cardamine pensylvanica                    ---1111--1---1--------  000101
Phegopteris connectilis                   ----112---------------  000101
Adiantum pedatum                          ----1-1---------------  000101
Brachyletrum erectum                      ----112---------------  000101
Circaea lutetiana                         ----1-1---------------  000101
Maianthemum racemosum                     ----1-1---------------  000101
Symphiotrichum lateriflorum               -----1------------1---  000101
Trientalis borealis                       ---1-----1------------  000101
```

Viburnum nudum var. cassinoides	--1----------	000101
Vaccinium corymbosum	--1----------	000101
Rubus hispdidus	--11-----1----------	000101
Dryopteris intermedia	--1----------	000101
Symplocarpus foetidus	--36-4----------	000101
Betula alleghaniensis	-----4-3----------2-	000101
Amphicarpaea bracteata	----13-1----------	000101
Viola pubescens	-----1----------1---	000101
Tilia americanum	----22----------	000101
Amelanchier arborea	---2----------1-	000101
Ilex verticillata	---1----------	000101
Ulmus rubra	---2----------	000101
Chrysosplenium americanum	---2-1----------	000101
Pilea pumila	---3-1----------	000101
Carex prasina	---1----------	000101
Dryopteris marginalis	---11----------	000101
Osmunda cinnamomea	---111----------	000101
Poa palustris	---1----------	000101
Ranunculus recurvatus	---1----------	000101
Veratrum viride	---1-1----------	000101
Caltha palustris	---1----------	000101
Scutellaria elliptica	---1----------	000101
Rhododendron viscosum	-----1----------1-	000101
Sambucus racemosa var. racemosa	-----1----------	000101
Bartonia paniculata	-----1----------	000101
Carex gracillima	-----1----------	000101
Smilax herbacea	-----1---1----------	000101
Carex bromoides	-----3----------	000101
Carex atlantica	-----1----------	000101
Chelone glabra	-----1----------	000101
Thalictrum pubescens	-----1----------	000101
Viola sororia	-----1----------	000101
Carex canescens	-----1----------	000101
Boehmeria cylindrica	-----1----------	000101
Solidago patula	-----1----------	000101
Lysimachia ciliata	-----1----------	000101
Osmunda regalis	-----1----------	000101
Scutellaria galericulata	-----1----------	000101
Maianthemum trifolium	-----1----------	000101
Sphagnum sp.	-----1----------	000101
Onoclea sensibilis	----1----------	000101
Laportaea canadensis	----3----------	000101
Sanicula sp.	----1----------	000101
Carex umbellata	----1----------	000101
Deparia acrostichoides	----1----------	000101
Betula lenta	--234--232321-341-313-	000110
Acer rubrum	--1314-11311111111111-	000110
Liriodendron tulipifera	--1144441131151111111-	000110
Carpinus caroliniana	--222-22--23----------	000110
Thelypteris noveboracensis	--1-2312111-2---1-211-	000110
Maianthemum canadense	--11-1-1---1--1-1---3-	000110
Polystichum acrostichoides	----3122--2-1-----211-	000110
Carex digitalis	----1211-1-1-1-1-11---	000110
Epifagus virginiana	---1-11-1--1-------11-	000110
Lindera benzoin	--1-1----11--1--------	000110
Ranunculus sp.	-----1-------1----1---	000110
Arisaema triphyllum	11-11111-11111-1-11---	000111

Leersia virginica	**5**----------	000111
Polygonum hydropiperoides	**4**----------	000111
Polygonum arifolium	**3**--1-1----------	000111
Typha latifolia	**2**----------	000111
Scirpus cyperinus	**2**----------	000111
Polygonum sagittatum	**1**----------	000111
Vaccinium pallidum	--11-1--11111-1-11--1-	001000
Ligustrum vulgare	-1-------1--------2---	001000
Anemone quinquefolia	-----11-------1----1--	001000
Polytrichum commune	--12----------11--222-	001000
Leucobryum sp.	--1--2--------11--214-	001000
Hamamelis virginiana	---1-1-2-----1---2--2-	001000
Prenanthes sp.	-----1----------11-	001000
Prunus serotina	-----1---11--11-1-11--	001001
Mitchella repens	--11-1-2111-111-11211-	001001
Fagus grandifolia	---3111111**5**4---311121-	001001
Carya alba	-----23---1-**2**--2-1----	001001
Cornus florida	-1-----2-**3**--------**2**---	001001
Ageratina altissima	-1-------1--12-1211---	001001
Carex rosea	---1--11------1---**3**11-	001001
Carex swanii	----1--11111--11111-1-	001001
Medeola virginiana	-----1--1--11-1----1--	001001
Uvularia sessilifolia	----11-1--1-1111-1-1--	001001
Carex platyphylla	----11--111111----1---	001001
Solidago caesia	-----1---11-111--1----	001001
Quercus prinus	----------**44**233-3-	001010
Quercus coccinea	----------**3**------	001010
Sonchus arvensis	----------111----	001010
Danthonia spicata	----------1111---	001010
Vitis sp.	----------1----	001010
Rosa carolina	----------1---	001010
Juncus greenii	----------**1**---	001010
Lespedeza sp.	----------11--	001010
Carex oligocarpa	----------**1**---	001010
Acalypha gracilens	----------1---	001010
Luzula campestris	----------1---	001010
Dennstaedtia punctilobula	----------2-----	001010
Veronica sp.	----------1-----	001010
Kalmia angustifolia	----------1-	001011
Epigaea repens	----------1-	001011
Polypodium virginianum	----------1-	001011
Viola canadensis	----------1-	001011
Quercus rubra	------331--24-**33**4-3---	001100
Pyrola elliptica	------1-----1-----11--	001100
Chimaphila maculata	-------11-1-1-1-1-1-11--	001100
Eurybia divaricata	-------11111111111111-	001100
Hepatica nobilis	------1----------**1**---	001100
Geranium maculatum	---------**1**--------**1**---	001100
Carex pensylvanica	-------4-**3**31**4**41122**4**41-	001101
Rubus idaeaus	------2----------1---	001110
Quercus alba	----3---2**3**33**2**3---2**4**4--	001110
Uvularia perfoliata	----------**11**----**1**---	001110
Potentilla simplex	---------1--1-----1---	001110
Galium circaeazans	----------1-**1**-----**1**---	001110
Thalictrum thalictroides	---------**1**--**1**1----**1**---	001110
Viburnum dentatum	---------**1**--**1**-----**1**---	001110
Castanea dentata	----------**3**------2-	001110

```
 Quercus velutina                  -----133-312-----3----  001111
 Acer saccharum                    ------311-3-----------  001111
 Celastrus orbiculatus             ------1-----11--------  001111
 Monotropa uniflora                ------111-1-1---1-----  001111
 Carex virescens                   ------------1---------  001111
 Hedeoma puligioides               ------------1---------  001111
 Rubus phoenocolasius              ---------1--11--------  001111
 Podophyllum peltatum              ------1---------------  001111
 Ailanthus altissima               -------------1--------  001111
 Viburnum prunifolium              -------------1--------  001111
 Ulmus americana                   -------------1--------  001111
 Botrychium dissectum              -------------1--------  001111
 Sassafras albidum                 -------2--------------  001111
 Ostrya virginiana                 -------3--2-----------  001111
 Carya sp.                         -------1-4-3-------1--  001111
 Carya glabra                      ----------3-----------  001111
Viburnum acerifolium               ----------1-----------  001111
Smilax glauca                      ----------1-----------  001111
Phegopteris hexagonoptera          ----------1-----------  001111
Amelanchier canadensis             ---------3------------  001111
Rosa sp.                           ---------1------------  001111
Rubus sp.                          ---------1------------  001111
Trichophorum planifolium           ----------------1-2--1  01
Lonicera japonica                  ---------1-------1---2  100
Cynadon dactylon                   --1------------------3  1010
Cynanchum rossicum                 ----------------------2  1011
Solanum dulcamara                  ----------------------2  1011
Schizachyrium scoparium            ----------------------3  1011
Sorghastrum nutans                 ----------------------2  1011
Tridens flavus                     ----------------------2  1011
Lolium perenne                     ----------------------3  1011
Monarda sp.                        ----------------------2  1011
Asclepias syriaca                  ----------------------2  1011
Achillea millefolium               ----------------------2  1011
Linaria vulgaris                   ----------------------2  1011
Pycnanthemum virginianum           ----------------------2  1011
Agrostis hyemalis                  ----------------------3  1011
Phleum pratense                    ----------------------3  1011
Allium vineale                     ----------------------1  1011
Symphyotrichum dumosum             ----------------------1  1011
Apocynum cannabinum                ----------------------1  1011
Asclepias tuberosa                 ----------------------1  1011
Anthoxanthum odoratum              ----------------------1  1011
Oxalis stricta                     ------------11----1--2  11
Galiium sp.                        ----1-1------1-------3  11

                                  00000000000000000000001
                                  01111111111111111111
                                   00000111111111111111
                                   01111000000001111111
                                        001111110000001
                                          000011000011
********** TWINSPAN completed **********
```

Appendix E. Dichotomous field key to the USNVC associations of Morristown National Historical Park.

1a Non-wooded vegetation: tree canopy lacking 2
1b Wooded vegetation: forests, shrublands, or woodlands 4

2a Upland herbaceous vegetation dominated by non native grasses and forbs; old fields ..... **Northeastern Old Field**
2b Herbaceous wetlands 3

3a Skunk cabbage (*Symplocarpus foetidus)* prominent in early season; jewelweed (*Impatiens capensis*), common blue violet (*Viola sororia*), green false hellebore (*Veratrum viride*), Jack in the pulpit (*Arisaema triphyllum*), sedges (*Carex spp.*), and sphagnum (*Sphagnum* spp.) characteristic in late season; small open patch within forest matrix, or shaded by overhanging trees ..... **Skunk Cabbage - Orange Jewelweed Seep**
3b Herbaceous vegetation of saturated soils dominated by cutgrass (*Leersia* spp.) and knotweed (*Polygonum* spp.) species ..... **Smartweed – Cutgrass Wetland**

4a Palustrine forested vegetation of saturated soils, dominated by red maple (*Acer rubrum*), ash (*Fraxinus* spp.) 5
4b Upland forest (red maple (*Acer rubrum*) may be present but at low cover); not influenced by flooding or water table 8

5a Forested wetland vegetation of saturated soils in headwater basin with braided streams, dominated by red maple (*Acer rubrum*), white ash (*Fraxinus americana)*, and tuliptree (*Liriodendron tulipifera*); yellow birch (*Betula alleghanienis)* present, with a high cover and diversity of sedges (especially bromelike sedge (*Carex bromoides*) and dryspike sedge (*Carex foenea*); shrub layer relatively well developed, characterized by common elderberry (*Sambucus nigra* ssp. *canadensis*) and swamp azalea (*Rhododendron viscosum*); herbaceous layer relatively rich, including roundleaf goldenrod (*Solidago patula*), white turtlehead (*Chelone glabra*) ..... **Montane Basic Seepage Swamp**
5b Forested vegetation at seasonally saturated sites, dominated by trees along streams and in low-lying areas, but not in headwaters 6

6a Small patch association of seasonally saturated sites, skunk cabbage (*Symplocarpus foetidus*) dominant early in growing season; shade formed by overhanging trees from adjacent upland, but wetland trees such as red maple (*Acer rubrum*) absent ..... **Skunk Cabbage - Orange Jewelweed Seep**
6b Forests adjacent to streams 7

7a Wetland forest characterized by skunk cabbage (*Symplocarpus foetidus*), jewelweed (*Impatiens capensis*), but with wetland trees such as red maple (*Acer rubrum*), American elm (*Ulmus americana*), blackgum (*Nyssa sylvatica*); American golden saxifrage (*Chrysosplenium americanum*) often present in rivulets ..... **Southern New England Red Maple Seepage Swamp**

7b Forests characterized by the presence of yellow birch (*Betula alleghaniensis*) and northern red oak (*Quercus rubra*). ..... . **Upland – Wetland Transitional Forest**

8a Upland forests characterized by strong dominance by a single species, or by nonnative trees, or by a mixture of early successional species at the edges of fields and openings 9

8b Upland forests characterized by higher diversity and relative absence of nonnative trees (however, shrub and herb layers may be characterized by exotics) 11

9a Upland forest dominated by black locust (*Robinia pseudoacacia*) ..... **Black Locust Successional Forest**

9b Upland forest heavily dominated by tuliptree (*Liriodendron tulipifera*) or by early successional species 10

10a Upland forests strongly dominated by tuliptree (*Liriodendron tulipifera*) and few other tree species with the exception of white ash (*Fraxinus americana*) or black locust (*Robinia pseudoacacia*) ..... **Successional Tuliptree Forest**

10b Upland forest bordering fields and openings; early successional species such as white ash (*Fraxinus americana),* black cherry (*Prunus serotina*) and nonnative trees mixed with oaks (*Quercus spp.*); exotic species dominate the understory ..... **Northeastern Modified Successional Forest**

11a Forest of lower slopes; sugar maple (*Acer saccharum*) present in quantity; relatively rich herbaceous layer, including mayapple (*Podophyllum peltatum*), broadleaf sedge (*Carex platyphylla*). ..... **Tuliptree – Beech – Maple Forest**

11b Forests of middle to upper slopes; sugar maple (*Acer* saccharum) absent or of very low cover 12

12a Forests with a high cover of American beech (*Fagus grandifolia*) 13

12b American beech (*Fagus grandifolia*) unimportant or absent 14

13a White oak (*Quercus alba*) abundant; northern spicebush (*Lindera benzoin*) and yellow birch (*Betula alleghaniensis*) absent or of low cover ..... **Northern Piedmont Mesic Oak – Beech Forest**

13b White oak (*Quercus alba*) absent; northern spicebush (*Lindera benzoin*), northern red oak (*Quercus rubra*), and yellow birch (*Betula alleghaniensis*) present in quantity. ..... **Upland – Wetland Transitional Forest**

14a Forest of middle slope characterized by the presence of abundant dead eastern hemlock (*Tsuga canadensis*) snags; northern red oak (*Quercus rubra*). ..... **Hemlock – Red Oak – Mixed Hardwood Forest**

14b Eastern hemlock (*Tsuga canadensis*) (snags or live) absent 15

15a Oak forests dominated by chestnut oak (*Quercus prinus*). ..... **Dry – Mesic Chestnut Oak – Red Oak Forest**

15b Forests characterized by the presence of hickory (*Carya spp.*); dominated by oaks (*Quercus alba, Q. rubra,* and/or *Q. velutina)* found on upper slopes with flowering dogwood (*Cornus florida*), American hornbeam (*Carpinus caroliniana*), and hophornbeam (*Ostrya virginiana*). ..... **Northeastern Dry Oak-Hickory Forest**

Appendix F. Mapping Observation Point Form.

1. USNVC Code _____	2. USNVC Name _____
3. Site Name _____	
5. Quad Name(s)	10. Directions
Plot marker Y_____ N_____ 11. Plot code _____	12. Survey Date: _____
16. Surveyors _____	
UTM Coordiates _____ Rover file _____ Time _____	20. Image# _____

Vegetation Composition and Structure

Strata / life form	Height	% Cover	Most abundant / characteristic species
Emergent Tree			
Tree Canopy			
Tree Sub-canopy			
Tall Shrub			
Short Shrub			
Herbaceous			
Nonvascular			
Vine / Liana			

Additional Comments:

35. Hydrologic influence:	23. Topographic sketch	24. Slope None __ Gentle __ Steep __
Upland __ Riparian __ Isolated basin __ Tidal __ Bog __ Other __		25. Slope Aspect _____

31. Soil moisture regime	34. Average soil texture	Unvegetated surface (% cover)
Extremely dry __	Sand __	Bedrock __
Very dry __	Sandy loam __	Litter, duff __
Somewhat dry __	Loam __	Large rocks (>10 cm) __
Moist __	Silt loam __	Small rocks (<10 cm) __
Somewhat wet __	Clay loam __	Sand __
Wet __	Clay __	Wood __
Very Wet __	Peat __	Water __
Permanently inundated __	Muck __	Other __
Periodically inundated __ (irregular)	Other __	

36. Environmental comments: Note homogeneity or heterogeneity of vegetation within the stand; erosion / sedimentation, etc.

Appendix G. Accuracy Assessment Form for USGS/NPS Vegetation Mapping Program.

AA Point: _____ Park: _____ Date: _____ Observers: _____

GPS Unit: _____ Projection: _____ Map datum: _____ Zone: ____

Easting: _ _ _ _ _ _ E Northing: _ _ _ _ _ _ _ N PDOP: _____ EPE: _____ m / ft: ____

Offset: YES / NO Easting Offset: + / - m Northing Offset: + / - m

Topographic Description: _____ Elevation: _____ m Aspect: _____

Vegetation Association at point: _____
Veg Assoc 2 w/in 50 m of point: _____
Veg Assoc 3 w/in 50 m of point: _____

Major Species by Strata
T1:_____

T2:_____

T3:_____

S1:_____

S2:_____

H:_____

V:_____

Rationale for Classification:_____

Fire Fuel Model: _____ Percent Cover of Canopy: _____ Canopy Cover Class: 1 2 3 4

Comments:_____

Appendix H. Field definitions for local and global USNVC association descriptions.

Field Definitions

LOCAL DESCRIPTION

Common Name (Park-specific)
A common or colloquial name used by the park for the Association.

Environmental Description
A summary of available information on the environmental conditions associated with the Association and any other important aspects of the environment which affect this particular type within the park, including elevation ranges and, where relevant, information on large landscape context, geology and soils.

Vegetation Description
A summary of available information on the vegetation, species composition (including dominant and diagnostic taxa, as well as problematic exotic species), structure (defining strata and their heights and percent cover), and variability of the vegetation of this Association as it occurs on the park.

FLORISTIC COMPOSITION

Most Abundant Species
Component plant species that are dominant (i.e., most abundant in terms of percent cover) for the community type as it occurs in the park.

Stratum
For each component plant species, the stratum (or strata) in which it occurs in the community within the park.

Values for Stratum are
Tree (canopy & subcanopy)
Tree canopy
Tree subcanopy
Shrub/sapling (tall & short)
Tall shrub/sapling
Short shrub/sapling
Herb (field)
Nonvascular
Floating aquatic
Submerged aquatic

Lifeform
The lifeform of each component plant species that is present within each designated stratum of the community as it occurs within the park. Lifeform definitions are from Table 3.1, page 37, of Whittaker, R. H. 1975. Communities and ecosystems. Second edition. Macmillan Publishing Co., New York. 387 pp.

Values for Lifeforms are:

Needle-leaved tree	Thorn tree
Broad-leaved deciduous tree	Evergreen schlerophyllous tree
Broad-leaved evergreen tree	Succulent tree

Palm tree
Tree fern
Bamboo
Needle-leaved shrub
Broad-leaved deciduous shrub
Broad-leaved evergreen shrub
Thorn shrub
Evergreen schlerophyllous shrub
Palm shrub
Dwarf-shrub
Semi-shrub
Succulent shrub
Ephiphyte
Vine/Liana
Forb
Graminoid
Succulent forb
Aquatic herb (floating & submerged)
Moss
Alga
Lichen
Fern or fern ally
Other/unknown
Other shrub
Other herbaceous
Liverwort/hornwort

Species Name
Global scientific name (and common name) for each floristic component species of the community as it occurs within the park.
Characteristic Species
Component plant species that are characteristic for the community type as it occurs within the park.
Other Noteworthy Species
Other noteworthy species (i.e., species that are not necessarily diagnostic of the community, but that are worth noting for some other reasons, such as those that are rare species or exotic invasives) that are found within the community in the park.

DISTRIBUTION

State
The two-letter postal code of the for U.S. state(s) in which the park occurs.
State Rank
The Heritage Conservation Subnational Rank that best characterizes the relative rarity or endangerment of the Association within the specified state. See **Global Rank** for equivalent values. A star (*) indicates that the Subnational Rank is for the NHP/CDC Element (nonstandard) not the IVC Association (standard) (see below).
Relationship
The **State Name** (see below) is the name that the state Natural Heritage Program applies to their community Element. The **Relationship to Standard** is a value that indicates the relationship between the NHP(**Nonstandard)** Element and the related **Standard** Association (IVC). Values for Relationship to Standard are:

> **= - Equivalent** = NHP community is equivalent to the standard Association
> **B - Broader** = the NHP community is more broadly classified than the standard Association
> **F - Finer** = the NHP community is more finely classified than the standard Association
> **I - Intersecting** = the NHP community is not clearly broader or finer than this standard Association; the standard and NHP communities are related in a way that is more complex than a simple broader/finer relationship

? - Undetermined = the relationship between the NHP community and this standard Association is unknown

State Name

If the IVC Association has been crosswalked to a state classification type and it is equivalent to the IVC type, the **State Name** is the name that the Natural Heritage Program applies to the same community. A value of [gname] indicates that the **State Name** is the same as the **Global Name**. A value of [not crosswalked] indicates that no state type representing the concept of the IVC Association has been identified. If a state type has been identified that is NOT equivalent to the IVC Association (**Standard**), then the subnational type is considered a **Nonstandard** community. In this case, the **State Name** is the name of the nonstandard community.

Reference

This is the primary reference for the Natural Heritage Program classification that contains the **State Name** and confirms the presence of the Association in the state.

Local Range

A description of the total range (including present and historic, if known) of the Association within the park.

ADDITIONAL INFORMATION

Classification Comments

Comments about classification criteria used to define the community or description of any remaining issues associated with its classification on the park.

Other Comments

Additional comments about the community within the park.

Local Description Authors

Name(s) of the person(s) primarily responsible for authorship of the current description of this community on the park.

Plots

List of plot codes for plots used in the identification and classification of the community on the park.

Inventory Notes

Information regarding the sampling of the community on the park.

GLOBAL INFORMATION

USNVC CLASSIFICATION

Physiognomic Class

Class designates the growth form and structure of the vegetation of a community.

Physiognomic Subclass

Subclass designates growth form characteristics (e.g., leaf phenology) of a community.

Physiognomic Group

Group designates the leaf type of a community, corresponding to climate.

Physiognomic Subgroup

Subgroup designates the relative human impact (natural/semi-natural or cultural) on a community.

Formation
Formation designates additional physiognomic and environmental factors, including hydrology, of a community.
Classification Code
The International Vegetation Classification (IVC) Standard Classification code for the respective level of the hierarchy. Classification codes for the different levels are comprised of the following:

- **Class**: Roman numerals (I–VII)
- **Subclass**: Class code plus an uppercase letter (A–Z)
- **Group**: Subclass code plus an Arabic number
- **Subgroup**: Group code plus either the uppercase letter N (Natural/Semi-natural) or the uppercase letter C (Planted/Cultivated)
- **Formation**: Subgroup code plus a lowercase letter (a–z)

Alliance
The names of dominant and diagnostic species are the foundation of the **Alliance Name**. At least one species from the dominant and/or uppermost stratum is included. In rare cases where the combination of species in the upper and lower strata is strongly diagnostic, species from other strata are included in the name. Species occurring in the same stratum are separated by a hyphen (-), and those occurring in a different strata are separated by a slash (/). Species occurring in the uppermost stratum are listed first, followed successively by those in lower strata. In physiognomic types where there is a dominant herbaceous layer with a scattered woody layer, alliance names can be based on species found in the herbaceous layer and/or the woody layer, whichever is more diagnostic of the type.

Species less consistently found in all associations of the alliance may be placed in parentheses, and these parenthetical names are generally listed alphabetically. In cases where a particular genus is dominant or diagnostic, but the presence of individual species of the genus may vary among associations, only the specific epithets are placed in parentheses.

Nomenclature for vascular plant species follows a nationally standardized list (Kartesz 1999), with very few exceptions. Nomenclature for nonvascular plants follows Anderson (1990), Anderson et al. (1990), Egan (1987, 1989, 1990), Esslinger and Egan (1995), and Stotler and Crandall-Stotler (1977).
Alliance Key
A unique identifier for each Alliance that begins with the string "A." followed by a unique 3- or 4-digit number.
Alliance (English name)
A repeat of the **Alliance Name** with a translation of the scientific names using standard Central Ecology-accepted common names for the plant taxa in the name.
Association
The **Association Name** includes the scientific names of dominant and diagnostic species. Species occurring in the same stratum are separated by a hyphen (-), and those occurring in different strata are separated by a slash (/). Species occurring in the uppermost strata are listed first, followed successively by those in lower strata. Within the same stratum,

the order of species names generally reflects decreasing levels of dominance, constancy, or indicator value. In physiognomic types where there is a dominant herbaceous layer with a scattered woody layer, Association names can be based on species found in either the herbaceous layer or the woody layer, whichever is more diagnostic of the type. If both layers are used, then the uppermost layer is always listed first, regardless of which may be more diagnostic.

Species less consistently found in all occurrences of the Association are placed in parentheses (). In cases where a particular genus is dominant or diagnostic, but individual species of the genus may vary among occurrences, only the specific epithets are placed in parentheses. Association names conclude with the **Class Name** in which they are classified.

In cases where diagnostic species are unknown or in question, a more general term may be used as a species placeholder (e.g., *Sphagnum* spp., Mixed Herbs, Mesic Graminoids). An environmental or geographic term, or one that is descriptive of the height of the vegetation (e.g., Dwarf Forest, Northern Shrubland), can also be used as a modifier when such a term is necessary to adequately characterize the Association. For reasons of standardization and brevity, however, this is kept to a minimum. For **Provisional** Associations, [Provisional] is added at the end of the name (ex. *Salix wolfii* Shrubland [Provisional]).

Vascular plant species nomenclature for Association and Alliance names follows the nationally standardized list of Kartesz (1999), with very few exceptions. Nomenclature for nonvascular plants follows Anderson (1990) and Anderson et al. (1990) for mosses, Egan (1987, 1989, 1990, 1991) and Esslinger and Egan (1995) for lichens, and Stotler and Crandall-Stotler (1977) for liverworts/hornworts.

Association (English name)

A repeat of the **Association Name** but with a translation of the scientific names using standard Central Ecology-accepted common names for the plant taxa used in the name. Unlike **Global Name**, names in parentheses should be fully contained within the parentheses, and [Provisional] is not added at the end of name.

Ecological System(s)

A list of the Ecological Systems (**Association Name** and **Elcode**) of which the Association is a member. Ecological Systems are groups of plant associations unified by similar ecological conditions and processes (e.g., fire, riverine flooding), underlying environmental features (e.g., shallow soils, serpentine geology), and/or environmental gradients (e.g., elevation, hydrology in coastal zones). They should form relatively robust, cohesive, and distinguishable units on the ground. In most landscapes, the Ecological System will manifest itself on the ground as a spatial aggregation at an intermediate scale (e.g., between the IVC Alliance and Formation scales).

GLOBAL DESCRIPTION

Elcode (Identifier)

For IVC ecological units, a unique identifier code. Associations have a code that begins with the string "CEGL" (Community Element GLobal) followed by a unique 6-digit

number; Ecological Systems have codes that begin "CES" (Community Ecological System) followed by the 3-digit primary division code, followed by a 3-digit number.

Concept Summary

A description of the range, structure, composition, environmental setting and dynamics associated with the community. Information includes a general understanding of the type, often with some concept of its distribution; environmental setting in which the type occurs and a summary of the important disturbance regimes, successional status, and temporal dynamics for this community rangewide; community structure/physiognomy; species by strata (dominant and diagnostic taxa); and key diagnostic characteristics that distinguishes it from similar types.

Environmental Description

A summary of available information on the environmental conditions of the Association rangewide and any other important aspects of the environment which affect this particular type, including elevation ranges and, where relevant, information on large landscape context, geology and soils.

Vegetation Description

A summary of available information on the leaf type and phenology, species composition (including dominant and diagnostic taxa, as well as problematic exotic species), structure (defining strata and their heights and percent cover), and variability of the vegetation of this Association rangewide and any additional comments relating to the vegetation.

FLORISTIC COMPOSITION

Most Abundant Species

Component plant species that are dominant (i.e., most abundant in terms of percent cover) for the community type as it occurs rangewide.

Stratum

For each component plant species, the stratum (or strata) in which it occurs in the community rangewide. 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 Lifeforms are:

Needle-leaved tree	Tree fern
Broad-leaved deciduous tree	Bamboo
Broad-leaved evergreen tree	Needle-leaved shrub
Thorn tree	Broad-leaved deciduous shrub
Evergreen schlerophyllous tree	Broad-leaved evergreen shrub
Succulent tree	Thorn shrub
Palm tree	Evergreen schlerophyllous shrub

Palm shrub	Aquatic herb (floating & submerged)
Dwarf-shrub	Moss
Semi-shrub	Alga
Succulent shrub	Lichen
Ephiphyte	Fern or fern ally
Vine/Liana	Other/unknown
Forb	Other shrub
Graminoid	Other herbaceous
Succulent forb	Liverwort/hornwort

Species Name
Global scientific name (and common name) for each floristic component species of the community as it occurs rangewide.
Characteristic Species
Component plant species that are characteristic for the community type as it occurs rangewide.
Other Noteworthy Species
Other noteworthy species (i.e., species that are not necessarily diagnostic of the community, but that are worth noting for some other reasons, such as those that are rare species or exotic invasives) that are found within the community rangewide.
USFWS Wetland System
Systems developed for the classification of wetlands by the U.S. Fish and Wildlife Service to classify. System refers to a complex of wetlands and deepwater habitats that share the influence of similar hydrologic, geomorphic, chemical, or biological factors. As defined in Cowardin et al. (1979), the values are:

> **Marine** - consists of open ocean overlying the continental shelf and its associated high-energy coastline.
> **Estuarine** - consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land.
> **Riverine** - includes all wetlands and deepwater habitats contained with a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5%.
> **Lacustrine** - includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30% areal coverage; and (3) total area exceeds 8 ha (20 acres).
> **Palustrine** - includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5%.

DISTRIBUTION

Range
A description of the total range (present and historic, if known) of the Association rangewide, using names of nations, subnations or states, ecoregions, etc.

States/Provinces
The two-letter postal codes for U.S. states and Canadian provinces in which the Association occurs. Mexican two-letter state abbreviations are preceded by "MX". When the occurrence of the Association in a state/province is uncertain, a ? is appended. The state code may be followed by the **State Rank** when known.

Federal Lands
List of federal lands where the Association occurs or is believed to occur. Names used are shortened versions of the official name of the Federal land unit with "National Park, National Forest," etc. dropped from the name. A ? indicates that presence is uncertain.
Federal Agency Abbreviations are:

BIA = Bureau of Indian Affairs
BLM = Bureau of Land Management
COE = U.S. Army Corps of Engineers
DOD = Department of Defense
DOE = Department of Energy
NPS = National Park Service
PC = Parks Canada
TVA = Tennessee Valley Authority
USFS = U.S. Forest Service
USFWS = U.S. Fish and Wildlife Service

CONSERVATION STATUS

Global Rank

The Heritage Conservation Status **Global Rank** which best characterizes the relative rarity or endangerment of the Association worldwide. Values for Global Rank are:

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

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

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

G4 = Widespread, abundant, and apparently secure, but with cause for long-term concern = Uncommon but not rare (although it may be quite rare in parts of its range, especially at the periphery); apparently not vulnerable in most of its range

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

G#G# = Numeric range rank (range no greater than 2) = Greater uncertainty about a rank is expressed by indicating the full range of ranks which may be appropriate; for example, a G1G3 rank indicates the rank could be G1, G2, or G3

GNR = Not yet ranked = Status has not yet been assessed

GNA = Rank not applicable

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

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

GU = Unrankable = Status cannot be determined at this time

Qualifiers:

? = Inexact numeric rank = A question mark added to a rank expresses an uncertainty about the rank in the range of 1 in either way on the 1–5 scale; for example, a G2? rank indicates that the rank is thought to be G2, but could be G1 or G3 (Note: G1? and G5? are both valid ranks)

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

For non-natural types, a **Global Rank** of **GNA** = **Rank not applicable** is assigned. They are further identified as one from the following:

Cultural - indicates that the Association is cultivated. Planted/cultivated areas are defined as being dominated by vegetation that has been planted in its current location by humans and/or is treated with annual tillage, a modified conservation tillage, or other intensive management or manipulation. The majority of these areas are planted and/or maintained for the production of food, feed, fiber, or seed.

Ruderal - indicates that the Association is considered ruderal. Ruderal communities are vegetation resulting from succession following anthropogenic disturbance of an area. They are generally characterized by unnatural combinations of species (primarily native species, though they often contain slight to substantial numbers and amounts of species alien to the region as well). In many landscapes, ruderal communities occupy large areas - sometimes more than any other category of communities - and can provide important biodiversity functions.

Modified/Managed - indicates that the Association is modified or managed. Modified/managed communities are vegetation resulting from the management or modification of natural/near-natural vegetation, but producing a structural and floristic combination not clearly known to have a natural analogue. Modified vegetation may be easily restorable by either management, time, or restoration of ecological processes. It is not yet clear how to deal with these communities in the IVC.

Invasive - indicates that the Association is weedy and invasive. Invasive communities are dominated by invasive alien species. Although these communities are often casually considered as "planted/cultivated," they are spontaneous, self-perpetuating, and not the (immediate) result of planting, cultivation, or human maintenance. Land occupied by invasive communities is generally permanently altered (converted) unless restoration efforts are undertaken. It is also important to recognize that these communities are novel; they are not merely a community "transplanted" from the native range of the dominant species. *Melaleuca* in south Florida, kudzu in the southeastern United States, tamarisk in the western United States, and red mangrove in Hawaii all form communities which have no equivalent in the native range of the dominant species (associated species, processes, landscape context, fauna, etc. are all significantly different).

Global Rank Date

The date the **Global Rank** was last ***reviewed*** (regardless of whether the rank was changed).

Global Rank Reasons

Reasons that the Heritage Conservation Status **Global Rank** for the Association was assigned, including key ranking variables and other considerations used.

CLASSIFICATION INFORMATION

Classification Status

The status of the Association in relation to the standard IVC. 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 IVC.

Nonstandard – the Association has not been accepted by NatureServe Central Ecology as a standard Association (i.e., it does not follow the standard classification).

Provisional* – the Association is a candidate for acceptance into the standard classification but has not yet been comprehensively reviewed by Central Ecology.

Circumscription Confidence

The degree of confidence associated with the classification of the Association. This confidence is based on the quality and type of data used in the analysis, as well as the extent to which the entire (or potential) range of the Association was considered.

Values for Circumscription Confidence are:

1 – Strong: Classification is based on quantitative analysis of verifiable, high-quality field data (species lists and associated environmental information) from plots that are published in full or are archived in a publicly accessible database. A sufficient number of high-quality plots covering the expected geographic distribution and habitat variability of the vegetation type, as well as plots from related types across the region, have been used in the analysis.

2 – Moderate: Classification is based either on quantitative analysis of a limited data set of high-quality, published/accessible plots and/or plots from only part of the geographic range, or on a more qualitative assessment of published/accessible field data of sufficient quantity and quality.

3 – Weak: Classification is based on limited, or unpublished/inaccessible plot data or insufficient analysis, anecdotal information, or community descriptions that are not accompanied by plot data. These types have often been identified by local experts. Although there is a high level of confidence that these types represent recognized vegetation entities, it is not known whether they would meet national standards for floristic types in concept or in classification approach if sufficient data were available.

Classification Comments

Comments about classification criteria used to define the Association, or to describe any remaining issues associated with the classification. Any potentially confusing relationships with other existing Associations should be indicated if there is a potential that further scrutiny may result in a change in the classification of the Association. Discussion of any atypical occurrences and why they are included in this 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 community should be included. Comments may explain confusion about the similarity between types that may not be distinguishable.

Similar Associations

The **Global Name** and **Elcode** of any closely related or apparently similar IVC association(s) which may be mistaken for this Association. They may be in the same or different Formation or Alliance. This includes only types whose classification is not at issue (e.g., two types have similar sounding names but are differentiated by the degree of canopy closure and lower frequency of associated light-requiring species). **Notes** regarding the relationship and/or distinction of each particular Similar Association may follow.

Related Concepts

Name used by agencies or other published or unpublished classification systems to describe community types that may be related to this Association. These might include Society of American Foresters (SAF) cover types, Kuchler PNV types, U.S. Fish and Wildlife Service (USFWS) wetland types, or other local or regional vegetation classifications. The **Other Community Name** is followed by the associated **Reference** and **Relationship**. The **Related Concept Reference** is the source reference for the **Related Concept**. **Relationship** indicates whether the type designated in **Other Community Name** is more, less, or equally inclusive of the IVC Association concept.

Values for Relationship are:

- **B – Broader:** the concept of the Other Community is broader than the Association concept
- **F – Finer:** the concept of the Other Community is finer (more narrow) than the Association concept
- **I – Intersects:** the concepts of the Other Community and the Association overlap (i.e., neither fully includes the other) and are related in a way that is more complex than a simple "broader/finer" relationship
- **= - Equivalent:** concept designated in Other Community Name is equivalent to the Association concept
- **? – Unknown:** the relationship of the Other Community to the Association has not been determined

Note: Names used by Heritage Programs/CDCs 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 I. Plants observed in Morristown National Historical Park during vegetation plot and thematic accuracy assessment sampling.

Vascular Plants Observed in Morristown National Historical Park during Vegetation Plot and Thematic Accuracy Assessment Sampling. Species with an asterisk (*) notate species that were observed during vegetation plot sampling, but were not sampled within plots.

Nomenclature follows the PLANTS 3.5 Database developed by the Natural Resources Conservation Service in cooperation with the Biota of North America Program (United States Department of Agriculture, Natural Resources Conservation Service 2006). For this report, some common names listed in the PLANTS database were changed to reflect the common names typically used by ecologists and resource managers in this region. The common and scientific names of plants observed during the vegetation plot and thematic accuracy assessment sampling are listed below. Nativity and invasiness also follow the PLANTS database.

Family	**Scientific Name**	**Common Name**
Aceraceae	*Acer rubrum*	red maple
	Acer saccharum	sugar maple
Anacardiaceae	*Toxicodendron radicans*	eastern poison ivy
Apiaceae	*Sanicula* sp.	sanicle
Apocynaceae	*Apocynum androsaemifolium*	spreading dogbane
	Apocynum cannabinum	Indianhemp
Aquifoliaceae	*Ilex verticillata*	common winterberry
Araceae	*Arisaema triphyllum*	Jack in the pulpit
	Symplocarpus foetidus	skunk cabbage
Araliaceae	*Panax trifolius**	dwarf ginseng
Asclepiadaceae	*Asclepias syriaca*[1]	common milkweed
	Asclepias tuberosa	butterfly milkweed
	*Asclepias viridiflora**	green comet milkweed
	Cynanchum rossicum[1]	European swallow-wort
Asteraceae	*Achillea millefolium*	common yarrow
	Ageratina altissima var. *altissima*	white snakeroot
	Bidens connata	purplestem beggarticks
	Bidens frondosa	devil's beggartick
	Cichorium intybus[1]	chicory
	Cirsium vulgare[1]	bull thistle
	Erigeron sp.	fleabane
	Eurybia divaricata	white wood aster
	Prenanthes sp.*	rattlesnakeroot
	Solidago caesia	wreath goldenrod
	Solidago patula	roundleaf goldenrod
	Sonchus arvensis[1]	field sowthistle
	Symphyotrichum dumosum	rice button aster
	Symphyotrichum lateriflorum	calico aster
Balsaminaceae	*Impatiens capensis*	jewelweed
Berberidaceae	*Berberis thunbergii*[2]	Japanese barberry
	Podophyllum peltatum	mayapple
Betulaceae	*Betula* sp.	birch
	Betula alleghaniensis	yellow birch

Family	Scientific Name	Common Name
Betulaceae (cont.)	*Betula lenta*	sweet birch
	Carpinus caroliniana	American hornbeam
	Ostrya virginiana	hophornbeam
Boraginaceae	*Hackelia virginiana*	beggarslice
Brassicaceae	*Alliaria petiolata*[2]	garlic mustard
	Cardamine pensylvanica	Pennsylvania bittercress
	Unknown genus	Unknown
Caprifoliaceae	*Lonicera japonica*[2]	Japanese honeysuckle
	Lonicera maackii[2]	Amur honeysuckle
	Sambucus nigra ssp. *Canadensis**	common elderberry
	Sambucus racemosa var. *racemosa*	red elderberry
	Viburnum acerifolium	mapleleaf viburnum
	Viburnum dentatum	southern arrowwood
	Viburnum lentago	nannyberry
	Viburnum nudum var. *cassinoides*	withe-rod
	Viburnum prunifolium	blackhaw
	Viburnum sieboldii[1]	Siebold's arrowwood
Caryophyllaceae	*Dianthus armeria*[1]	Deptford pink
Celastraceae	*Celastrus orbiculatus*[2]	oriental bittersweet
	Euonymus alata[1]	winged burning bush
Cornaceae	*Cornus florida*	flowering dogwood
Cyperaceae	*Carex* sp.	sedge
	Carex atlantica	prickly bog sedge
	Carex bromoides	bromelike sedge
	Carex canescens	silvery sedge
	*Carex crinita**	fringed sedge
	Carex digitalis	slender woodland sedge
	Carex foenea	dryspike sedge
	Carex gracillima	graceful sedge
	Carex oligocarpa	richwoods sedge
	Carex pensylvanica	Pennsylvania sedge
	Carex platyphylla	broadleaf sedge
	Carex prasina	drooping sedge
	Carex rosea	rosy sedge
	*Carex siccata**	dryspike sedge
	Carex swanii	Swan's sedge
	Carex umbellata	parasol sedge
	Carex virescens	ribbed sedge
	Scirpus cyperinus	woolgrass
	Scirpus sp.	bulrush
	Trichophorum planifolium	bashful bulrush
Dennstaedtiaceae	*Dennstaedtia punctilobula*	eastern hayscented fern
Dryopteridaceae	*Dryopteris* sp.	woodfern
	Deparia acrostichoides	silver false spleenwort
	Dryopteris intermedia	intermediate woodfern
	Dryopteris marginalis	marginal woodfern
	Onoclea sensibilis	sensitive fern
	Polystichum acrostichoides	Christmas fern
Elaeagnaceae	*Elaeagnus umbellata*[1]	autumn olive

Family	Scientific Name	Common Name
Ericaceae	*Epigaea repens*	trailing arbutus
	Kalmia angustifolia	sheep laurel
	Rhododendron sp.	rhododendron
	Rhododendron viscosum	swamp azalea
	Vaccinium corymbosum	highbush blueberry
	Vaccinium pallidum	Blue Ridge blueberry
Euphorbiaceae	*Acalypha gracilens*[1]	slender threeseed mercury
Fabaceae	*Amphicarpaea bracteata*	American hogpeanut
	Lespedeza sp.	lespedeza
	Robinia pseudoacacia[1]	black locust
Fagaceae	*Castanea dentata*	American chestnut
	Fagus grandifolia	American beech
	Quercus alba	white oak
	Quercus coccinea	scarlet oak
	Quercus prinus	chestnut oak
	Quercus rubra	northern red oak
	Quercus velutina	black oak
Gentianaceae	*Bartonia paniculata*	twining screwstem
Geraniaceae	*Geranium maculatum*	spotted geranium
Hamamelidaceae	*Hamamelis virginiana*	American witchhazel
Juglandaceae	*Carya alba*	mockernut hickory
	Carya glabra	pignut hickory
	Carya ovata	shagbark hickory
	Juglans nigra	black walnut
Juncaceae	*Juncus greenei*	Greene's rush
	Luzula campestris	field woodrush
Lamiaceae	*Clinopodium vulgare*[1]	wild basil
	Glechoma hederacea[1]	ground ivy
	Hedeoma pulegioides[1]	American false pennyroyal
	*Monarda fistulosa**	wild bergamot
	Monarda sp.	beebalm
	Pycnanthemum virginianum	Virginia mountainmint
	Scutellaria elliptica	hairy skullcap
	Scutellaria galericulata	marsh skullcap
Lauraceae	*Lindera benzoin*	northern spicebush
	Sassafras albidum	sassafras
Leucobryaceae	*Leucobryum* sp.	leucobryum moss
Liliaceae	*Allium vineale*	wild garlic
	Erythronium americanum	dogtooth violet
	Maianthemum canadense	Canada mayflower
	Maianthemum racemosum ssp. *racemosum*	feathery false lily of the valley
	Maianthemum trifolium	Threeleaf false lily of the valley
	Maianthemum sp.	mayflower
	Medeola virginiana	Indian cucumber
	Uvularia perfoliata	perfoliate bellwort
	Uvularia sessilifolia	sessileleaf bellwort
	Veratrum viride	green false hellebore
Magnoliaceae	*Liriodendron tulipifera*	tuliptree
Menispermaceae	*Menispermum canadense*	common moonseed

Family	Scientific Name	Common Name
Monotropaceae	*Monotropa uniflora*	Indianpipe
Nyssaceae	*Nyssa sylvatica*	blackgum
Oleaceae	*Fraxinus americana*	white ash
	Fraxinus nigra	black ash
	Fraxinus pennsylvanica	green ash
	Ligustrum vulgare[1]	European privet
Onagraceae	*Circaea lutetiana* ssp. *canadensis*	broadleaf enchanter's nightshade
	Ludwigia palustris	marsh seedbox
Ophioglossaceae	*Botrychium dissectum*	cutleaf grapefern
Orobanchaceae	*Epifagus virginiana*	beechdrops
Osmundaceae	*Osmunda cinnamomea*	cinnamon fern
	Osmunda regalis	royal fern
Oxalidaceae	*Oxalis stricta*[1]	common yellow oxalis
Papaveraceae	*Sanguinaria canadensis*	bloodroot
Pinaceae	*Abies concolor*[1]	white fir
	Picea abies[1]	Norway spruce
	Tsuga canadensis	eastern hemlock
Plantaginaceae	*Plantago lanceolata*[1]	narrowleaf plantain
Poaceae	*Agrostis hyemalis*	winter bentgrass
	Agrostis sp.*	bentgrass
	Anthoxanthum odoratum[1]	sweet vernalgrass
	Brachyelytrum erectum	bearded shorthusk
	Cinna arundinacea	sweet woodreed
	Cynodon dactylon	Bermudagrass
	Dactylis glomerata[1]	orchardgrass
	Danthonia spicata	poverty oatgrass
	Dichanthelium clandestinum	deertongue
	Digitaria ischaemum[1]	smooth crabgrass
	Eragrostis spectabilis	purple lovegrass
	Festuca rubra[1]	red fescue
	Festuca subverticillata[1]	nodding fescue
	Glyceria melicaria	melic mannagrass
	Leersia oryzoides	rice cutgrass
	Leersia virginica	whitegrass
	Lolium perenne[1]	perennial ryegrass
	Microstegium vimineum[2]	Japanese stiltgrass; Nepalese browntop
	Panicum sp.	panicgrass
	Phleum pratense[1]	timothy
	Poa palustris	fowl bluegrass
	Schizachyrium scoparium	little bluestem
	Setaria sp. [1]	bristlegrass
	Setaria parviflora[1]	marsh bristlegrass
	Sorghastrum nutans[1]	Indiangrass
	Tridens flavus[1]	purpletop tridens
Portulacaceae	*Claytonia virginica**	Virginia springbeauty
Polygonaceae	*Polygonum arifolium*	halberdleaf tearthumb
	Polygonum caespitosum[1]	oriental ladysthumb
	Polygonum hydropiperoides	swamp smartweed
	Polygonum persicaria	spotted ladysthumb

Family	Scientific Name	Common Name
Polygonaceae (cont)	*Polygonum sagittatum*	arrowleaf tearthumb
	Polygonum virginianum	jumpseed
	Rumex acetosella[1]	common sheep sorrel
Polypodiaceae	*Polypodium virginianum*	rock polypody
Polytrichaceae	*Polytrichum commune*	polytrichum moss
Primulaceae	*Lysimachia ciliata*[1]	fringed loosestrife
	Lysimachia nummularia[1]	creeping jenny
	Trientalis borealis	starflower
Pteridaceae	*Adiantum pedatum*	northern maidenhair
Pyrolaceae	*Chimaphila maculata*	striped prince's pine
	Pyrola sp.	wintergreen
	Pyrola elliptica	waxflower shinleaf
Ranunculaceae	*Anemone quinquefolia*	nightcaps
	Caltha palustris	yellow marsh marigold
	Hepatica nobilis	hepatica
	Ranunculus recurvatus	blisterwort
	Ranunculus sp.	buttercup
	Thalictrum pubescens Pursh	king of the meadow
	Thalictrum thalictroides	rue anemone
Rosaceae	*Amelanchier arborea*	common serviceberry
	Amelanchier canadensis	Canadian serviceberry
	Malus sp.[1]	apple
	Potentilla canadensis	dwarf cinquefoil
	Potentilla simplex	common cinquefoil
	Prunus serotina	black cherry
	Rosa carolina	Carolina rose
	Rosa multiflora[2]	multiflora rose
	Rosa sp.	rose
	Rubus allegheniensis	Allegheny blackberry
	Rubus hispidus	bristly dewberry
	Rubus idaeus	American red raspberry
	Rubus phoenicolasius	wine raspberry
	Rubus sp.	blackberry
Rubiaceae	*Galium asprellum*	rough bedstraw
	Galium circaezans	licorice bedstraw
	Galium sp.	bedstraw
	Mitchella repens	partridgeberry
Saxifragaceae	*Chrysosplenium americanum*	American golden saxifrage
Scrophulariaceae	*Chelone glabra*	white turtlehead
	Linaria vulgaris[1]	butter and eggs
	Penstemon digitalis	talus slope penstemon
	Verbascum thapsus[1]	common mullein
	Veronica sp.[1]	speedwell
Simaroubaceae	*Ailanthus altissima*[1]	tree of heaven
Smilacaceae	*Smilax glauca*	cat greenbrier
	Smilax herbacea	smooth carrionflower
	Smilax rotundifolia	roundleaf greenbrier
	Smilax sp.	greenbrier
Solanaceae	*Physalis* sp.	groundcherry

Family	Scientific Name	Common Name
Solanaceae (cont)	*Solanum carolinense*[1]	Carolina horsenettle
	Solanum dulcamara[1]	climbing nightshade
Sparganiaceae	*Sparganium* sp.	bur-reed
Sphagnaceae	*Sphagnum* sp.	sphagnum
Thelypteridaceae	*Phegopteris connectilis*	lLong beech fern
	Phegopteris hexagonoptera	broad beechfern
	Thelypteris noveboracensis	New York fern
Tiliaceae	*Tilia americana*	American basswood
Typhaceae	*Typha angustifolia*	narrowleaf cattail
	Typha latifolia	broadleaf cattail
Ulmaceae	*Ulmus americana*	American elm
	Ulmus procera	English elm
	Ulmus rubra	slippery elm
Urticaceae	*Boehmeria cylindrica*	smallspike false nettle
	Laportea canadensis	Canadian woodnettle
	Pilea pumila	Canadian clearweed
Violaceae	*Viola blanda*	sweet white violet
	Viola canadensis	Canadian white violet
	Viola palmata	early blue violet
	Viola pubescens	downy yellow violet
	Viola sororia	common blue violet
Violaceae (cont)	*Viola* sp.	violet
Vitaceae	*Parthenocissus quinquefolia*	Virginia creeper
	Vitis aestivalis	summer grape
	Vitis labrusca	fox grape
	Vitis sp.	grape

[1]Not native to northeastern U.S.
[2]Not native to northeastern U.S., invasive

Appendix J. Index of representative photographs of vegetation classification sampling plots in Morristown National Historical Park, by figure number.

Page

Tuliptree – Beech - Maple Forest
Figure 8. MORR.19 30

Northern Piedmont Mesic Oak-Beech Forest
Figure 9. MORR.06 35

Successional Tuliptree Forest
Figure 10. MORR.17 41

Northeastern Dry-Oak Hickory Forest
Figure 11. MORR.13 51

Dry-Mesic Chestnut Oak - Red Oak Forest
Figure 12. MORR.01 57

Black Locust Successional Forest
Figure 13. MORR.08 66

Southern New England Red Maple Seepage Swamp
Figure 14. MORR.20 71

Montane Basic Seepage Swamp
Figure 15. MORR.22 79

Hemlock – Red Oak – Mixed Hardwood Forest
Figure 16. MORR.03 84

Northeastern Old Field
Figure 17. MORR.04 88

Smartweed – Cutgrass Wetland
Figure 18. MORR.09 96

Northeastern Modified Successional Forest
(No photograph available)

Upland – Wetland Transitional Forest
(No photograph available)

Skunk Cabbage – Orange Jewelweed Seep
(No photograph available)

Appendix K. Index of representative photographs of vegetation classification sampling plots in Morristown National Historical Park, by plot number.

Page

MORR.01 Dry-Mesic Chestnut Oak – Red Oak Forest (Figure 12) 57

MORR.03 Hemlock –Red Oak – Mixed Hardwood Forest (Figure 16) 84

MORR.04 Northeastern Old Field (Figure 17) 88

MORR.06 Northern Piedmont Mesic Oak-Beech Forest (Figure 9) 35

MORR.08 Black Locust Successional Forest (Figure 13) 66

MORR.09 Smartweed – Cutgrass Wetland (Figure 18) 96

MORR.13 Northeastern Dry-Oak Hickory Forest (Figure 11) 51

MORR.20 Southern New England Red Maple Seepage Swamp (Figure 14) 71

MORR.17 Successional Tuliptree Forest (Figure 10) 41

MORR.19 Tuliptree – Beech - Maple Forest (Figure 8) 30

MORR.22 Montane Basic Seepage Swamp (Figure 15) 79

No photographs taken of three associations:

Upland / Wetland Transitional Forest
Skunk Cabbage - Orange Jewelweed Seep
Northeastern Modified Successional Forest

Appendix L. Bibliography for global descriptions from the U.S. National Vegetation Classification.

Anderson, M., F. Biasi, and S. Buttrick. 1998. Conservation site selection: Ecoregional planning for biodiversity. The Nature Conservancy, Eastern Regional Office, Boston, MA. 18 pp.

Aulbach-Smith, C. Personal communication. Botanical Services of SC.

Baalman, R. J. 1965. Vegetation of the Salt Plains National Wildlife Refuge, Jet, Oklahoma. Unpublished Ph.D. dissertation, University of Oklahoma, Norman.

Bartgis, R. 1986. Natural community descriptions. Unpublished draft. Maryland Natural Heritage Program, Maryland Department of Natural Resources, Annapolis.

Berdine, M. A. 1998. Maryland vegetation classification. Maryland Department of Natural Resources, Annapolis, MD.

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.

CAP [Central Appalachian Forest Working Group]. 1998. Central Appalachian Working group discussions. The Nature Conservancy, Boston, MA.

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.

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.

Damman, A. W. H. 1977. Geographical changes in the vegetation patterns of raised bogs in the Bay of Fundy region of Maine and New Brunswick. Vegetation 35:137–151.

Damman, A. W. H., and B. Kershner. 1977. Floristic composition and topographical distribution of the forest communities of the gneiss areas of western Connecticut. Naturaliste Canadien 104:23–45.

Dowhan, J. J., and R. Rozsa. 1989. Flora of Fire Island, Suffolk Country, New York. Bulletin of the Torrey Botanical Club 116:265–282.

Drake, J. and D. Faber-Langendoen. 1997. An alliance level classification of the

vegetation of the Midwestern United States. The Nature Conservancy, Midwest Conservation Science Department, Minneapolis, Minnesota, USA.

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 B. J. Dibeler. 1992. Vegetation of the New Jersey Brigade Area of

Morristown National Historical Park—Final Report. Technical Report NPS/NAROSS/NRTR-92/13. Department of the Interior. North Atlantic Region. Boston, MA

Elias, T. B. 1980. The complete trees of North America, field guide and natural history. Book Division, Times Mirror Magazines, Inc. 948 pp.

Enser, R. 1993. Natural community classification for Rhode Island (draft). Rhode Island Natural Heritage Program. Providence, RI.

Enser, R. 1999. Natural communities of Rhode Island. Unpublished draft, December 1999. 22 pp.

Eyre, F. H., editor. 1980. Forest cover types of the United States and Canada. Society of American Foresters, Washington, DC. 148 pp.

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. 1999. Plant communities of limestone, dolomite, and other calcareous substrates in the George Washington and Jefferson national forests, Virginia. Natural Heritage Technical Report 99-4. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond. Unpublished report submitted to the USDA Forest Service. 218 pp. plus appendices.

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., and N. E. Van Alstine. 1999. Plant communities and floristic features of sinkhole ponds and seepage wetlands in southeastern Augusta County, Virginia. Banisteria 13:67–94.

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. 1996. Ecological land units of the Laurel Fork Area, Highland County, Virginia. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Natural Heritage Technical Report 96-08. Richmond. 114 pp. plus appendices.

Fleming, G. P., and W. H. Moorhead, III. 2000. Plant communities and ecological land units of the Peter's Mountain area, James River Ranger District, George Washington and Jefferson national forests, Virginia. Natural Heritage Technical Report 00-07. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond. Unpublished report submitted to the USDA Forest Service. 195 pp. plus appendices.

Fleming, Gary P. Personal communication. Ecologist, Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

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.

Gawler, S. C. 2002. Natural landscapes of Maine: A guide to vegetated natural communities and ecosystems. Maine Natural Areas Program, Department of Conservation, Augusta, ME. [in press]

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.

Gould, A. M. A., and M. A. Berdine. 1998. Identification and protection of reference wetland natural communities in Maryland: Northern Piedmont and Blue Ridge circumneutral seepage swamps. The Biodiversity Program, Maryland Department of Natural Resources, Wildlife and Heritage Division, Annapolis. 77 pp. plus appendices.

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.

Hoagland, B. 2000. The vegetation of Oklahoma: A classification for landscape mapping and conservation planning. The Southwestern Naturalist 45(4):385–420.

Hunt, D. 1997a. Long Island oak forest project: Classification justification. Unpublished materials. New York Natural Heritage Program, Latham, NY.

INAI [Iowa Natural Areas Inventory]. No date. Vegetation classification of Iowa. Iowa Natural Areas Inventory, Iowa Department of Natural Resources, Des Moines.

Keever, C. 1973. Distribution of major forest species in southeastern Pennsylvania. Ecological Monographs 43:303–327.

Keever, C. 1979. Mechanisms of plant succession on old fields of Lancaster County, Pennsylvania. Bulletin of the Torrey Botanical Club 106(4):299–308.

Lea, C. 2003. Vegetation types in the National Capital Region Parks. Draft for review by NatureServe, Virginia Natural Heritage, West Virginia Natural Heritage, Maryland Natural Heritage, and National Park Service. March 2003. 140 pp.

Ludwig, J. D., G. P. Fleming, C. A. Pague, and T. J. Rawinski. 1993. A natural heritage inventory of mid-Atlantic region national parks in Virginia: Shenandoah National Park. Natural Heritage Technical Report 93-5. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond. 352 pp.

MENHP [Maine Natural Heritage Program]. 1991. Natural landscapes of Maine: A classification of ecosystems and natural communities. Unpublished document. Office of Comprehensive Planning, Maine Natural Heritage Program, Augusta. 77 pp.

MNNHP [Minnesota Natural Heritage Program]. 1993. Minnesota's native vegetation: A key to natural communities. Version 1.5. Minnesota Department of Natural Resources, Natural Heritage Program, St. Paul, MN. 110 pp.

McCoy, K. M., and G. P. Fleming. 2000. Ecological communities of U.S. Army Garrison, Fort Belvoir, Fort Belvoir, Virginia. Natural Heritage Technical Report 00-08, Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond. Unpublished report submitted to the U.S. Army. 156 pp. plus appendices.

McDonald, A. 1938. Erosion and its control in Oklahoma Territory. Miscellaneous Publication 301, U.S. Department of Agriculture, Washington, DC.

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.

NatureServe Ecology - Southeastern United States. No date. Unpublished data. NatureServe, Durham, NC.

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.

Overlease, W. R. 1987. 150 years of vegetation change in Chester County, Pennsylvania. Bartonia 53:1–12.

Patterson, Karen D. Personal communication. Ecologist, Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

Perles, S. J., G. S. Podniesinski, E. A. Zimmerman, W. A. Millinor, and L. A. Sneddon. 2006a. 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. 2006b. 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. 2006c. Vegetation classification and mapping at Gettysburg National Military Park and Eisenhower National Historic Park.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 1 and Volume 2 (Appendix G) of 2. Technical Report NPS/NER/NRTR—2007/076. National Park Service. Philadelphia, PA.

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., G. P. Fleming, and F. V. Judge. 1994. Forest vegetation of the Ramsey's Draft and Little Laurel Run Research Natural Areas, Virginia: Baseline ecological monitoring and classification. Natural Heritage Technical Report 94-14. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond. 45 pp. plus appendices.

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.

Russell, E. W. B., and A. E. Schuyler. 1988. Vegetation and flora of Hopewell Furnace National Historic Site, eastern Pennsylvania. Bartonia 54:124–143.

Schmalzer, P. A., and H. R. DeSelm. 1982. Vegetation, endangered and threatened plants, critical plant habitats and vascular flora of the Obed Wild and Scenic River. Unpublished report. USDI National Park Service, Obed Wild and Scenic River. 2 volumes. 369 pp.

Schotz, Al. Personal communication. Community Ecologist. Alabama Natural Heritage Program. Huntingdon College, Massey Hall, 1500 East Fairview Avenue, Montgomery, AL 36106-2148.

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.

Southeastern Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe, Durham, NC.

Sperduto, D. D. 1997b. A preliminary classification of natural communities in the New Hampshire Coastal Lowlands Ecoregion. NH Natural Heritage Inventory / The Nature Conservancy, Division of Forests and Lands, Department of Resources and Economic Development, Concord, NH.

Sperduto, D. D. 2000b. A classification of wetland natural communities in New Hampshire. New Hampshire Natural Heritage Inventory, Department of Resources and Economic Development, Division of Forests and Lands. Concord, NH. 156 pp.

Sperduto, D. D., and W. F. Nichols. 2004. Natural communities of New Hampshire: A guide and classification. New Hampshire Natural Heritage Inventory, DRED Division of Forests and Lands, Concord, NH.

Stephenson, S. L., and H. S. Adams. 1991. Upland oak forests of the Ridge and Valley Province in southwestern Virginia. Virginia Journal of Science 42:371–380.

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

The Nature Conservancy and Environmental Systems Research Institute. 1994. 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>

Thompson, E. 1996. Natural communities of Vermont uplands and wetland. Nongame and Natural Heritage Program, Department of Fish and Wildlife in cooperation with The Nature Conservancy, Vermont chapter. 34 pp.

Thompson, E. H., and E. R. Sorenson. 2000. Wetland, woodland, wildland: A guide to the natural communities of Vermont. The Nature Conservancy and the Vermont Department of Fish and Wildlife. University Press of New England, Hanover, NH. 456 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.

VDNH [Virginia Division of Natural Heritage]. No date. Unpublished data. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond.

Vanderhorst, J. 2000b. Plant communities of Harper's Ferry National Historical Park: Analysis, characterization, and mapping. West Virginia Natural Heritage Program, West Virginia Division of Natural Resources, Elkins, WV. 37 pp.

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.

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.

NPS D-116, April 2008

National Park Service
U.S. Department of the Interior

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

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

EXPERIENCE YOUR AMERICA ™